4-H BEEKEEPING PROJECT

LEADERS' GUIDE

University of California Agricultural Extension Service

4-H–Ag88

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4-H BEEKEEPING PROJECT

Leaders Guide

OPPORTUNITIES FOR THE LEADER

In the beekeeping project you, as the 4-H leader, have the opportunity to teach boys and girls about biology with one of the most fascinating animals. Your boys and girls will enjoy the story of the colony organization and the division of work among worker, queen, and drone bees.

The vital importance of bees in the production of agricultural crops, such as fruits, melons, and seeds, will be new information to most of your boys and girls. The greatest satisfaction to you and the 4-H members will come in learning to manage the bee colony. A sweet harvest of honey is the reward for a job well done.

THOSE YOU LEAD

Most good 4-H leaders want to understand boys and girls better. Most of the members you will work with will be 10 to 13 years old. With this age group, you have the problem of setting a pace that will enable members to do efficient work without strain.

Since the interest span of younger members is short, try to guide them to select short-term projects. The honey production project fits this age group best. In a year, they can produce some honey and learn something about bees. This age group likes to participate in group activities. You can plan many club activities in which all members take part. A trip to one of the member's home to see his apiary or to a beekeeper's apiary in the county would fulfill this need.

These youngsters are still in the play stage; encourage them to make a game of learning. One way to do this would be to ask them to answer elementary questions about bees. This could be organized as a contest among the members for a few minutes in each meeting.

If you have teenagers in your group, you will need to recognize their new independence of thought and the desire to express themselves. This can be done by asking them to help with planning the bee project program. They can exercise their improved abilities and interests if you will encourage them to undertake more difficult projects. The queen production and pollination projects are presented particularly for this age group.

Share the program with them. In this way, you will recognize their desire to be adults some of the time. One of the best ways to work with older members in sharing is to work with them as junior leaders. In this capacity, they can assume responsibility for much of the project program.

We wish you a very happy and successful experience with your 4-H boys and girls in the beekeeping project. Remember, if you have need for help, call on your community club leader or your farm advisor.

THE LEADER'S RESPONSIBILITIES

Check each member individually to be sure that he has no serious allergic reaction to beestings before he begins the project. If there is any doubt, recommend to his parents that they have their doctor test him.

One of your chief responsibilities should be to hold periodic meetings with the members, usually once a month. Sometimes during the year the leader and the members may want to meet more often. Unless members meet at least once a month, they lose contact with the 4-H group and the program, and their interest wanes.

You should keep abreast of your members' progress. This can be done in many ways. One is to visit the members and the parents during the year to see how the project is going at home. If you encourage the members to discuss their projects in the meetings, you can get a pretty good evaluation of their progress. Or, if you require some achievement from each member at each meeting and for the year, you can measure his progress. For example, a report or demonstration or talk given by the member at a meeting will help. Encourage each member to strive for the goal of a completed project.

As the 4-H leader in the beekeeping project, you also are a member of the 4-H Community Club and the County 4-H Club Council. To help your boys and girls accomplish as much as they can, attend your Community Club meetings and keep informed on the Community Club program and ways in which your members can participate. Attendance at the 4-H Club Council meeting should be accepted as part of your job. The best informed leaders usually have the largest number of members participating in county, regional, and state events.

You will be called upon by the Community Club leader for cooperation from your group in the Community Club program. The most successful leaders work closely with the Community Club leader.

Warn your members never to abandon colonies or leave frames exposed. Neglected bees will become diseased and may spread the infection to healthy colonies.

MEETINGS

A successful meeting with your boys and girls will:

- Fit the needs of the project group
- Begin on time
- Last for not more than 1½ hours

Here is an outline of a typical meeting:

- Leader or junior leader calls the meeting to order
- Hear reports of members — 20 to 30 minutes
- Question-answer session — 20 to 30 minutes
- Topic for meeting (have one for each meeting) — 30 minutes. Leader, junior leader, or member opens with 10-minute presentation on topic. Keep topic simple. After the presentation, open to discussion for 20 minutes.
- Leader or junior leader explains the next meeting's program — schedule a member to present a talk, demonstration, or topic for the next meeting.

Suggested Meeting Topics

Have a good first meeting topic. Explain the three 4-H projects to beginners – beekeeping fundamentals and equipment needed.

- A colony of bees – activities of bees in colonies, types of bees in colonies, food for bees, production of honey and wax.
- Placing a package of bees and queen in the hive. Ask your farm advisor for slide set on this topic.
- Starting with bees – how? when? where?
- Care of bee colony – each of these could be a topic for a single meeting:

  Weather as related to care of bees
  Equipment needed to work bees
  Feeding bees
  Moving bees
  Diseases of bees

- Races of bees—

  Those used in U.S. and their characteristics
  Those found in other parts of the world

- Harvesting honey—

  Removing honey from hive
  Removing honey from combs – extracting

- Preparing honey for market—

  Temperature to prevent granulation
  How to produce creamed honey

- Tour of an apiary
- Wintering bees

  Check queen
  Number of supers for overwintering
  Adequate honey and pollen for bees – why?

ACTIVITIES AND EVENTS

Your boys and girls will learn by exhibiting their bees, honey, and beeswax at their county fair and each 4-H exhibit day. Your county fair manager can tell you if bees, honey, and beeswax have been included in the premium book in the past. If you have enough boys and girls interested in exhibiting, he may be able to provide classes for the beekeeping project. When preparing exhibits for competition at your county fair, follow closely the requirements in the county fair premium book.

You may find the following helpful in preparing classes for exhibits.

BEE DIVISION EXHIBITS

- Bees should be displayed in glass display hives.
- Extracted honey should be displayed in glass; not less than 1 pound.
- Limit – three entries per section per exhibitor. Not more than one entry from any one floral source.

Bees

To be exhibited in one full-frame single-story observation hive or one full-frame plus shallow or 1-pound sections.

Honey

Comb honey (one 1-pound section)
Cut-comb honey (1 package) – size 2" x 4"
Extracting frame – standard size, full-depth, 1 frame
Other honey (1-pound standard honey jar) – labeled to kind

Beeswax

Natural wax – formed in 1-pint cottage cheese or sour cream cartons, approximately 1 pound.

CONTAINERS FOR EXHIBITING EXTRACTED HONEY

A 1-pound container is suggested for 4-H exhibit use.

All types of honey must be free from serious damage and at least as free from excessive foreign material as honey that has been strained through standard bolting cloth of 23 meshes per inch. Serious damage shall be deemed to mean any injury or defect that seriously affects the appearance or edibility of the honey, such as overheating, which destroys both natural color and flavor; fermentation, which causes either foam and/or sourness; and objectionable flavor from any source.

If honey to be exhibited is labeled as to a certain floral source, it should have the predominate taste of the source.

One to three jars are considered one exhibit. This would mean 1 to 3 pounds of honey would constitute an exhibit.

U.S. GRADES FOR HONEY

U.S. Grades for Extracted Honey

(1) U.S. grade A or U.S. Fancy
(2) U.S. grade B or U.S. Choice
(3) U.S. grade C or U.S. Standard
(4) U.S. grade D or U.S. Substandard

U.S. Grades for Comb Honey

(1) U.S. Fancy
(2) U.S. No. 1
(3) U.S. No. 1 Mixed Color
(4) U.S. No. 2
(5) Unclassified

Shallow-Frame Comb Honey

(1) U.S. Fancy
(2) U.S. No. 1
(3) Unclassified

Cut-Comb Honey

(1) U.S. Fancy
(2) U.S. No. 1
(3) Unclassified

Chunk or Bulk-Comb Honey

(1) U.S. Fancy
(2) U.S. No. 1
(3) Unclassified

Copies of grade standards for extracted honey and comb honey may be obtained from the Processed Products Standardization and Inspection Branch, Fruit and Vegetable Division, Agricultural Marketing Service, USDA, Washington, D. C. 20250.

SCORECARDS

Entry Numbers

FOR BEES EXHIBITED IN OBSERVATION HIVES	
1. Glass display hive – well made, clean, ventilated	25%
2. Queen – laying or virgin, marked	20%
3. Workers – enough to cover frame	20%
4. Brood present	20%
5. General conditions (overall appearance)	15%
	100%
COMB HONEY AND CUT-COMB HONEY	
1. Properly marked	50%
2. General appearance	25%
3. Well wrapped	25%
	100%
EXTRACTING FRAME	
1. Frame – clean and free of propolis and honey	25%
2. Well filled and capped	25%
3. Honey one color	25%
4. General appearance – comb should not be cracked, weeping, or sagging; there should be no spur comb	25%
	100%
OTHER HONEY	
1. Label – any type	30%
• Completeness (15%) name, address, grade, weight, and floral source	
• Neatness (15%)	
2. Grade – honey shall be marked either U.S. Fancy (U.S. grade A) or U.S. Choice (U.S. grade B), and shall be judged as marked	25%
3. Floral source – color and flavor shall be weighed against the grade and floral source marked	25%
4. Fill – 1" to top of jar	10%
5. General appearance	10%
	100%
NATURAL WAX	
1. Well-formed block–no air bubbles	33%
2. Free of foreign material	34%
3. Light in color	33%
	100%

DEMONSTRATIONS

To give a demonstration, your 4-H member may present something that he has learned in his 4-H work. Your 4-H farm advisor has material that will describe a demonstration and how to work with a 4-H member to prepare a demonstration.

Following are some suggested topics for demonstrations:

How to make a frame-wiring apparatus
How to fasten foundation into frames
How to make a wire embedder, using electricity
How to make cell cups for rearing queens
How to rear queens
How to make a Boardman or other type feeder
How to use a hive tool
How to introduce a package of bees into a hive
How to open a colony for inspection
How to introduce a queen into a colony of bees

Your members can think of many other topics for demonstrations.

WHERE CAN YOU GET HELP?

A community club leader often can be of special help to you if you have questions about your 4-H project. Other beekeepers will help you if you will call on them. A tour of an apiary usually is one of the best ways to use other beekeepers. A beekeeper who has a special way of managing his bees probably would be pleased to explain his methods to your members, and they would find it interesting.

Your 4-H farm advisor often can lead you to sources of help.

The county agricultural commissioner will want to demonstrate bee diseases to the members of your project group and help them inspect their colonies.

If there is a beekeepers' organization in your county, they can help in many ways. Ask them to allow your members to present demonstrations at their meetings.

Following is a list of California equipment supply houses:

Diamond National Corporation, Apiary Department, Chico
Montgomery Ward, Oakland
Sears Roebuck, Los Angeles
Huston Honey Company, Corona
Los Angeles Honey Company, Los Angeles and Madera

The following books cover almost all phases of practical and theorethical bee culture, as well as the romance of beekeeping. Some of these books may be available in your public library and also through book dealers.

BEGINNERS' BOOKS

First Lessons in Beekeeping. M. G. Dadant. Dadant and Sons publishers, Hamilton, Illinois.

Starting Right with Bees. A. I. Root. A. I. Root Company publishers, Medina, Ohio.

500 Answers to Bee Questions. A. I. Root. A. I. Root Company publishers, Medina, Ohio. 3d Edition, 1955.

How To Keep Bees and Sell Honey. Walter T. Kelley. Walter T. Kelley Company publishers, Clarkson, Kentucky. 4th Edition, 1964.

Life of the Bee. M. Maeterlinck. New American Library (paperback), 1954.

The Behavior and Social Life of Honey Bees. Ronald Ribbands. Dover Publications, Inc., 180 Varick Street, New York, N. Y. (paperback)

BEEKEEPING TEXTBOOKS

ABC and XYZ of Bee Culture. A. I. Root. A. I. Root Company publishers, Medina, Ohio, revised 1962.

Beekeeping. J. E. Eckert and F. R. Shaw. The Macmillan Company, New York, New York, 1960.

The Hive and the Honey Bee. Roy A. Grout, Editor. Dadant and Sons, Hamilton, Illinois, publishers, revised 1963.

OTHER VALUABLE BOOKS

American Honey Plants. Frank C. Pellett. American Bee Journal, Hamilton, Illinois, 1930.

Anatomy of the Honey Bee. R. E. Snodgrass. Comstock Publishing Associates (Division of Cornell University Press), Cornell University, Ithaca, New York, 1956.

Bees: Their Vision, Chemical Senses, and Language. Karl von Frisch, Cornell University, Ithaca, New York, 1956. (Also paperback.)

The Dancing Bees. Karl von Frisch, Harcourt Brace and Company (paperback), no date.

Queen Rearing. H. H. Laidlaw and J. E. Eckert, University of California Press, Los Angeles and Berkeley, 1962.

OTHER VALUABLE BOOKS – continued

World of the Honey Bee. Collin G. Butler, Collins Cleartype Press, London and Glasgow, 1954.

Communication Among Social Bees. Martin Lindauer, Harvard University Press, Cambridge, Massachusetts, 1961.

FILMS

Your farm advisor can help you obtain these films and a free slide set showing a method for installing bees in a hive.

The Honey Industry – Its Importance in Food Production. Film No. 4440, 12 minutes, color, sound. This film shows the University of California apiary and extracting equipment, pollination of flowers with diagram of flower parts, the importance of honey bees as pollinators, and harvesting and processing honey. Rental fee.

The Honey Bee. Film No. 3014, 10 minutes, sound, black and white, produced by Encyclopedia Britannica, Incorporated. Shows bee feeding larvae in glass-sided view and most of hive activities through glass walls of hive. Excellent film for bee biology and behavior. For all groups. Rental fee.

Secret of the Hive. Film No. 27–613, 30 minutes, color and sound, produced in Japan.

Secrets of the Bee World. Film No 27–579, 13 minutes, color and sound, produced by Walt Disney. Free.

Honey–Nature's Golden Treasure. Film No. 27–605, 15 minutes, color, produced by California Honey Advisory Board.

Social Insects–The Honey Bee. Film No. 27–622, 24 minutes, color, produced by Encyclopedia Britannica, Inc.

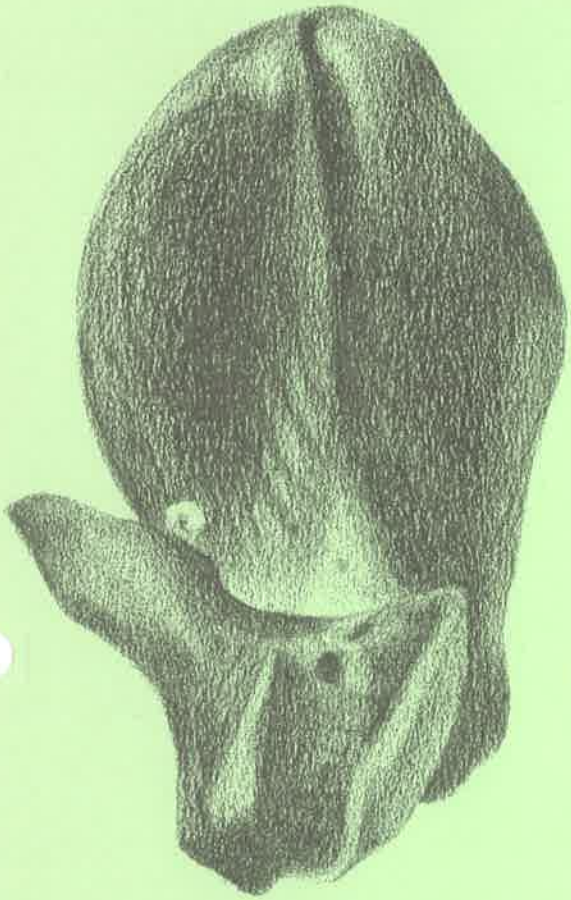
Here's how U C A E S helps your 4-H program

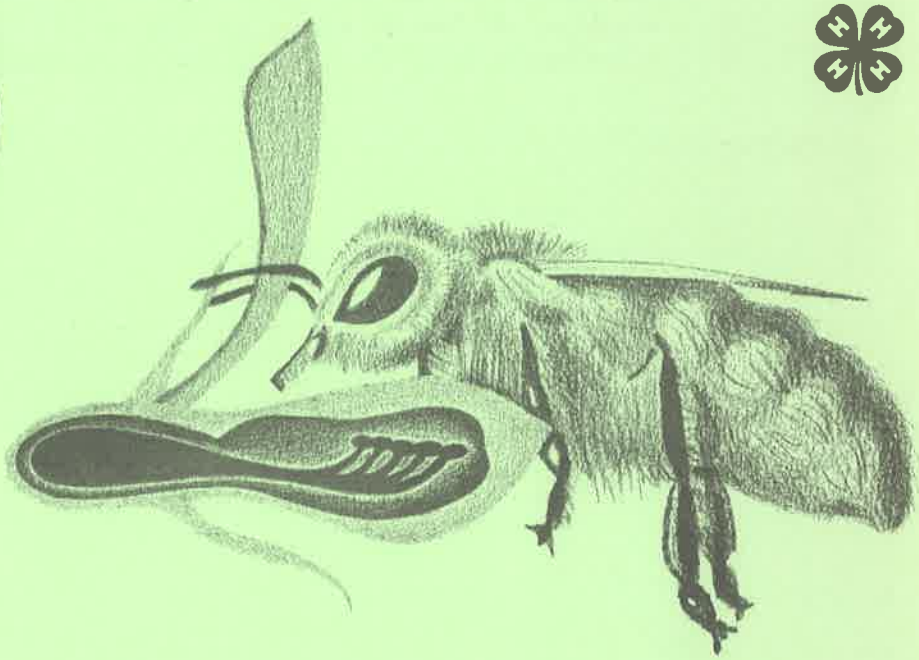
The Agricultural Extension Service of the University of California and the United States Department of Agriculture serve and assist 4-H Club members, their parents and leaders with professional guidance, training, and literature.

The University of California is represented in your county by farm and home advisors, one or more of whom are responsible for 4-H Club work. They bring the latest information on agriculture and home economics to you and your family. The Agricultural Extension Service prepares and distributes publications, such as this one, to help you in your 4-H work, and to help make 4-H Club work in California a success.

4-H BEEKEEPING PROJECT

MEMBERS MANUAL





UNIVERSITY OF CALIFORNIA

AGRICULTURAL EXTENSION SERVICE

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4-H BEEKEEPING PROJECT

Members Manual

There are three kinds of 4-H beekeeping projects.

The honey producer's project is for you if you have not had any experience with bees. In this project, you will work with one or more hives of bees to produce honey.

When you have completed 1 year in the honey producer's project, you are eligible for the pollinator's or queen producer's project.

HOW TO START

Before you enroll in this project, be sure that you know how beestings affect you. A swelling at the site of the sting is considered normal, but if you have a more extreme reaction, we advise you not to take this project.

Next, decide if you have adequate space for your apiary. If you are in or near a city, be sure you can locate your colonies where they will not interfere with highway or pedestrian traffic. They should not be too near cattle-feeding lots, fruit-drying centers, garden pools, or neighboring houses. Usually, this means that your apiary should be located at least 50 feet from any point at which the bees would be a source of danger.

Some cities and counties have ordinances regulating the location of bees. Be sure to check with your county agricultural commissioner about such ordinances. In populated areas, it is a good safety practice to provide a source of water for your bees near the colony. This reduces the possibility that the bees will use human or animal water sources. Apiaries should be located above flood danger and irrigation water. The hive entrance should face away from prevailing winds that interfere with the flight of bees, or you should provide a windbreak of brush or trees.

Your bees will need shade in parts of the state where the temperatures are above 95° F in the summer and fall. However, colonies generally do not need shade during the winter.

Place your colonies on concrete or stone foundations or on benches a foot or so off the ground for ease of handling and also to protect the colonies from damage by termites, ants, and dry rot. Do not locate colonies in areas where there are ants. If you are in a mountain region where there are bears, the most successful protection is an electric fence.

An ideal apiary location furnishes enough spring flowers to supply pollen and nectar for the bees to build up their colonies for a major nectar flow. Late-blooming plants should provide food for the bees during the winter. A desirable location should have enough pollen and nectar plants to keep the colonies in good condition and to produce a surplus for you.

If your location requires that you move your bees, you might consider working with a commercial beekeeper. Ask him to include your bees with his when he moves. You may be able to work with the beekeeper when he works his bees and learn firsthand from him.

What do I do?

- Raise one or more hives of bees.
- Sell the surplus honey for profit or use it at home.
- Attend one project meeting a month.
- Keep records on your project.
- Give your completed records to your leader when he asks for them.
- Give one demonstration or talk on bees each year.

How much will it cost?

In time: 1½ hours in project meeting each month. Unlimited number of hours inspecting your bees, harvesting honey, and preparing equipment.

In money and equipment: Prices vary each year; consult your leader for cost of new and used equipment. For one hive you will need:

1 package of bees (2- or 3-pound) and 1 queen
1 bottom board
Two 10-frame full-depth hive bodies
Two 10-frame ½- or ¾-depth supers
1 cover
20 Hoffmann self-spacing standard full-depth frames
20 sheets medium brood foundation
40 Hoffmann self-spacing ½- or ¾-depth frames
40 sheets super foundation, ½- or ¾-depth
1 spool ¼-pound tinned wire - 26 gauge
1 queen excluder
1 smoker
Paint for cover, bottom board, 2 full-depth hive bodies and 2 ½- or ¾-depth supers
1 hive tool
1 bee veil
1 spur wire embedder or electric embedder
Eyelets for frames

Optional equipment may include:

1 white coverall
1 uncapping knife
1 pair bee gloves
1 bee brush
1 frame wiring outfit

You may buy complete hives, including bees, from a local beekeeper.

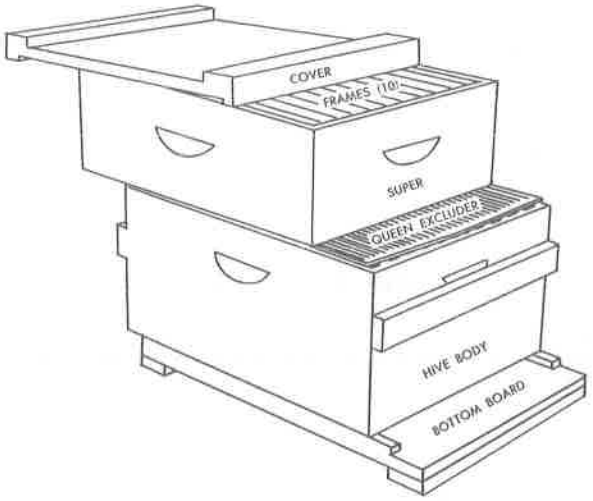


Figure 1. A 2-story 10-frame hive arranged to show main features. See back cover for plans.

Your success with your beekeeping project will be in direct proportion to your knowledge of bee behavior, hive management, and nectar plants. If you decide to become a 4-H beekeeper, you must be ready to inspect your bees often during the swarming season in the spring. Check the colonies every 7 to 10 days to be sure that there are no queen cells being formed and that the bees have adequate space to expand. This weekly inspection, along with attendance at meetings and other jobs with your beekeeping project, will keep you busy most of the year.

HONEY BEES

Apis mellifera Linnaeus is the scientific name for the species of honey bees found in the United States. All of the honey bees found in the United States were imported from foreign countries. These varieties are commonly called races, since they all will interbreed. The first imported variety, known as the German black, has been replaced gradually by the Italian bees. Italians are more resistant to European foulbrood, have a pleasing bright color, and are more gentle. Many races have been tried in the United States and California, but only three continue to be used. Italians, Caucasians, and Carniolans all have been used in some parts of California.

Italian—You can recognize an Italian bee by the three to five bands of yellow on its abdomen. The head, most of the thorax, and the remainder of the abdomen are black with yellowish hairs. Darker strains of this race are called leather-colored or three-banded Italians.

Caucasian—The Caucasian race of bees is black with grayish hairs. Purebred Caucasians are gentle, prolific, and do not swarm excessively. They are known for their tendency to build burr and bridge combs between the frames, which make the combs more difficult to remove from the supers. They also gather and use greater amounts of propolis (bee glue), made of a resinous material collected by bees from plants.

Carniolan—The Carniolan race is found in Carintha, neighboring Carniola, and in Yugoslavia down to Dalmatia. These bees resemble the gray Caucasians. The segments of the abdomen are black with grayish rings on the edges, and covered with whitish hairs. Carniolans are known as the gentlest bees. They build up quickly in the spring, which often leads to excessive swarming.

THE HONEY BEE COLONY

A colony of honey bees usually consists of one queen, a few hundred drones, and several thousand workers. During the summer when the bees are collecting nectar and pollen, the colony may consist of as many as 60,000 bees. The drones are more numerous in early spring than in the fall.

The queen is reared in a special cell that usually is suspended vertically from the surface or the lower part of the comb. She develops from the same kind of egg as the workers, but she emerges in a shorter time than either the worker or the drone, because she is fed royal jelly, a special food secreted by young workers known as nurse bees. The quantity and quality of this royal jelly depend mostly on the environmental conditions affecting the colony.

Normally, the queen is much longer than either the workers or the drones. Because she has a longer abdomen, her wings appear shorter and her thorax slightly larger than the workers' but smaller than the drones'. She does not have pollen baskets or wax glands. Her sting is stouter than the workers', has fewer and shorter barbs, and is curved. She rarely uses her sting, except when she emerges from her cell and encounters other queens in the colony. The young queens battle until only one is left.

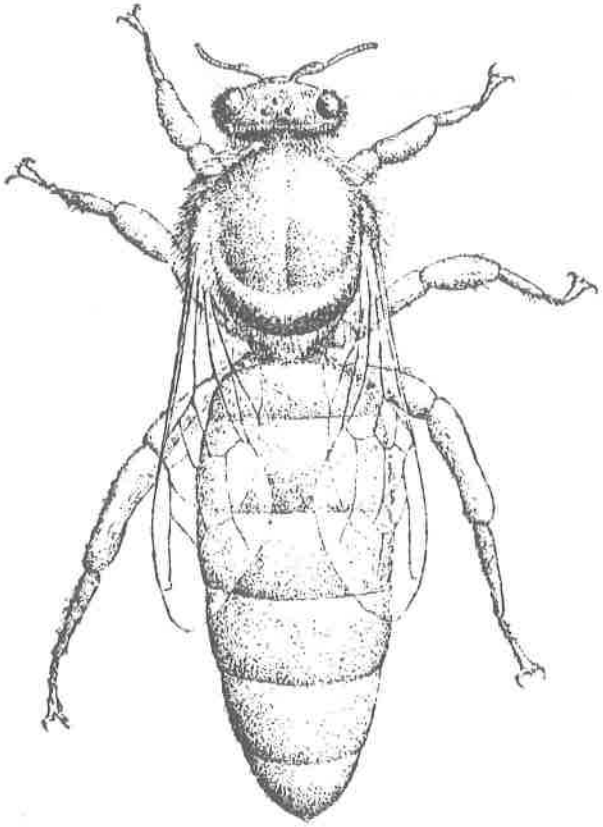
Her chief function is to lay eggs. Usually, within 5 to 10 days after leaving the cell, the queen takes one or more flights and mates with several drones while in the air. She may mate more than once before starting to lay, but never after she begins laying. The sperm received from the drone or drones are stored within a special organ of the queen, called the spermatheca. The number of eggs laid by a normal queen depends largely on the amount of food she receives and on a favorable temperature in the hive.

The queen can lay worker or drone eggs at will, but her activities are governed by factors that affect the colony as a whole. When there is a shortage of nectar and suitable pollen, brood rearing is slowed or may stop entirely. In most of California, no brood will be found in normal colonies during a short period in late fall and early winter. The queen lays drone eggs in drone cells early enough in the spring and during the summer to provide adult drones by the time a colony normally would swarm.

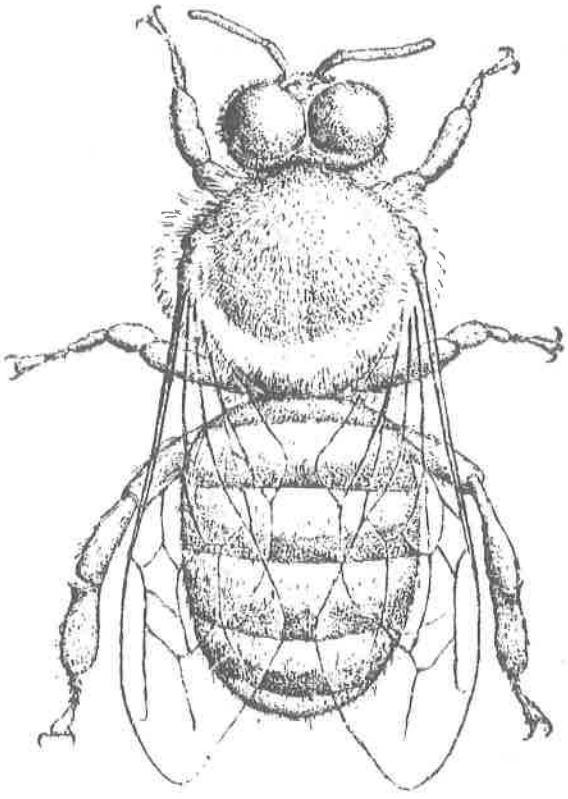
As the queen ages, she gradually uses up her supply of sperm and may lay an increasing number of drone eggs. If she fails to mate, all of her bees are drones.

The drones are larger and heavier than the workers, but not as long as the queen. It is easy to identify a drone by its compound eyes that come together at the top of the head. The eyes of the queen and workers are on the sides of the head. The drones are the male bees in the colony; their sole function is to mate with the queen.

The drones have no sting and none of the many useful structures of the worker bees. The young drones are fed by the workers; the older drones feed themselves. At the approach of winter, the drones are driven from the colony to starve.

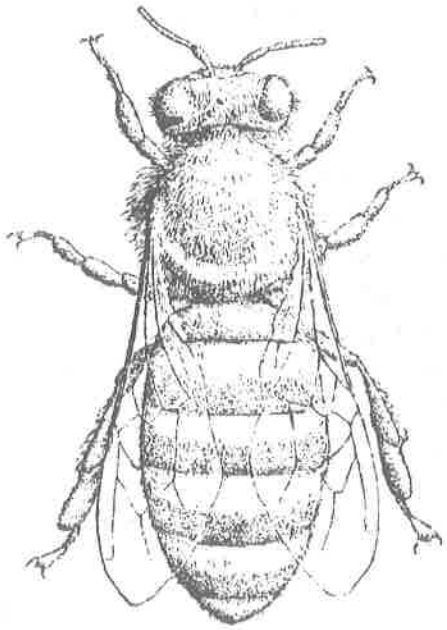


QUEEN



DRONE

The workers, although females, lack the fully developed reproductive organs of the queen. They are produced from fertilized eggs laid in worker cells. The workers perform all the labor of the hive. Immediately after emerging, they groom themselves, and eat honey and pollen to gain strength. As they become acquainted with the hive and grow older, they do a number of jobs in the colony. They may clean out the cells and the hive, feed the older larvae and then the younger larvae, take orientation flights, evaporate nectar, build comb, and act as sentinels and ventilators. During the latter half of their lives, they engage in field duties of carrying water, pollen, nectar, and propolis. The worker bees may live for 6 to 8 weeks during the seasons of active flight. However, in winter when they are less active, they may live for several months. Usually, enough workers survive the winter to carry on in the spring until others are reared to take their place.



WORKER

BEE FOOD

Pollen, nectar, water, and salt are the natural food materials for bees. The pollen supplies the bee with the protein essential to the growth of the developing bees; nectar provides the sugars for energy. Both pollen and nectar provide minerals and other substances important to the bees' diet. Worker bees can live on honey or on syrup made from sugar, and apparently require little pollen except in the first few days and later to rear the brood. The nurse bees use honey, pollen, and water to produce the royal jelly secreted by the food glands located in the heads. All the developing forms of the bee, known as larvae, are fed royal jelly the first 3 days after they hatch from the eggs. Then the worker and drone larvae are fed a mixture of honey, pollen, and royal jelly. The queen receives royal jelly all during her larval stage.

THE COLONY NEST

In 10 days to 2 weeks after you install a 2- or 3-pound package of bees in your single-story hive, check it to see if the bees are developing normally. If all is well, many frames will be filled with comb containing brood, pollen, and honey. Each frame will contain brood in the center, surrounded by pollen, with honey in the area between the pollen and the frames. As you inspect your bees throughout the season, you will note that all of the foundation is built into combs, and the pollen is concentrated mostly in the outside combs of the brood chamber. After 21 days, the first eggs laid will have developed into worker bees which will cut their way out of their cells. The hive bees will polish the used cells, and the queen will deposit eggs in them. This is why, in the same frame, you may see two or more cycles of brood, ranging from eggs to emerging bees.

A good queen lays her eggs in a compact arrangement, leaving very few empty cells. She attaches an egg to the bottom of each cell.

The pearly white larvae that hatch remain coiled in the bottoms of the cells until they finish the feeding stage. As the larvae enter the next stage, they extend lengthwise in the cells and are sealed in by the worker bees with a finely porous cap of wax material. The larvae line their cells with a silken cocoon and change into pupae.

Capped brood cells in a new comb are a light straw yellow. They become darker as more generations are reared in the cell. The cappings of honey cells normally are white. They may be travel stained with propolis and pollen, or they may look watersoaked as the capping touches the honey beneath. Pollen cells seldom are sealed; usually they are only partly filled. Sometimes pollen cells may be filled with honey and then sealed so that on the surface they look like cells of honey. The walls of old cells will thicken somewhat. Each time a bee emerges, the cells are cleaned and polished so thoroughly that the brood comb can be used for many years without any noticeable effect on the size of the bees produced in them. Old brood combs are very dark, sometimes almost black. Although darkened with use, these cells do not add much color to honey stored in them.

Drone cells usually are found on the lower edges and corners of the frame. Parts of the combs that are stretched or injured also may produce drone cells.

If the space for brood rearing is limited to one or two stories with the use of a queen excluder, some frames may be entirely filled with brood, with the honey and pollen crowded to the outside combs.

THE CYCLE OF THE YEAR

In the spring, brood rearing may begin in the center of the bee cluster some weeks before the first spring flowers bloom. When the first spring flowers bloom, the bees will work hard at collecting the pollen and nectar they find. They collect water to mix with the honey in making the larval food. This first pollen and nectar of the year stimulate brood rearing.

Usually, the young bees increase faster than the old ones die, so that the population of the colony increases. With the increase in production of young bees and honey, the brood chamber may be come crowded. When crowded conditions occur, the bees prepare to divide the colony by swarming. The first evidence of this preparation is the formation of queen cells along the bottoms and sides of the brood combs. Some days before the swarm is to leave the colony, the nurse bees feed the queen less and less, and she gradually reduces the number of eggs she lays.

Scout bees begin to search for a new home. More workers remain in the hive so that the colony begins to loaf, and many bees may cluster on the front of the hive. Any time after the first queen cells are sealed (and sometimes before), the field bees and many of the hive bees fly in front of the hive, producing a characteristic roar. The air in the vicinity of the hive is filled with excited, swirling bees, creating a high-pitched tone which, once heard, is seldom forgotten. Small groups of bees begin to cluster here and there after a few minutes of flying, and finally form a large cluster in one place. The old queen, who leaves the hive with the swarm, is located somewhere in this cluster. If her wings have been clipped, she may be found on the ground in front of the hive. When the queen is with the swarm, the bees hang in a cluster for a few minutes or an hour or more

before taking wing. Then, they fly directly to their new home in one continous flight. Sometimes they remain clustered overnight, or even build combs where they have clustered. in the hive, you will find many frames of brood, some bees, and several queen cells from which queens may be ready to emerge.

The first queen to emerge usually goes to the other queen cells, tears a little hole in the side of each, and stings the inmate. The worker bees then tear down the queen cells, drag out the dead queens, and carry them from the hive. The queen takes her mating flight within 5 to 10 days and returns to the hive to begin to lay eggs.

As the nectar flow draws to a close, the drones are starved and driven out by the worker bees. You can be sure that the nectar flow has come to an end when you see this happening. The bees no longer have excess moisture from the evaporation of nectar to use in brood rearing and in cooling the hive, so they seek more watering places. More of the honey is stored in the brood nest. Brood rearing generally is brought to a close as fall approaches. The old bees die, and the colony gradually dwindles from about 60,000 bees to 20,000 or 30,000. This reduction in colony population extends over several weeks. The worker bees seem to sense the coming of winter; they collect large amounts of propolis and use it to fill the cracks and make the hives tight for the winter weather.

Bees do not hibernate as many insects do. But, as the days grow colder, the bees become less active. They gather close together to form a tight cluster when the temperature of the air around them falls below 57° F. If it becomes colder than this, the bees form a still tighter cluster. As the bees form a tighter cluster and become less active, the temperature within the cluster gradually rises until it is maintained at 57° F or higher. The cluster generally is formed on combs containing honey. As the honey is used, the bees move to another source of honey. Close clusters are formed only during the colder period. In many places in California, bees seldom are confined to the hives for more than a few days at a time during the winter. The bees may attempt to work eucalyptus or other winter-blooming plants when the temperature is below the critical point for the bee, which is about 45° F. This shortens the lives of the workers and reduces the strength of the colony.

Table 1. Average Number of Days in the Developmental Periods of the Honey Bee

	EGG	LARVA	PUPA	TOTAL DAYS
Queen	3	5½	7½	16
Worker	3	6	12	21
Drone	3	6½	14½	24

DISEASES AND ENEMIES OF BEES

Honey bees are subject to disease, just as other living creatures are. Some bee diseases, particularly those affecting the brood, are highly infectious. **Request a certificate of inspection showing freedom from disease when you purchase bees or used beekeeping equipment.** Examine your colonies frequently to determine their condition. If you suspect disease is present, contact your county agricultural commissioner. The California apiary laws of the State Department of Agriculture require that the location of each apiary must be registered with the county agricultural commissioner. This helps control disease. Contact your county agricultural commissioner's office to be sure that you are acquainted with these laws, and to obtain information about the latest apiary regulations.

If, for any reason, you can no longer carry your bee project, notify your leader at once. Do not neglect or abandon colonies. Do not leave frames exposed. Bees that are not properly cared for may become diseased and may spread the infection to healthy colonies.

BROOD DISEASES OF HONEY BEES

The diseases of honey bees are divided into those affecting the brood and those affecting the adults. The major brood diseases are outlined in the table on pages 10, 11.

American foulbrood is the most common serious brood disease. It kills the larvae soon after the cells are sealed. The beekeeper seldom discovers the disease until the cappings of occasional cells of sealed brood have sunken and show a greasy appearance, often with irregular perforations. The dead larvae may be brownish yellow to coffee brown. They always are stretched lengthwise in the cell, but they retain their normal shape for only a short time after death; then they become a flat mass. At this stage, if the contents of a diseased cell are stirred with a toothpick and the decayed material slowly withdrawn, it oftens forms a rope 1 to 4 inches long before breaking. The larva finally will form a scale which usually adheres tightly to the lower side and the bottom of the cell. This scale is difficult to see. Your leader or apiary inspector can help you learn how best to detect American foulbrood scale. Where the disease is well advanced, pupae also die. The remains of the pupae may show their tongues extending upward, sometimes attached to the top of the cell. Most of the cells with scale are uncapped. This disease attacks the worker brood mostly; in rare instances, drone and queen larvae are infected.

Spores of the disease can survive in honey for an indefinite period. Thus the bees can spread the disease by robbing honey from diseased combs. Swarms from diseased colonies may carry the disease. Beekeepers can spread disease by transferring equipment from diseased colonies to healthy ones. If you think you have this disease in your colonies, call your apiary inspector at your county agricultural commissioner's office; he will help you with the control.

European foulbrood does not occur in all sections of California. Often, the disease does not appear in either strong or weak colonies until a second or third cycle of brood in spring. Then, the colony gradually weakens until there are not enough bees to store a maximum amount of honey. With the beginning of the nectar flow, the disease may disappear, or it may continue in somewhat abated form throughout the season. It may result in the death of a colony. The larvae are attacked while still coiled in the bottom of the cells, usually in a very early stage. They generally turn whitish yellow; they lose their well-rounded form and become so translucent that the breathing tubes can be seen through the body wall. Sometimes, the diseased larvae become light to dark brown. The dead larvae generally are found in almost any position in the cells, on the side or bottom of the cell, or near the front. The bees can remove the scale formed in the final stages in the cells. The ropiness of the larvae is less noticeable than in American foulbrood, and in many cases is not found. It is believed that this disease is caused by a mixture of bacteria that results in the variety of symptoms which may vary with the type of bacteria present. Sometimes, European foulbrood is confused with certain stages of American and parafoulbrood.

Parafoulbrood usually attacks the larvae before the cells are sealed, but occasionally it kills late larvae in sealed cells and also young pupae. The dead brood first appear grayish white and then become light brown, brown, reddish brown, or dark brown. Scales which formed in the cells usually are removed.

Because the symptoms of parafoulbrood may be confused with American or European foulbrood, it is recommended that you contact your apiary inspector if you see something that resembles disease.

Sacbrood describes the main symptom of this disease. The skin of the infected larva remains intact, but the body contents are watery and flow to the posterior portion of the larva when it is held in a vertical position outside the cell. The larvae generally are infected in the late larval or pupal stages. Therefore, they usually are found in sealed cells or in cells which have been uncapped by the bees. The dead larva is located in the cell with the head lying outward and extending upward. The tip of the head generally is black, while the rest of the body varies from gray to brown. The disease is caused by a virus which is mildly infectious. Although it sometimes reduces the strength of the colony, it seldom is serious. No definite treatment is recommended. Queens should not be reared from a colony containing sacbrood, because some strains of bees seem more susceptible to the disease than others.

DISEASES OF ADULT BEES

Nosema affects the lining of the intestines of adult bees. It generally does not destroy a colony, although it may reduce colony strength considerably. Nosema is most common during the late spring and usually disappears with summer warm weather. Trembling and crawling bees may be found in front of a hive infected with this disease. Many others may be found within the colony. Often, the wings become disjointed. In the later stages of infection, the bees are unable to fly. The dead may be found in large numbers for some distance from the hive.

The disease is spread by contaminated combs during periods when bees are confined to their hives by bad weather, and by contamination of the drinking water into which diseased bees have fallen.

Table 2. Summary of Symptoms of Brood Diseases of Bees

	AMERICAN FOULBROOD	EUROPEAN FOULBROOD	PARAFOULBROOD	SACBROOD
Causative organism	Bacillus larvae	Bacillus pluton	Bacillus para-alvei	Filterable virus
Age of larvae attacked	Usually die after cell is capped	Usually die while coiled in the cell, before cell is capped	Mostly unsealed, but more in sealed cells than with European foulbrood	Usually die after capping of cell
Appearance of brood combs	Cappings become sunken and perforated. Dead brood in capped or perforated cells, or in cells uncapped by bees	Brood becomes spotted; many open cells with yellowish to dull-gray larvae. Few cell cappings may be perforated	Resemble combs with European foulbrood, although more sealed cells affected	Slightly irregular, ordinarily only few cells affected. Dead mostly in perforated or uncapped cells
Position of infected forms in cell	Stick to lower sides and bottom of cell, stretched lengthwise in cell	Various positions; may be on bottom or side near opening of cell	Usually irregular, as in European foulbrood, or may be fully extended	Stretched lengthwise of cell, head prominently raised
Color of infected forms	Light brown to coffee brown; finally become dark brown to almost black	Yellowish white; finally change to brown or black	Reddish brown to dark brown. Scales in unsealed cells lighter in color	Grayish to straw yellow, becoming grayish black to black; head end usually black
Odor	Odor of rotten milk, especially in ropy stage	Sour to that of decayed meat; not always in evidence	Slight in unsealed cells, but very putrid in sealed cells	Slightly sour

Cuticle	Becomes soft and loses form	Remains entire, but becomes translucent with tracheae showing through	Becomes soft, and may be translucent	Remains entire and tough, while contents are watery. Does not adhere to cell
Consistency	Sticky, roping out 2 to 4 inches in viscid stage	Unsealed larvae watery or pasty, seldom sticky; occasional sealed larvae may rope slightly	Dead larvae often become soft and watery. Sealed dead may be ropy	Watery to granular, never ropy
Pupae	Sometimes affected so that the tongue sticks up across the opening of the cell, a sure sign of the disease	Rarely affected	An occasional pupa is killed, but not so many as in American foulbrood	Seldom affected
Characteristics of the scales	Dark brown, adhere tightly to cell wall; cannot be removed easily by the bees. Brittle	Segmentation and tracheae often visible. Dark brown to black, easily removed on drying. Tough and rubbery	Easily removed from the cells. Segmentation and tracheae sometimes visible	Tough, brittle, easily removed. Head end remains prominently tilted upward
Sex of larvae attacked	Usually only worker brood; rarely drone and queen larvae	All sexes	Generally worker and drone	Mostly worker; occasionally drone brood

Paralysis appears to be caused by a virus infection. Generally, bees affected by paralysis become almost devoid of hair. They appear shiny and greasy, and their bodies sometimes are swollen. The bees shake and shiver; their wings often are flat and distorted. Such bees are found in front of the entrances, on the bottom boards, and on combs of the colonies affected. Control is obtained by requeening infected colonies with queens from queen mothers whose bees do not exhibit any symptoms of this disease. The symptoms generally disappear if the affected colony is given emerging brood from other colonies and then requeened with a young, vigorous queen.

Acarine disease never has been found in the United States or Canada. It is mentioned here because an embargo is in effect against the importation of honey bees into the United States from any country except Canada. This is a precaution against the introduction of this disease. The disease is caused by a mite, Acarapis woodi, that invades the breathing tubes of adult bees.

ENEMIES OF BEES

The wax moth in its larval form attack combs and destroys them by burrowing through the cells. It feeds on pollen and waste materials found in the cells. The adult female may lay 400 to 800 eggs in small crevices around the hive. These hatch within 5 days or more, depending on the temperature. As the larvae feed on the combs, they form a mass of webs and leave waste material behind. After the feeding period, the larvae spin their pupal cases in the combs or on the frames or walls of the hive. They chew depressions in the wood before spinning their cocoons. In California, under favorable food and temperature conditions, two or more generations may be produced within a single season. If the colony is strong, the wax moth is not very successful (especially with Italian bees). Usually, the presence of wax moth in a colony indicates that the colony is weak.

Control of this insect has been very effective with ethylene dibromide. Your 4-H leader can give you help in the use of this material.

Ants are a nuisance to the beekeeper. In the small apiary, individual colonies may be protected from ants by setting the hives on stands or benches with the legs in cans of oil. Inspect these cans frequently to see that leaves or grass have not made bridges over the oil. Since many of the ant poisons are very difficult to keep from the bees, take every caution if they are used in the apiary.

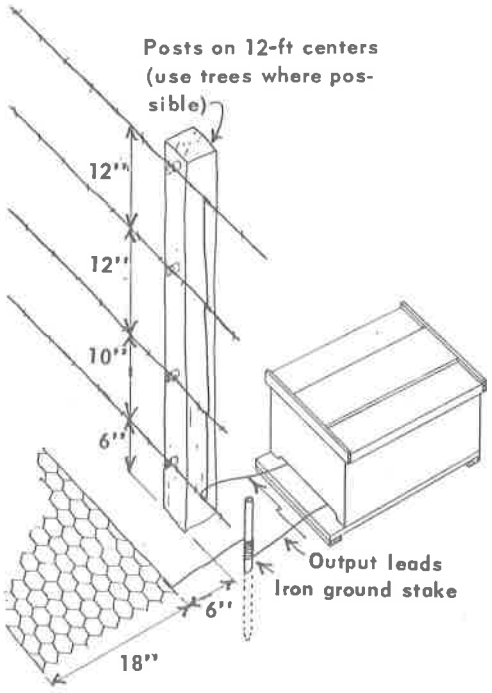
Mice may destroy combs in the hive or storage during the winter. If a queen excluder is placed between the brood chamber and the bottom board during the fall and winter, mice cannot injure the combs in the colony. A wire guard of ⅜-inch mesh over the entrance will protect the hive against mice.

Skunks visit the hives at night, scratch the dirt in front of the hive or at the entrance, and eat the bees that investigate the disturbance. To help control skunks, place small quantities of drone brood and 1-inch-square pieces of strychnine beside the hive for the skunks to eat. Do not use this where there is a possibility of pets eating the comb.

A 4-foot fence of poultry netting will keep skunks out of small apiaries. To be effective, it should be folded along the ground and outside the fence.

Bears may be destructive in areas near mountains. A specially designed electric fence has been effective in keeping bears from the apiary.

Figure at right shows one type of electric fence installation used to protect an apiary from the depredations of bears and other large animals. The battery and "controller" are housed in an empty hive or weatherproof box inside the enclosure. A fence of four wires and a ground of poultry netting are connected to the controller output and to a ground stake. The fence wires (on insulators) are connected in parallel to the output wire of the controller.



HANDLING AND MANAGEMENT OF THE HIVE

HANDLING BEES

You will have fun working with your bees if you make preparations carefully and follow the rules for good handling of the hive.

1. First, light up your smoker. Burlap sacking is the most common fuel, but shavings, excelsior, or other materials are usable. Get a good smoke coming from your smoker.

2. Tie your coverall or pant legs securely.

3. Put on the veil and be sure that it is securely tied and arranged to protect your head and neck.

4. Put on your gloves. Even the most experienced beekeeper uses gloves if the bees are exceptionally cross. However, as you gain experience in handling bees you may find that you will not need them.

5. If the weather is unsettled or a storm is threatening, it is best to delay working your bees until more favorable weather.

OPENING THE HIVE

When you are thoroughly protected from the bees, approach the hive from the side. Be sure to keep out of the line of flight. Blow a puff or two of smoke into the hive entrance to disorganize the guards and distract the attention of the bees from the disturbance. Still standing at the side of the hive, pry up the cover and **blow a little smoke across the frames before removing the cover.** If the bees are not driven down into the hive and seem to want to attack, puff more smoke down between the frames and replace the cover for a few seconds. Use only a little smoke to subdue the bees. Too much smoke will disorganize the colony and it will be a long time before they settle down again.

To separate the frames, insert the hive tool between the outside frame and the hive wall and pry toward the center. Then loosen it from the other frames by prying it back again before trying to take the frame out of the hive. When you remove the first frame from the hive, set it on one end against the opposite side of the hive to make it easier to remove the other frames.

Hold the frames in a vertical position when the comb is examined, so that the sunshine or strong light will fall on the part being inspected. To turn the comb over to examine the opposite side, lower one end of the frame and pivot it on the top bar, keeping the frame in a vertical position. By handling it this way, you will protect new combs that may be soft and stretch in hot weather. To make it easier to withdraw frames, use only nine frames (in a 10-frame hive body or super) equally spaced in a hive body or super, instead of the usual ten. If the bees seem to become unsettled while you are working with them, use a puff of smoke across the frames to quiet them down again. If you are opening a hive for the first time, you will be nervous and your motions will be jerky, but try to remember not to jolt or jar the hive. Usually, you will replace the frames in their original position, unless you can improve the condition of the hive by changing the arrangement somewhat. Never drop a frame into a hive. Avoid killing bees. Injured bees give off an odor which often causes the other bees to sting. Careful handling of the frames will protect the queen against injury. If you locate the queen on a frame, do not set the frame outside the hive; she may drop off the frame and be lost. If you must set the frame with the queen outside the hive, use two frames together with the queen on the inside surface.

As a new beekeeper, you will be interested in what is going on in your beehive. This means that you will want to open the hive frequently to see the activity inside. The normal temperature of the brood nest is 92° to 95° F. Keep the hive open only long enough to make your inspection, so the brood will not become chilled. To gain the most from your examinations of your hives, you should record what you see and the results of your examination. Keep a special notebook where you note the date and your observations; it will supply you with valuable information accumulated during the year.

FINDING THE QUEEN

It is more important to recognize the work of a good queen than to find her on the combs. Adequate brood in all stages for the season in a good pattern in the combs indicates that she is doing a good job.

If you must find the queen, open the hive as gently as possible, using no more smoke than necessary. If there is likely to be brood in two stories, set the upper story on the overturned cover and examine the lower chamber first. Very carefully examine the comb that contains eggs, for the queen usually will be on or near such a comb. If there are no eggs or young larvae in the chamber, the queen will be in the second story. Examine the frames in the second story before setting it back on the first. If the hive is jarred or if too much smoke is used, the queen may hide or run to the side of the hive or to the bottom board where she will be very difficult to find. If you are unable to find the queen, shake the bees into a hive body and force them with smoke to run through a queen excluder into the story below. The queen will be

found on the excluder. She is much easier to find if you mark her with a spot of bright color on the top of her thorax. You can mark your queen with automobile lacquer or fingernail polish. If you are going to mark your queen or lift her from the comb, be sure to pick her up by the wings with thumb and forefinger; do not exert any pressure on her abdomen. Queens very rarely sting the handler.

INTRODUCING THE QUEEN

Buy your queens from established queen breeders, unless you have enough experience with bees to know how to rear your own.

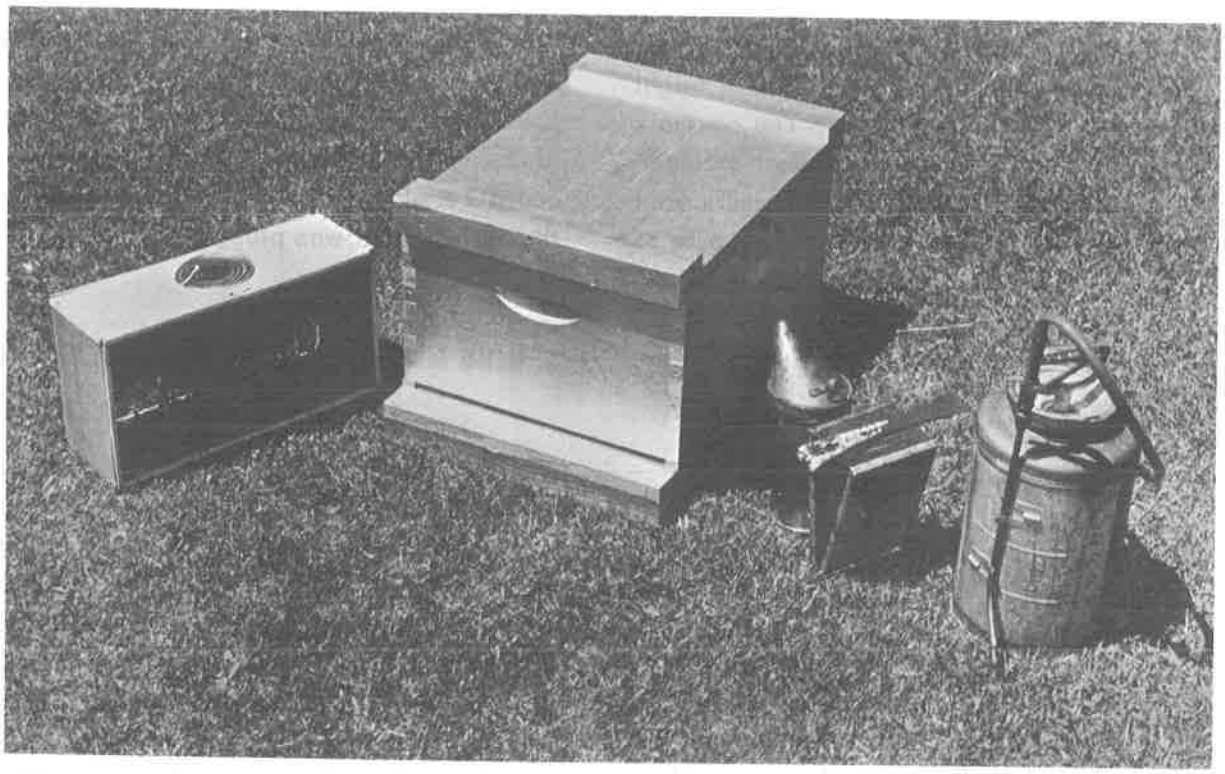
Colonies can be requeened at any time, but most beekeepers introduce queens near the close of a nectar flow or in the spring. Usually, the best time to requeen is during the spring nectar flow. There are several ways to introduce a queen. Most beekeepers use a queen cage composed of three compartments. One compartment is filled with soft candy, as well as the hole leading into this compartment from the outside. The hole is covered with a small piece of cork or a plug of soft paper. To introduce the queen into the cage, remove the cork in the hole at the candy end of the cage. Place the cage on its side between two top bars. The bees are able to feed the queen through the wire. The other bees will eat the candy at the end of the cage in 12 to 24 hours. In the process, they become adjusted to the presence of the queen in the hive. They generally accept her when she leaves the cage through the opening that was plugged by the candy.

SPRING MANAGEMENT — ESTABLISHING THE COLONY

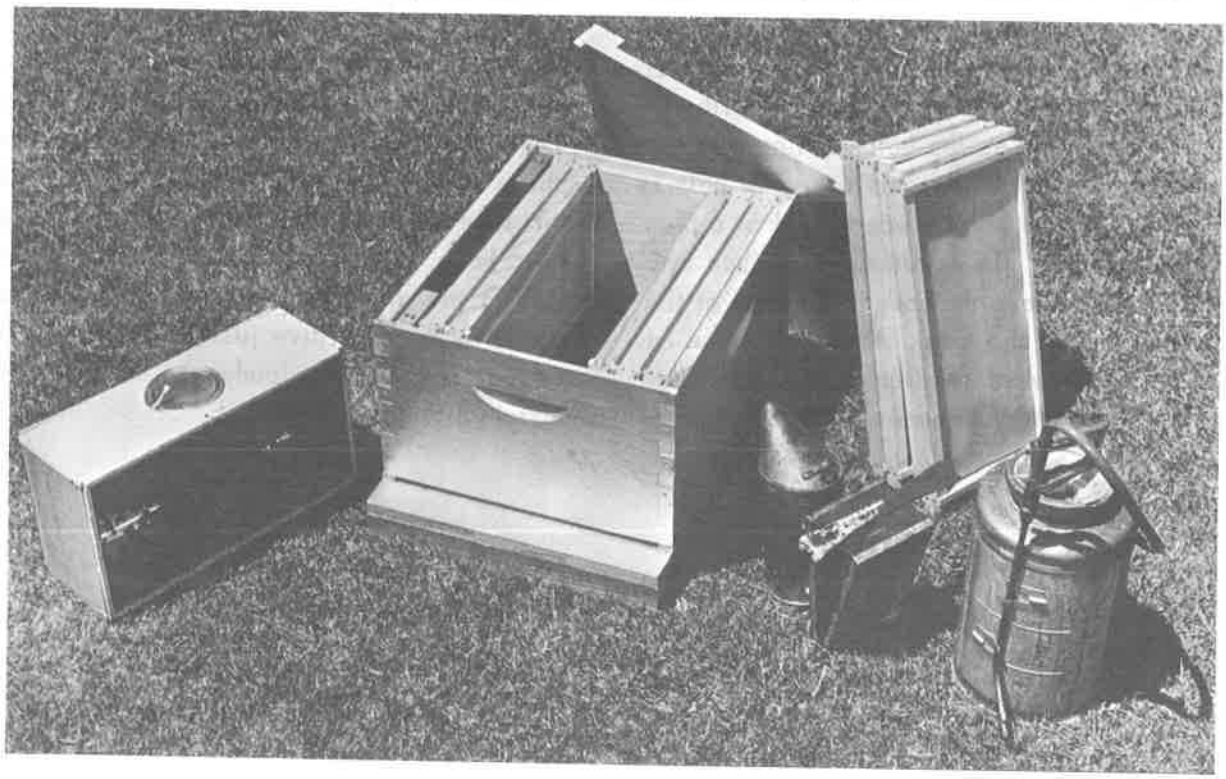
The best time to receive bees to begin your project is in the spring when the blossoms will supply the food needed for brood rearing and feeding the bees. Place two combs with pollen and three full frames of honey in the hive when the packaged bees are installed. If you do not have this food available, feed the bees a sugar syrup until they can support themselves. To prepare the sugar syrup, use equal parts water and sugar, either by volume or weight.

When you receive the packages of bees, feed them all the sugar syrup they will take. The easiest method for feeding bees is to shake or spray thin syrup onto them through the wire sides of the cage. After feeding your bees, keep them in a cool room until late in the afternoon. They will drift less if put in the new hive just before dark. If the day is cool and cloudy, the bees can be installed at any time.

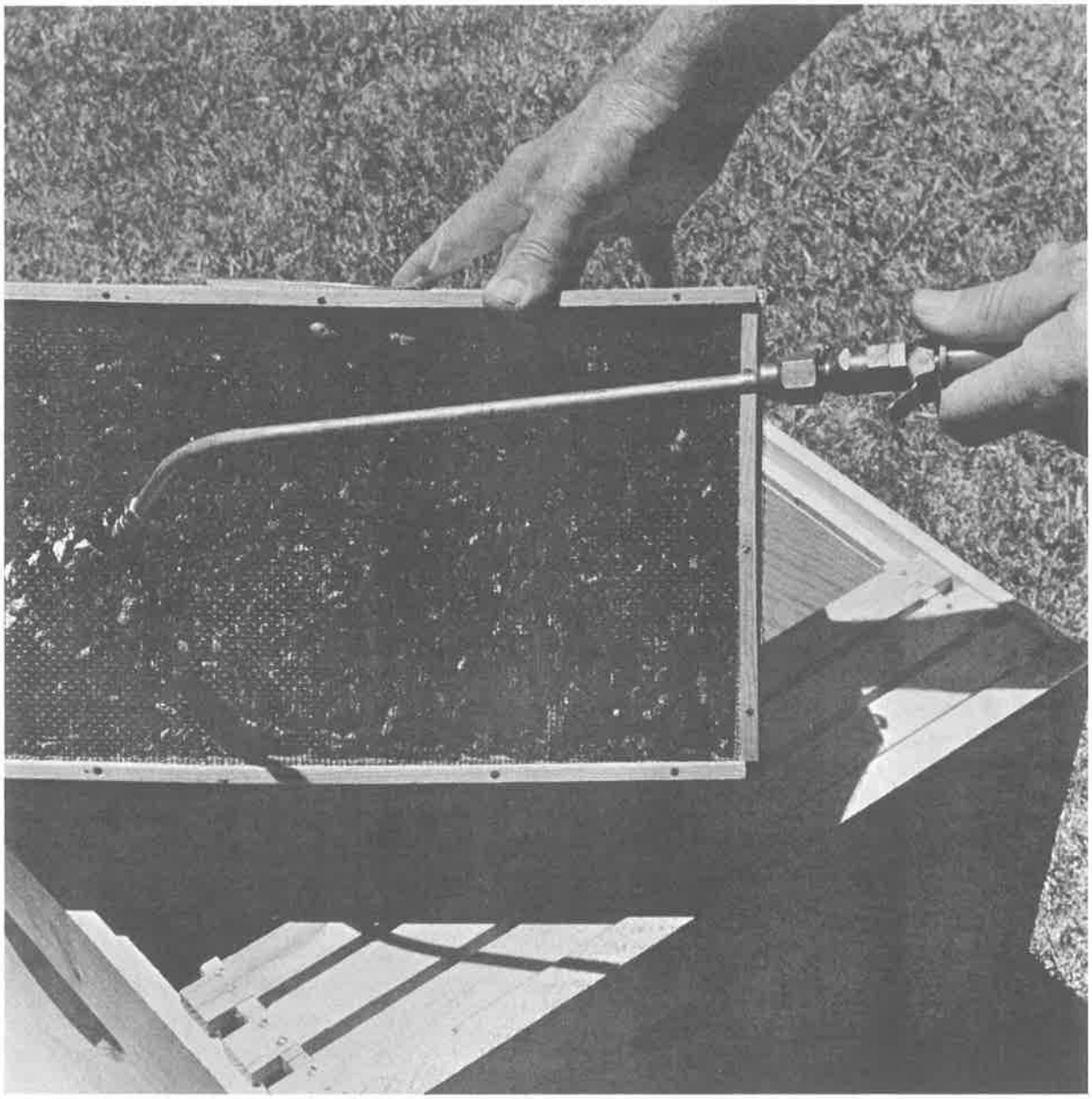
A Method for Installing Packaged Bees into a Hive.



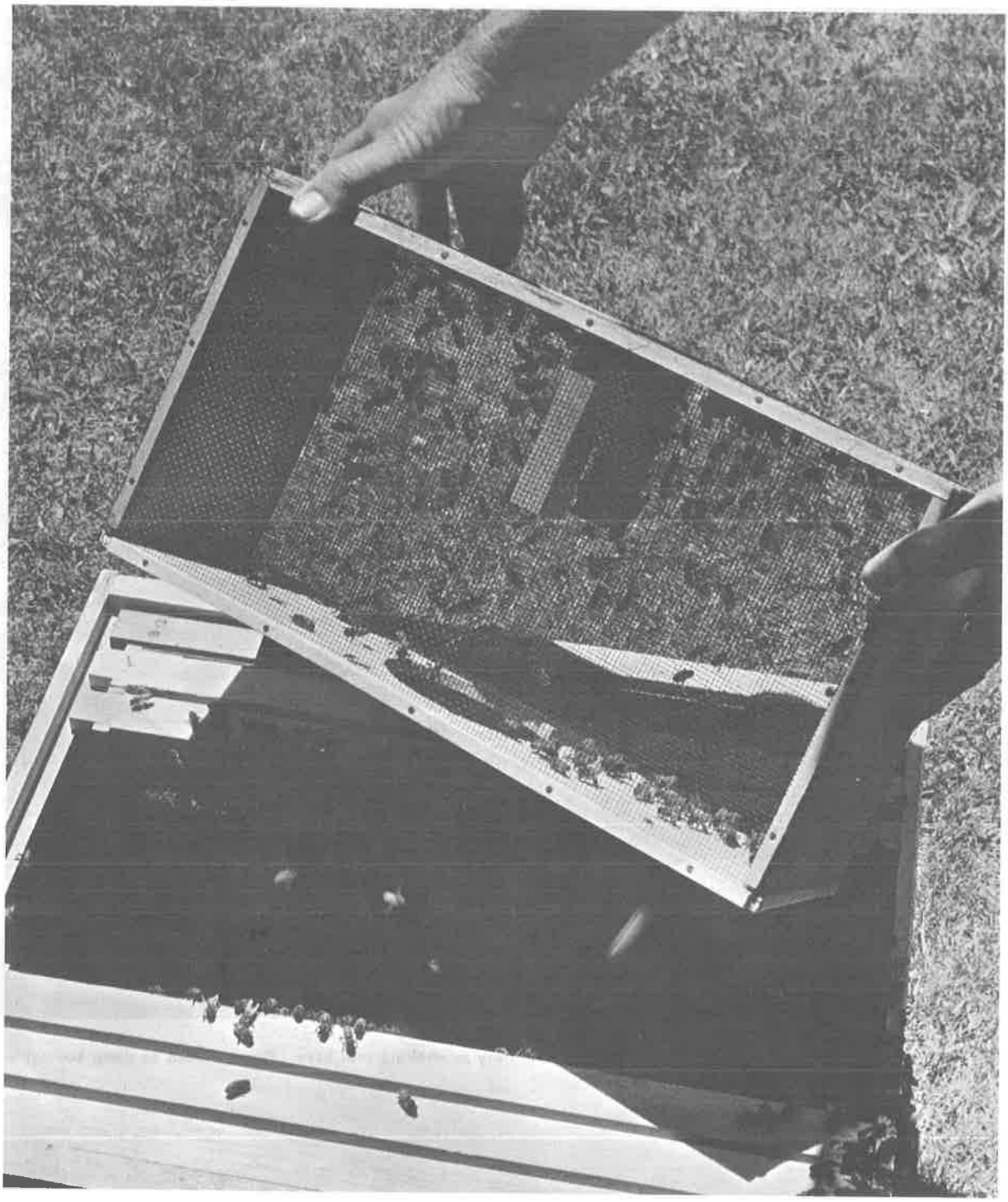
Step 1. Equipment and hive ready for installation of a package of bees. From left to right — a package of bees, beehive, the beehive smoker, the hive tool, and a sprayer containing sugar syrup.



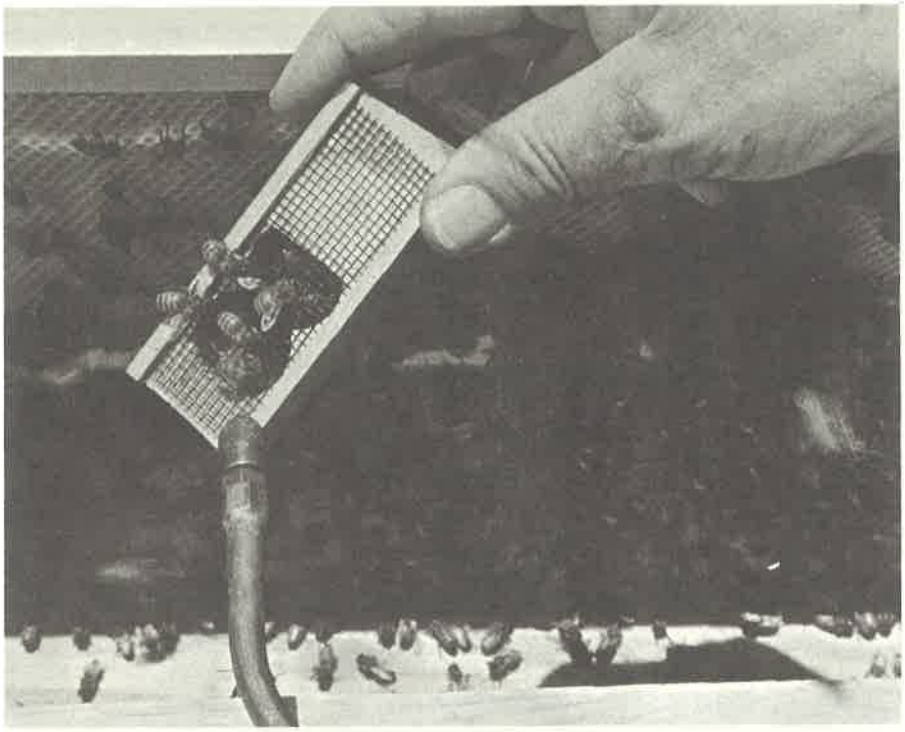
Step 2. Open hive with four frames removed to provide space for bees to be shaken from package to hive. Note division board feeder on left side inside hive. Fill with sugar syrup for feeding (one part sugar to one part water by volume or weight).



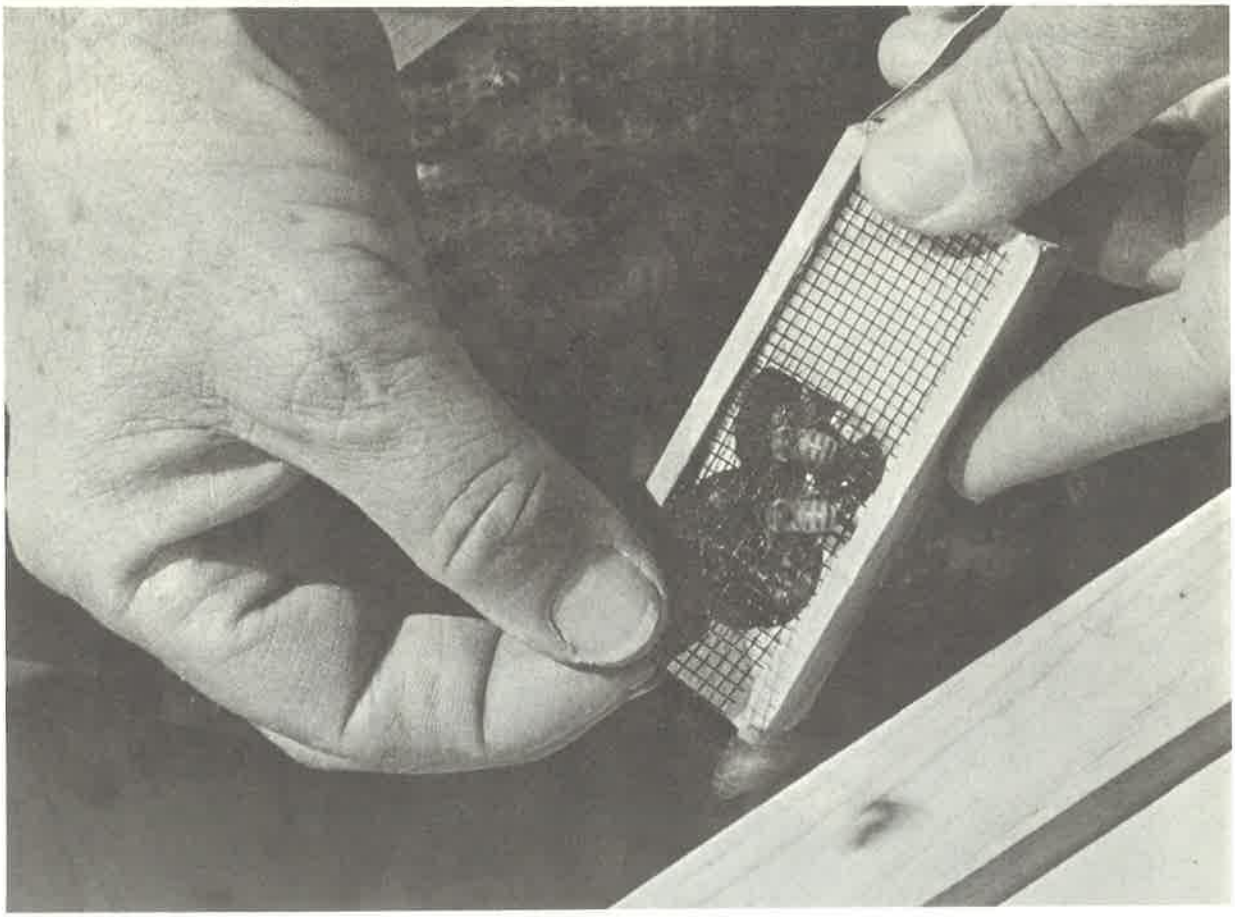
Step 3. Spray bees and package with sugar syrup preparatory to shaking into hive. Bees should be damp but not wet.



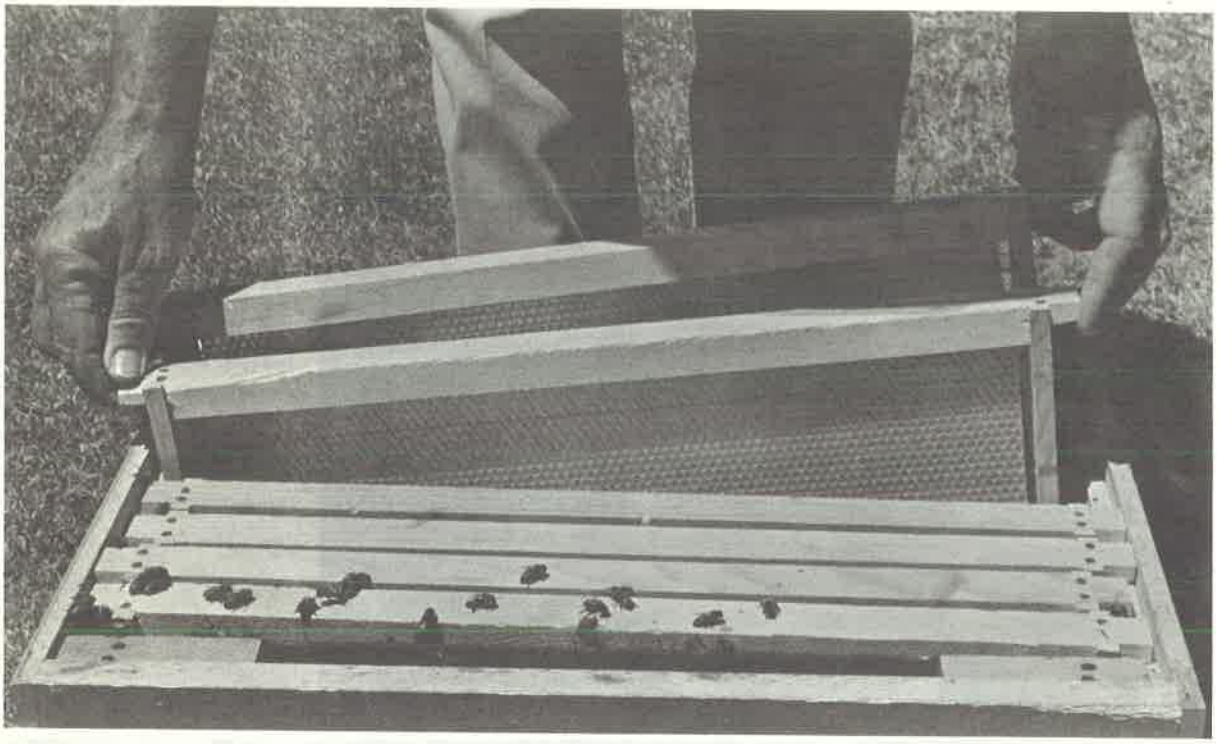
Step 4. Shake bees from package into hive.



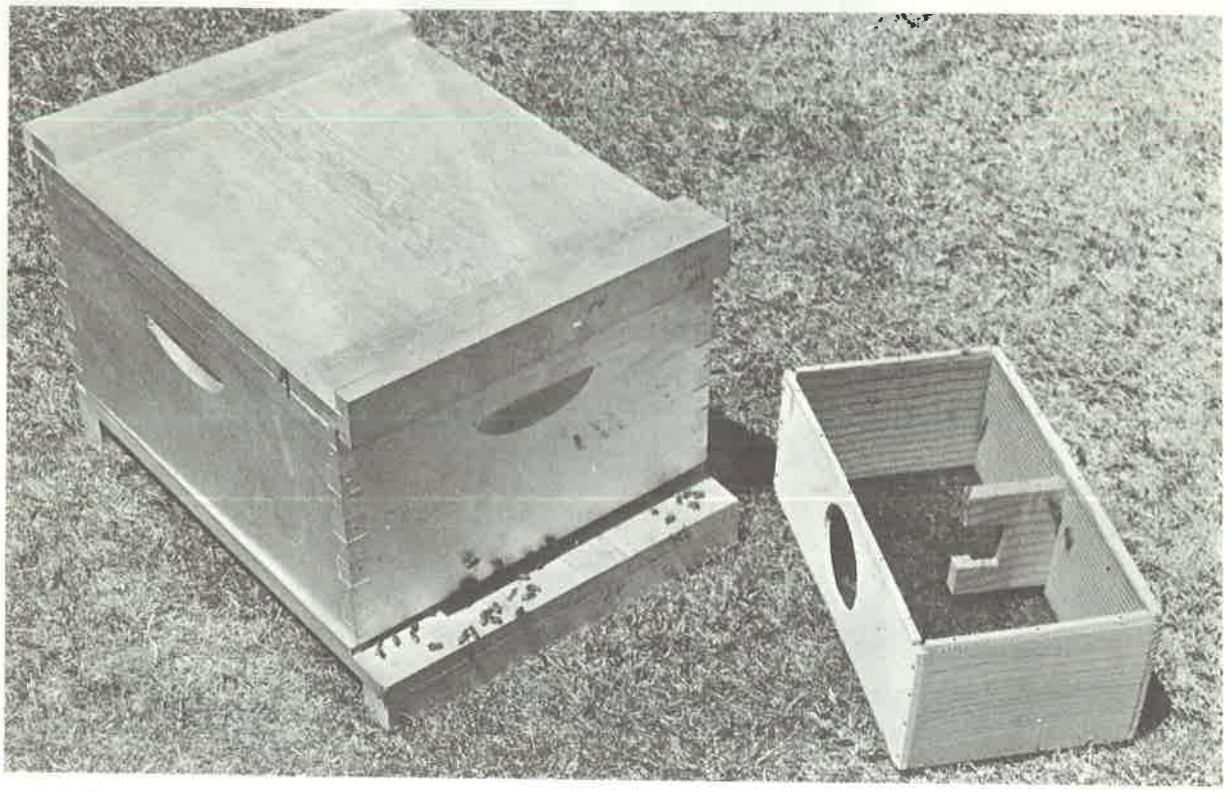
Step 5. Spray queen lightly with sugar syrup before releasing into hive. This prevents queen from flying and makes her more acceptable to the bees.



Step 6. Remove screen from queen cage to release queen into hive. Gently move queen onto bee mass in hive from opened cage.



Step 7. Replace frames removed earlier. If bees are still in mass in bottom of hive, let frames settle by own weight so that bees are not mashed.



Step 8. After bees are installed, leave package temporarily by entrance so any bees remaining in cage can leave and join colony. Do not disturb introduced bees for 1 week after installing in hive.

EXTRACTED HONEY PRODUCTION

For producing extracted honey, provide each colony with a two-story brood chamber, a queen excluder, and at least three half-depth supers, each containing nine frames of comb. These supers will store as much honey in nine combs evenly separated as in ten placed close together; and combs with cells extending beyond the wood of the frame are easier to uncap. When the combs of the second brood chamber are being whitened around the top bars with new wax, the queen may be confined in the lower brood chamber below an excluder. The lower body should contain empty comb and sealed brood to give the queen room to lay.

Add a super of comb on top of the second brood chamber. Put most of the unsealed brood into the body above the excluder. This will reduce swarming and may give the colony enough room for 2 or 3 weeks. Under favorable conditions, all the worker brood above the queen excluder will emerge, and the cells will be filled with honey within 3 to 4 weeks. The colonies may build queen cells in this super. These can be destroyed 10 days after putting on the excluder, or the virgin queens can be left to die on the excluder. If these virgin queens can get out of the hive through a crack, they may fly, mate, and return to start a second brood nest above the queen excluder.

If you do not have enough supers for all of the honey crop, you can extract each super when the combs are three-fourths capped. Then the combs can be replaced for storing additional surplus honey. In the early spring or late fall, unless most of the cells are sealed, there may be some uncapped honey that is unripened. Unripe honey will sour if extracted.

EXTRACTING HONEY

A honey extractor usually is used to remove honey from a comb by centrifugal force. Two- and four-frame extractors may be purchased from most bee supply houses. Some project groups have purchased a small extractor for all of their members to use.

If an extractor is not available and only a few combs are to be harvested, you may cut the comb from the frame and mash it in a double boiler or in a kettle set in a hot-water bath. The wax will melt and come to the top of the honey. Cool the honey and lift off the hardened wax layer on top. Then strain the honey through fine-mesh nylon cloth. Allow the honey to settle overnight, and it is ready to bottle for marketing.

When processing honey and beeswax, give careful attention to all possible fire hazards, because beeswax catches fire easily.

COMB HONEY PRODUCTION

Comb honey is more difficult to produce. The colonies have to be crowded almost to the swarming point, and the nectar flow has to be more constant and large enough to produce combs of good quality. All the combs must be sealed to be salable. The cost of sections, equipment, and labor is greater than for the production of extracted honey. Unless you have had some years of experience with bees, you should produce extracted honey first and learn about bee behavior and how to manage bees.

SWARM PREVENTION

Swarming will be one of your chief problems. We know that swarming is caused by:

Overcrowding in the brood nest

Lack of storage space

Presence of old queens

Lack of ventilation in the hive

Confinement of the colony to the hive during the nectar flow by cold or rainy days during a normal swarming period.

Swarming seems to be greater in areas where there is more pollen. Swarming can be reduced during a heavy nectar flow if the colony is given ample comb space in which to rear brood and store honey.

Here is one method you can use to make new colonies:

When the nectar flow has begun, the queen excluder which is located on the top of the hive body will be moved up to the top of the second body. This gives you a hive containing brood in both stories. When brood is found in both stories and the colony will soon need additional comb space, lift off the story, place the queen excluder on top of the lower chamber, then a super of combs, and then the former second brood chamber on top. Destroy any queen cells. After 9 to 10 days, examine the hive again. If the queen is in the top story, set this chamber aside on a new bottom board and supply a cover. If she is in the lower chamber, set this aside and put the top story in its place. If you find eggs in the comb you added 10 days previously, place this comb in the chamber set aside with the queen. Exchange the frames of sealed brood for empty combs. You should find mainly sealed brood in the two hive bodies on the original stand. Destroy all queen cells. Transfer the bees with the combs.

If the queen is of good stock, you can leave one of the queen cells to requeen the colony. It is best to introduce a young laying queen into the queenless portion. Usually, this will solve the swarming problem for the rest of the season and increase the number of colonies. You may want to unite the two colonies at the beginning of the nectar flow in the summer or later.

HOW TO HARVEST HONEY

To harvest your honey crop, first remove the bees from the combs of honey. This may be done: 1) By shaking and brushing the bees from the combs, 2) by using a bee escape board, 3) by using chemicals such as carbolic acid or benzaldehyde, known as oil of almond.

The bee escape board may fit your operation best. This device allows the bees to leave but not enter the super. Place it under a super of honey with the escape entrance up. The super usually will be free of bees by the following morning. This method disturbs a colony very little. The super above the bee escape board should be bee-tight, so that the combs will not be robbed by other bees. It should not be left on during hot weather, as the combs may melt down.

The simplest method for removing bees from combs of honey is to shake the combs with a sharp downward motion and brush the remaining bees off the combs. As combs are freed of bees, place them in an empty hive body and cover them to keep the bees from robbing.

Dilute carbolic acid sprinkled on a cloth may be used to repel the bees from the supers before the combs are removed. This chemical will burn the skin and can injure the eyes, so be extremely cautious if you use it. Oil of almond (benzaldehyde) is a safer chemical and quite effective. This material is used as a flavoring in foods. It works best at temperatures around and below 80° F, since it has a tendency to scatter the bees when used in warmer weather.

CAUTION – NEVER use chemicals for removal of honey except under the guidance of your leader.

REARING QUEENS

If you are in the queen producer's project, you no doubt have had a number of years of experience with bees and know what system you want to follow in raising your queens.

The following method will get you started with a few queens:

1. For a supply of cell cups, cut off and use the embryo cups which are present in most colonies. Good cups can be made from strips of drone comb, shaved down to within ¼ inch of the midrib, with every third cell mashed down. You can purchase pressed wax cups from supply dealers, or you can make cups by dipping. When making cups by dipping, use a single forming stick. You can make the forming stick or purchase it from supply dealers. The stick is made of round hardwood about 3 inches long, with a ⅜-inch diameter at a point ½ inch from the tip, tapering to between ¼ and $^{5}/_{16}$ inch at the tip. Round the end to give the bottom of the wax cell a concave form. To test for size, fit into a natural queen cell cup.

2. Use clean wax to make the cell cups. Melt the wax in a water-jacketed tray or double boiler, and keep it at a temperature just above the melting point. When the wax is melted, dip the forming stick into cold water, shake off the excess, and dip the stick into the wax to a depth of about ⅜ inch. Remove the stick quickly and hold it in the air until the wax is solidified; again dip it into the wax and quickly remove it. Repeat this process four or five times. After the final dipping, immerse the mold into the cold water and leave it there a few minutes. A gentle twist will remove the cell cup from the stick. Dip the stick in water again before you form the next cell.

3. Bars made from regular frame bottom bars can be fastened into a modified standard frame. It should have blocks ¼ inch thick, ¾ inch wide, and 1½ inches long, nailed to the inside of the end bars to form ledges on which the cell bars can rest. The lower block should touch the bottom bar. Space the lower ends of the second bar of blocks about ⅜ inch above the tops of the first blocks, and make the lower end of the third pair of blocks the same distance above the upper ends of the second pair. Such a frame will take three bars of cells and have about a 2-inch space for comb beneath the top bar. This will give enough room for about 45 cells.

To attach the cell cups to the bars, pour some melted wax along one side of the bar to form a base for the cells. Pick up each wax cup by inserting the forming stick into it. Dip the end of the cup into the melted wax and tightly press the cup bottom into the wax on the bar. Space the cups about ¾ to ⅞ inch from center. When the bar is filled, pour melted wax along each side and between the cell cups to reinforce their attachment to the bar and make a firm base by which to handle the cells when the bees have completed them.

A supply of royal jelly may be obtained from natural cells. In the bottom of each cell cup, place a small drop of royal jelly taken from the natural queen cells. With a transfer needle, place a young worker larva, 12–24 hours old, into each cup. The transferring (grafting) should be done in a warm, humid room, free from draft. Place the cell bars in the frame with the cells inverted, and give the frame to strong queenless colony, known as a cell-builder colony.

Before you make the queenless cell builders, feed the bees honey or sugar syrup for at least a day or two. Add pollen if there is not enough available in the field. The pollen may be fed in cakes, candy, sugar syrup, natural pollen combs, or by filling the cells of an empty comb about half full of pollen pellets and spraying the pellets with thin sugar syrup.

To make a queenless cell builder, dequeen a colony and leave only sealed or emerging brood, except for two frames of very young larvae which are placed in the middle of the hive. Place a pollen comb next to one of the combs of the larvae. The outside comb should be well filled with pollen and honey. If necessary, add more bees to make the colony very strong. Feed the colony continuously after dequeening, unless a sufficient and reliable flow is on. The first cells may be given to the colony the day after it is made queenless.

Shortly before the first cells are given, remove the center comb of larvae and allow the bees to cluster in the space which should now have a comb of pollen on one side and a comb of larvae on the other. Put succeeding grafts or prepared cells in the center at 3- or 4-day intervals, moving older ones aside.

Maintain queenless cell builders by replacing combs from which bees have emerged with combs of sealed or emerging brood. Do this once a week. Replace comb of the larvae with younger larvae a few hours prior to each graft, and shift the other cells to their new location in the hive. Also remove the ripe cells 9 to 10 days after grafting. Occasionally, it may be necessary to add more bees.

Shake additional bees from an outyard into a screen cage and supply them with sugar syrup. Several hours or a day later, spray them lightly with sugar syrup just before adding them to the cell builder.

The first body of the two-story queenless cell builder should be well filled with honey and pollen, and the second body should be made

up and maintained as just described. Twice as many bees are required to fill the hive as are required for the one-story cell builder.

Cell builders often build natural cells. Examine all of the brood combs once a week and destroy the queen cells. Shake enough bees from each comb to expose cells which may be hidden in a comb corner.

When ripe queen cells are removed, cut them from the bars with a thin-bladed knife, by stripping off the layer of wax fastening the cell cups to the bar. Separate the cells and discard small or poorly formed cells. Place the cells between layers of padded cloth and carry them to the mating yards.

Queens emerge from their cells approximately 13 days after hatching from the egg, or 11 days after grafting.

If a ripe queen cell is held before a strong light and tilted slightly to one side, the outline of the image within can be seen quite clearly, and sometimes the movement of legs or wings can be seen. Many breeders candle their cells in this way, and thus can be sure of getting only cells containing live queens to their nuclei.

Take the queen cells from the cell builder 1 or 2 days before the queens are due to emerge, and put them into nuclei. The bees become used to the queen before she emerges from the cell.

Hang queen cells in a normal manner between the top bars of two frames next to the brood, or gently push them into the surface of the comb near brood or where the bees are clustering. If the weather is cold, it is better to place the cells an inch or so below the top bar, or where the bees can cluster around the cell and keep it warm. Always leave the cell end free for the queen to cut her way out.

Two main types of nuclei are used for mating queens. One is the divided hive. A standard hive body is divided into two, three, or four separate compartments, each with a separate entrance. The partitions generally are of wood. In some nuclei, the partitions are fitted into grooves cut into the end walls of the hive; then the bottom is stripped to prevent the board from pulling up when the comb is removed. The compartment tops are closed with individual wood covers or with canvas tacked to the partitions to permit opening one compartment at a time. The entrances should be arranged on the ends or the sides so that no two are on the same side of the hive. This arrangement helps the queens and bees mark their own entrance, and reduces the danger of bees drifting from one nucleus to another. The nucleus can be made up with a comb of honey and partly filled frames of brood and bees taken from colonies with large populations. The interchangeable frames make it easy to add or remove bees, honey, and brood to keep the nuclei in proper strength. To prevent the bees from drifting back to their parent colonies, make up the nuclei in one yard and then remove to another. The entrances can be closed with wire cloth or green grass while the nuclei are being formed.

The second type of nucleus is known as the baby nucleus. These contain frames approximately 4 by 5 inches. They vary considerably in construction and size, but a typical baby nucleus measures about 5¾ inches deep, 4¾ inches wide, and 5¾ inches long on the inside, with walls ⅜ inch thick. The box holds two or three frames and a feeder. The entrance is a $\frac{7}{16}$-inch hole in the front near the alighting board. The entrance can be closed with a metal disc, and the queen can be confined by a piece of queen excluder. The cover fits down over all sides, or simply over the end. A 1-inch screen opening in the back provides ventilation.

The best food for nuclei is honey stored in the comb. A nucleus should have ample stores at all times, for it is difficult to rear queens when the mating colonies are short of honey and pollen. There is danger of robbing during seasons when nectar is scarce or when the nucleus is too small to be self-supporting. When combs of honey are not available, the best substitute is heavy sugar syrup in a feeder enclosed within the nucleus.

After the queen emerges, takes her mating flight, and lays eggs, she may be placed in a cage for shipment. Before caging the queen for use or shipment, be sure she is laying normally. The presence of eggs and brood in the combs and the nucleus usually means that the queen is laying.

In this project, you no doubt will be working with a queen breeder and will obtain much help and instruction from him.

For more details on queen rearing, refer to Queen Rearing by Harry H. Laidlaw, Jr. and J. E. Eckert.

POLLINATING

If you are in the pollinator's project, you will need to find means for moving your bees to the crops to be pollinated. In some cases it may be possible for you to arrange with a commercial beekeeper to include your colonies with his when he moves them. In this way you could rent colonies for pollination and work with the commercial beekeeper to learn more.

APIARY RECORDS

Successful beekeepers keep records to learn whether they are making or losing money.

Records on the origin and age of the queen of each colony will help you improve your stock. You can recognize outstanding colonies, and you might use the queens from these colonies in developing more colonies.

Records on the variations in weight of a hive, together with the blooming dates of the various flowering plants yielding nectar and pollen, will reveal many factors which influence the behavior and production of colonies in the apiary. You will be able to plan your work ahead during the winter months.

PREPARATION FOR FALL AND WINTER

Your colony will be in good condition for fall and winter if you have a young queen and 5 pounds or more of bees. Your colony also should have enough honey and pollen to last until the spring supply is available. In most parts of California, 30 pounds of honey will be sufficient. Bees overwinter most successfully in two-story hives. The second story should be left full of honey. The lower story generally accumulates enough pollen in the lower brood chamber to carry the bees through the winter.

Weak or queenless colonies should be united with "queen-right" colonies. Make sure that each colony has a watertight cover fastened or weighted down so that it will not be blown off during the winter. Provide protection from the wind, but the colony should not be in the shade during the winter. Above the snow line, you may protect the colonies by wrapping the hive in building paper and covering it with tar paper on the outside. Make the top watertight.

Last, but most important, be sure that each colony is free of disease and has a good queen.

DEMONSTRATIONS

How to introduce packaged bees into the hive

How to use a hive tool

How to graft 1-day-old larvae into queen cells

How to candle queen cells

How to make a nucleus for mating queens

How to introduce a queen into a hive

How to remove bees from a super to harvest the honey

How to obtain liquid honey from combs without an extractor

How to open the hive

How to dress to work with bees

Safety in the apiary

SERVICE TO OTHERS

The California Honey Advisory Board, 127 South Milton Avenue, Whittier, California, has a large supply of literature on honey and its uses. Mrs. Mona Shaeffer, Home Economist Manager, would be very happy to work with any 4-H member in promoting the sale of honey.

Service clubs always are interested in hearing from 4-H boys and girls about their projects. Perhaps you can talk to your local service clubs and acquaint them with the bee industry in California.

You can help others by removing bees from places where they might be hazardous to people and animals. List your name with the agricultural commissioner or other county agencies as a 4-H member who would be glad to pick up stray swarms.

WORD DEFINITION

Brood – the eggs, larvae, and pupae of the honey bee.

Brood nest – that part of the beehive devoted to brood rearing.

Brood rearing – the act of feeding and caring for the brood.

Cell – one of the compartments of the honeycomb in which the brood is reared or the food is stored.

Cluster – a number of bees clinging together to form a solid mass.

Colony – a community of bees living in close association and contributing to their mutual support by their labor.

Comb – a mass of cells composed of wax, built by honey bees in the nest or hive to contain their brood and stores of honey and pollen.

Drone – a male bee.

Egg – the first stage of development of the bee; it is laid by the queen.

Foundation – a thin sheet of beeswax, imprinted with the cell basis of the honeycomb, placed in a frame to shorten the time of comb building and increase comb uniformity.

Hive – a manmade dwelling for honey bees.

Honey flow – that period when bees turn nectar into an abundance of honey.

Larva – the immature and wormlike form between the egg and the pupal stage.

Larvae – more than one larva.

Nectar – a sweet liquid secreted by plants. A chief source of honey for bees.

Nucleus – a small colony used to mate queens.

Nuclei – more than one nucleus.

Package – a wire cage containing bees. Usually shipped from southern and western bee producers to northern honey producers.

Pollen – the fine, many-colored grains found upon the stamens of flowers. Gathered and used by the bees in feeding the larvae.

Propolis – a many-colored resinlike material collected by bees from the buds of trees and used by the bees as a cement – also called bee glue.

Pupa – the form assumed by bees after the larval stage and maintained without evident change in size and structure until the adult stage.

Queen – a female bee having fully developed ovaries and reproductive organs.

Royal jelly – an extremely rich food which the worker bees secrete and feed to the larvae that are destined to become queens.

Super – a wooden box with frames containing foundation which is added to the hive above the brood nest.

Worker – female bee having organs adapted for performing the labor of the colony.

BOOKS AND MANUALS

The following materials cover almost all phases of practical and theoretical bee culture as well as the romance of beekeeping. Some of these books may be in your public library or available from book dealers.

Books for Beginners

ABC and XYZ of Bee Culture. A. I. Root. The A. I. Root Company, Medina, Ohio, revised 1962.

Beekeeping. J. E. Eckert and F. R. Shaw. The Macmillan Company, New York, N.Y., 1960.

The Hive and the Honey Bee. Roy A. Grout. Dadant and Sons, Hamilton, Illinois, revised 1963.

Other Valuable Books

American Honey Plants. Frank C. Pellett. American Bee Journal, Hamilton, Illinois, 1930.

Anatomy of the Honey Bee. R. F. Snodgrass. Comstock Publishing Associates (Division of Cornell University Press), Cornell University, Ithaca, New York, 1956.

Bees: Their Vision, Chemical Senses, and Languages. K. von Frisch. Cornell University, Ithaca, New York, 1956.

The Dancing Bees. K. von Frisch. Harcourt Brace and Company (paperback book), no date.

Life of the Bee. M. Maeterlinck. New American Library (paperback book), 1954.

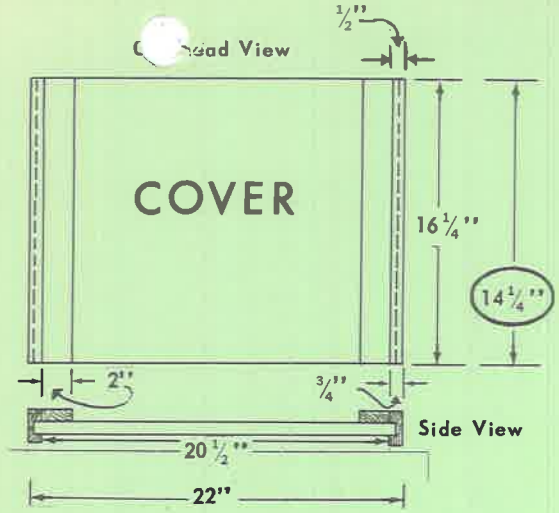
Queen Rearing. H. H. Laidlaw and J. E. Eckert. University of California Press, Los Angeles and Berkeley, 1962.

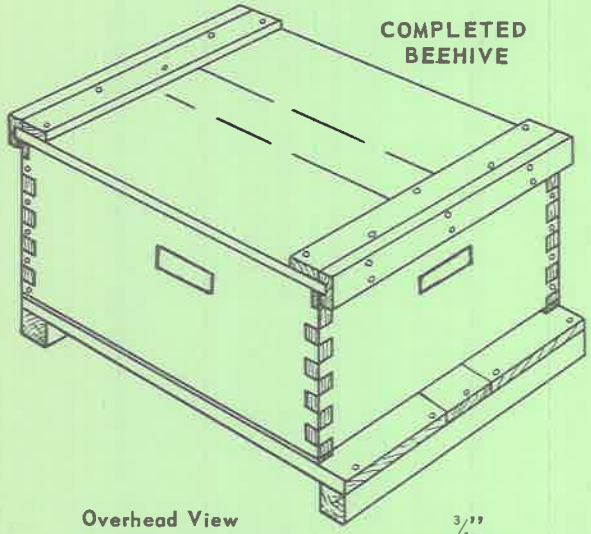
Monthly Publications

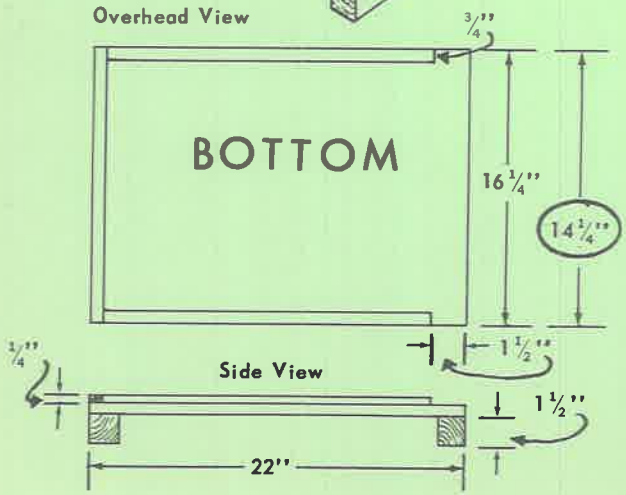
Gleanings in Bee Culture. The A. I. Root Company, Medina, Ohio 44256.

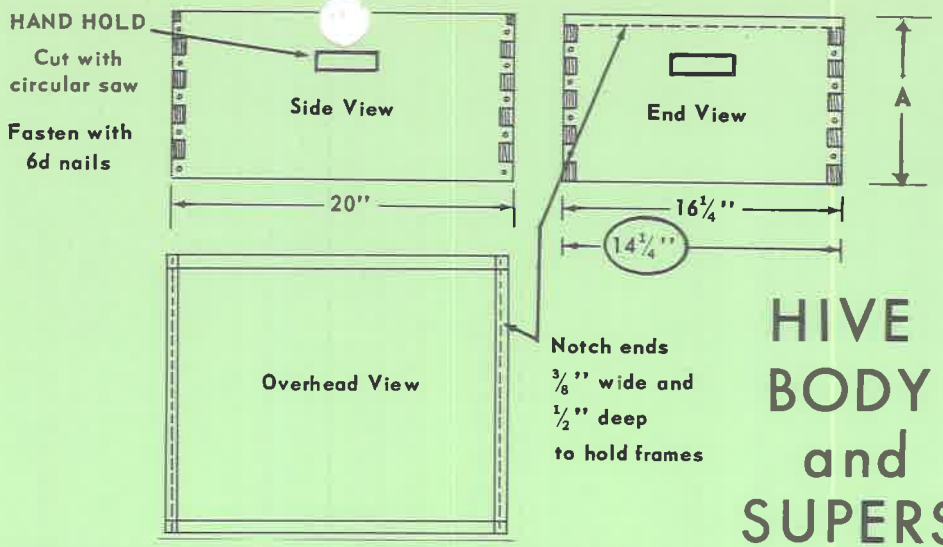
American Bee Journal. Hamilton, Illinois 62341.

HIVE BODY and SUPERS



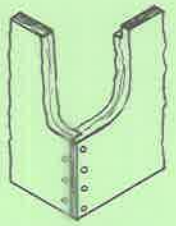






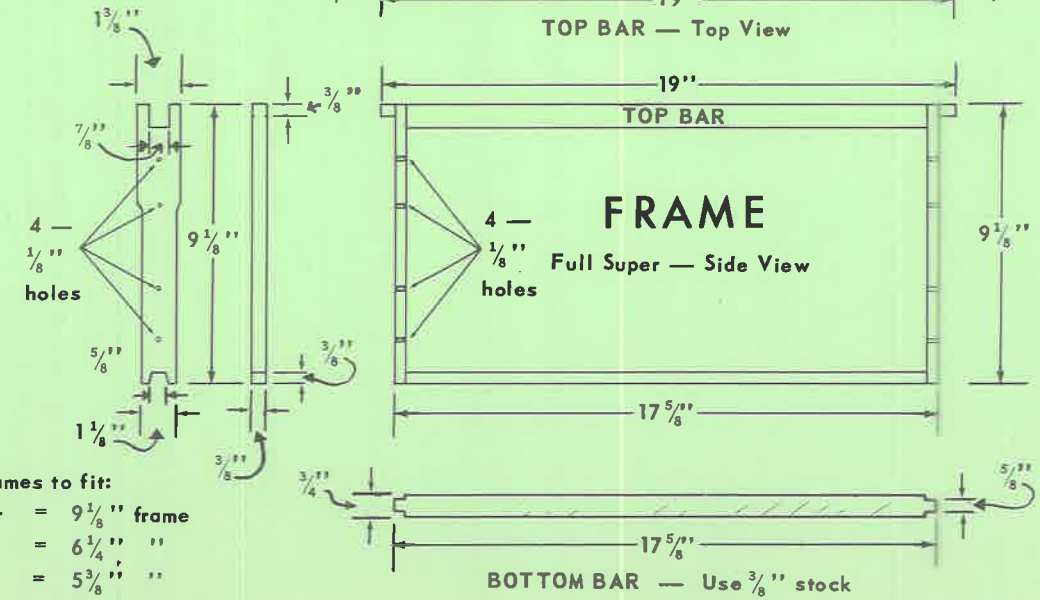
Dimension

Hive body or full super	= 9 5/8"
Three-quarter super	= 6 5/8"
Shallow super	= 5 3/4"
Comb honey super	= 4 5/8"



Use 1" milled lumber (3/4" actual thickness) for construction.
Dimensions are given for a 10-frame unit.
Alternate dimensions are circled and are for an 8-frame unit.

FRAME FULL SUPER



Depth of frames to fit:

9 5/8" super	=	9 1/8" frame
6 5/8" "	=	6 1/4" "
5 3/4" "	=	5 3/8" "
4 5/8" "	=	4 1/2" " or 4 1/4" comb sections

BEEKEEPING PROJECT OUTLINE

COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

In your first year in the Beekeeping Project, you will learn how to care for bees and produce honey.

After you have completed 1 year as a honey producer, or can satisfy your leader that you have the skills and knowledge needed to be a honey producer, you may enroll in either the Queen Producers' Project or the Pollinators' Project.

HONEY PRODUCERS' PROJECT

WHAT DO I DO?

Raise one or more hives of bees.

Sell the surplus honey for profit or use it at home.

Attend one project meeting a month.

Keep records on your subject.

Give your completed records to your leader when he asks for them.

Give one demonstration or talk on bees each year.

Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

4-H–2003

REPRINTED JANUARY 1980

WHAT DO I LEARN?

The secrets of the beehive:

- Where honey comes from
- What bees do in the hive
- The three kinds of bees found in each hive
- Where beeswax comes from
- Arrangement of the colony nest
- What bees feed on
- The "cycle" of the year
- How bees "talk" to each other
- What to do with your bees through the year's "cycle."
- The "races" of bees
- Nectar plants in California, where they grow and when they bloom

WHAT SKILLS WILL I ACQUIRE?

You will learn how to:

- Prepare to handle bees
- Use the bee smoker
- Use the hive tool
- Open a hive for inspection
- Decide if there is a queen in the hive
- Handle frames to inspect them
- Place a package of bees in a hive
- Introduce a queen to a hive

HOW MUCH WILL IT COST?

In time: 1½ hours in project meeting each month. Unlimited number of hours inspecting your bees, harvesting honey, and preparing equipment.

In money and equipment: Prices vary each year; consult your leader for cost of new and used equipment. For one hive you will need:

- 1 package of bees (2- or 3-pound) and 1 queen
- 1 bottom board
- 2 10-frame full-depth hive bodies
- 4 10-frame half-depth supers
- 1 cover
- 20 Hoffman self-spacing standard full-depth frames
- 20 sheets medium brood foundation
- 40 Hoffman self-spacing half-depth frames
- 40 sheets thin super foundation, half-depth
- 1 spool ¼-pound tinned wire
- 1 queen excluder
- 1 smoker
- paint for cover, bottom board, 2 full-depth hive bodies, and 4 half-depth supers
- 1 hive tool
- 1 bee veil
- 1 spur wire embedder or an electric embedder

Optional equipment may include:

- 1 white coverall
- 1 uncapping knife
- 1 pair bee gloves
- 1 bee brush
- 1 frame wiring outfit

You may buy complete hives including bees from a local beekeeper.

POLLINATORS' PROJECT

WHAT DO I DO?

Manage enough colonies to pollinate at least 5 acres of the crop you have selected, or the total crop if less than 5 acres.
Rent your hives with those of an established beekeeper for pollination, if you prefer.
Produce honey.
Sell the surplus honey or use it at home.
Attend one project meeting a month.
Keep records on your project.
Give your completed records to your leader when he asks for them.
Give one demonstration or talk on bees each year.
Record costs and management on forms supplied.

HOW MUCH WILL IT COST?

In time: 1½ hours in project meeting each month. Unlimited number of hours inspecting your bees, harvesting honey, moving bees, and preparing equipment.

In money: Equipment needed will depend on number of hives needed to fulfill contracts for pollination service.

WHAT DO I LEARN?

What happens when a flower is pollinated
How to manage your bees for maximum pollination of a crop
The value of honey bee pollination to California's agriculture
The skills needed to:

move bees
distribute honey bees in crops for most efficient pollination.

QUEEN PRODUCERS' PROJECT

WHAT DO I DO?

Produce as many queens as possible, using one or more colonies as cell builders and at least one breeder queen for grafting.
Produce your queens in cooperation with a commercial breeder who agrees to buy your queens.
Or:

Establish your own market among other 4-H beekeepers or others.
Shake and sell packaged bees.
Attend one project meeting a month.
Give your completed records to your leader when he asks for them.
Give one demonstration or talk on bees each year.

HOW MUCH WILL IT COST?

In time: 1½ hours in project meeting each month. Unlimited number of hours inspecting your bees, caging queens, harvesting honey, shaking bees if you sell packaged bees, and preparing equipment.

In money: Cost will vary greatly. Equipment needed will include:

One or more colonies of bees
Grafting tools and place to graft
An incubator (may or may not be needed)

WHAT DO I LEARN?

The fundamental principles of queen rearing and breeding.
The skills needed to:

graft or transfer bee larvae to cells
candle queen cells
manage cell-builder colonies
select a good breeder queen
build and manage queen nuclei
mark and clip queens
cage queens
ship queens

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture, James B. Kendrick, Jr., Director, Cooperative Extension, University of California.

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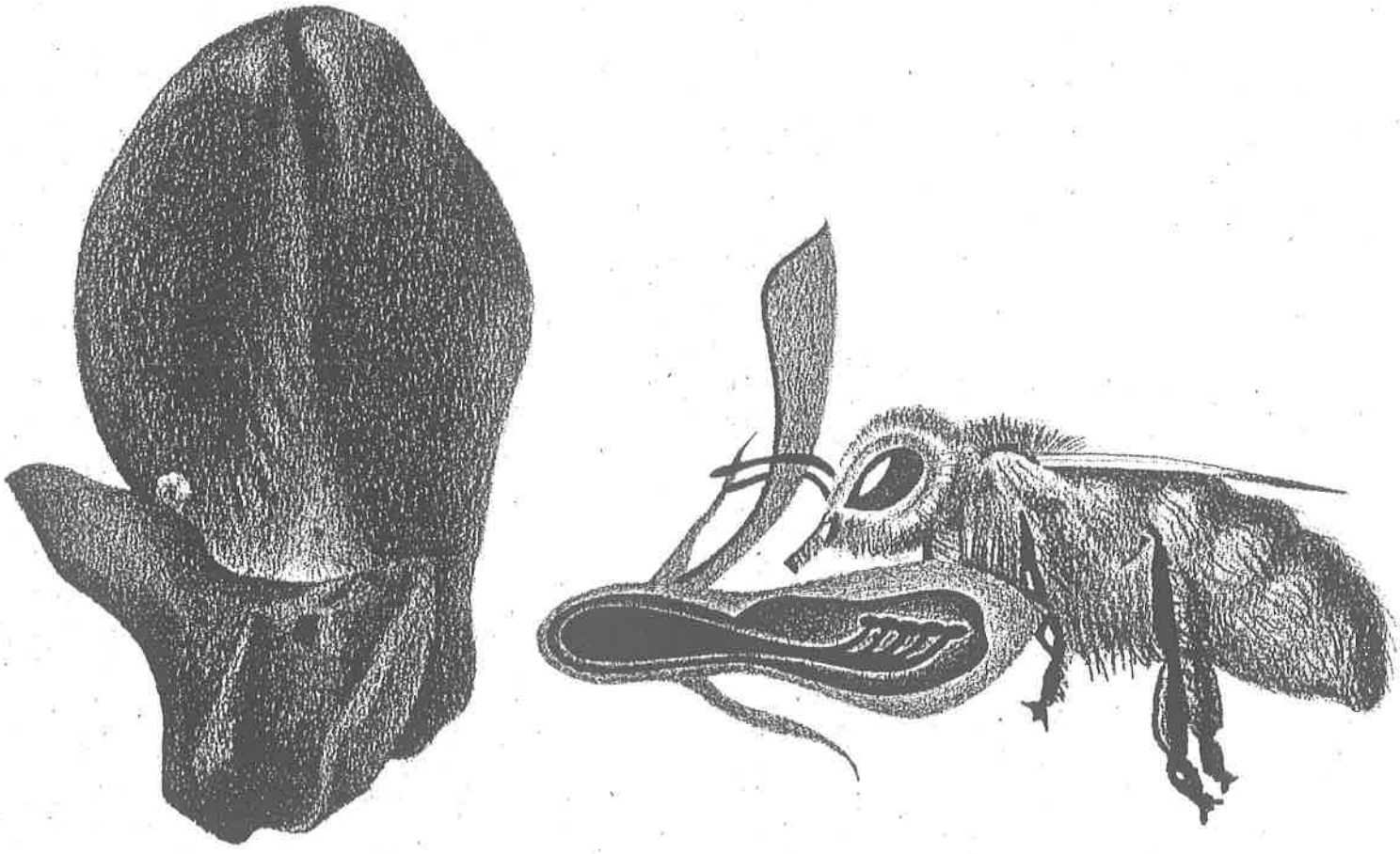
4-H BEEKEEPING PROJECT



COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

4-H Ag88
Rev. 9/75

The authors are: Ward Stanger, Extension Apiculturist, Davis; Harry H. Laidlaw, Professor, Emeritus, Department of Entomology, Davis; and Len Foote, Program Supervisor, Control and Eradication, Division of Plant Industry, California Department of Food and Agriculture, Sacramento.

CONTENTS

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4-H BEEKEEPING PROJECT

> Be sure you know how a bee sting affects you before starting this project. If you don't know, have a doctor test you for your reaction to a bee sting.

In this project, you can work with one or more hives of bees to produce honey, learn how to produce queens, or rent your bees for use in pollinating crops.

Do

Manage one or more hives of bees. Spend as many hours as necessary to inspect bees, harvest honey, and prepare equipment.

Sell the surplus honey for profit or use it at home.

Attend project meetings.

Keep records on your project.

Give at least one demonstration each year.

Take part in activities related to the project.

Equipment

Unless you plan to buy a colony of bees in a hive, you need the following items for one hive of bees. Prices vary from one year to the next so check with suppliers to find out the current prices of new and used equipment.

Bees: one package of bees (2 pounds) and one queen; a colony in a hive; or hive a swarm

1 bottom board

1 10-frame, full-depth hive body

2 10-frame, half-depth supers **or**
1 full-depth super

1 cover

10 Hoffman self-spacing, standard full-depth frames for hive body

10 sheets medium brood foundation for full-depth frames

20 Hoffman self-spacing, half-depth frames **or**
10 self-spacing, full-depth frames

20 sheets thin, half-depth super foundation **or**
10 sheets thin, full-depth super foundation

1 spool $^1/_4$-pound tinned wire

1 queen excluder

1 smoker

Paint for cover, bottom board, hive body, and supers

1 hive tool

1 bee veil

1 spur wire embedder or electric embedder

Optional:

1 pair white coveralls

1 uncapping knife

1 pair bee gloves

1 frame wiring outfit

1 copy of *Fundamentals of California Beekeeping*, Manual 42, available from county 4-H office. (Cost: $1.00.)

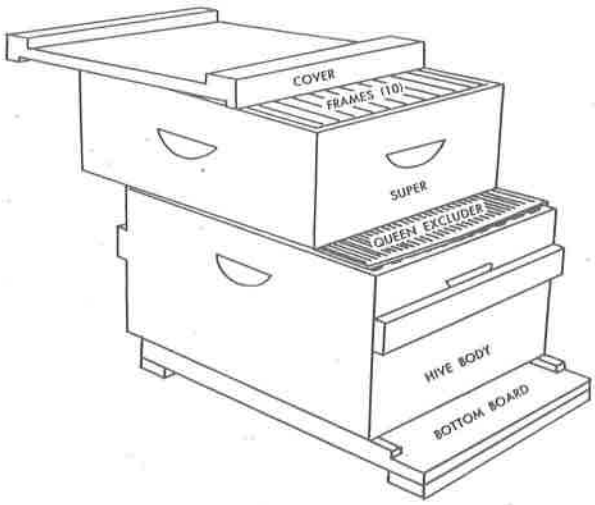


Figure 1. A two-story, 10-frame hive arranged to show main features. See back cover for plans.

LOCATION

You must have an adequate place for an apiary. If you live in or near a city, be careful where you locate bee colonies. Don't place apiaries near highway or pedestrian traffic or close to swimming pools or neighboring homes. It's a good safety practice to provide a source of water near the colony to reduce the chance that the bees will use human or animal water sources.

Locate apiaries where they are out of flood danger from drainage areas. Place the hive so the entrance faces away from prevailing winds, or provide a windbreak. If you live in an area where temperatures reach 95° F. or above during the summer and fall, provide shade for the bees.

Place bee colonies on concrete or stone foundations 1 foot or more above the ground for ease in handling and to protect the colonies from damage by termites, ants, and dry rot.

An ideal location for an apiary is in an area where there are enough spring flowers to supply pollen and nectar for the bees to use to increase the colony population and to store a bumper crop of honey. Fall-blooming plants are also needed to provide food for the bees during the winter. A desirable location has enough pollen and nectar sources to keep the colonies in good condition and to produce a honey surplus for you.

The California apiary laws, enforced by the California Department of Food and Agriculture, require that you register the location of each apiary with the county agricultural commissioner. Also ask your county agricultural commissioner about city or county ordinances and state regulations that pertain to the keeping of bees.

If, for any reason, you can no longer maintain a bee project, inform the appropriate people at once. Don't neglect or abandon colonies. Don't leave frames exposed. Bees that aren't correctly cared for may become diseased and may spread the infection to healthy colonies.

OBTAINING A COLONY

Packaged Bees and a Queen

Order packaged bees well in advance. Have them delivered in the spring when lots of plants are in bloom to supply nectar and pollen to feed the bees. (Your county 4-H office can give you a list of California bee breeders.)

When you receive the packaged bees, feed them all the sugar syrup they will take. Use a container with a perforated top to shake the syrup (one part water and one part sugar) onto the bees through the wire sides of the package. Carefully feed the bees so they don't become stuck together in a mass. If the weather is cool and cloudy, shake the bees into the hive immediately after feeding. On bright, warm days, feed the bees and put the package in a cool room until late afternoon. The bees will drift less if you put them in a new hive just before dark.

To install a package of bees in a hive, follow the method shown in figures 2 to 9. Feed the new colony until it begins to store honey from natural sources. When the new colony population fills the hive body, it's ready to store honey and pollen whenever nectar and pollen are available.

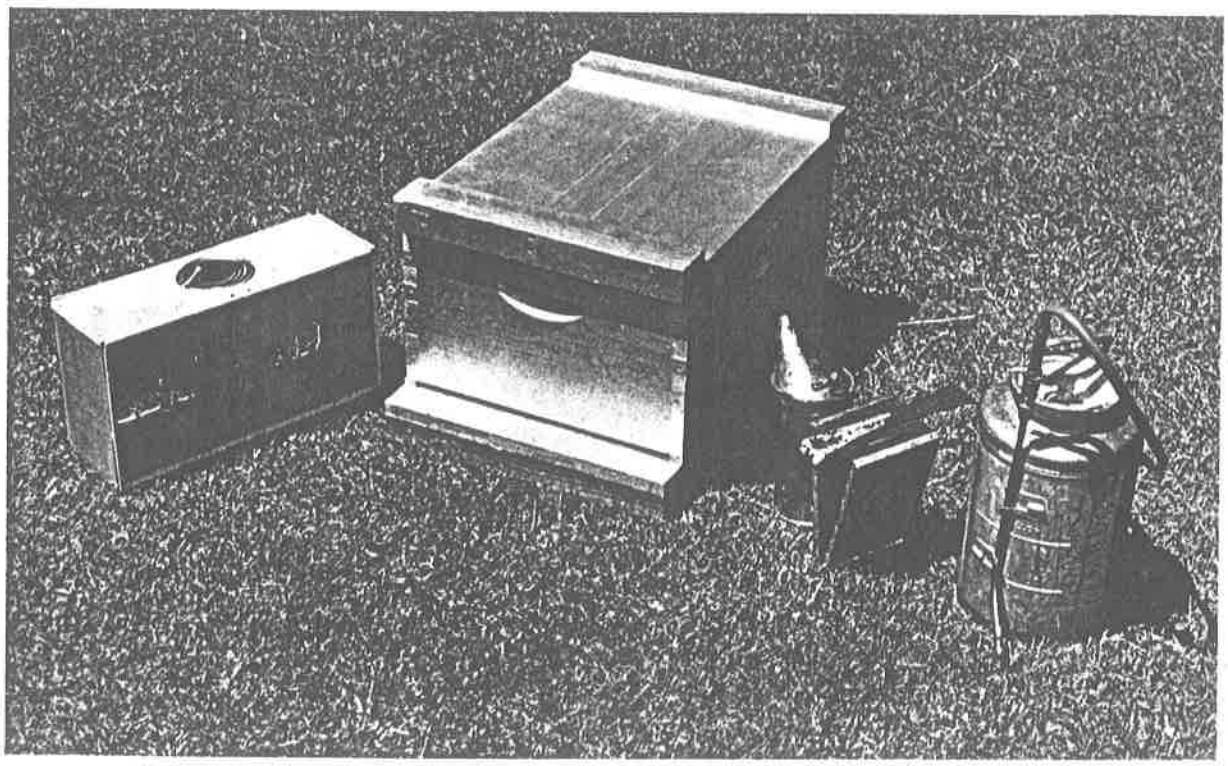


Figure 2. Equipment and hive ready for installing a package of bees. From left to right: package of bees, hive, smoker, hive tool, and sprayer containing sugar syrup.

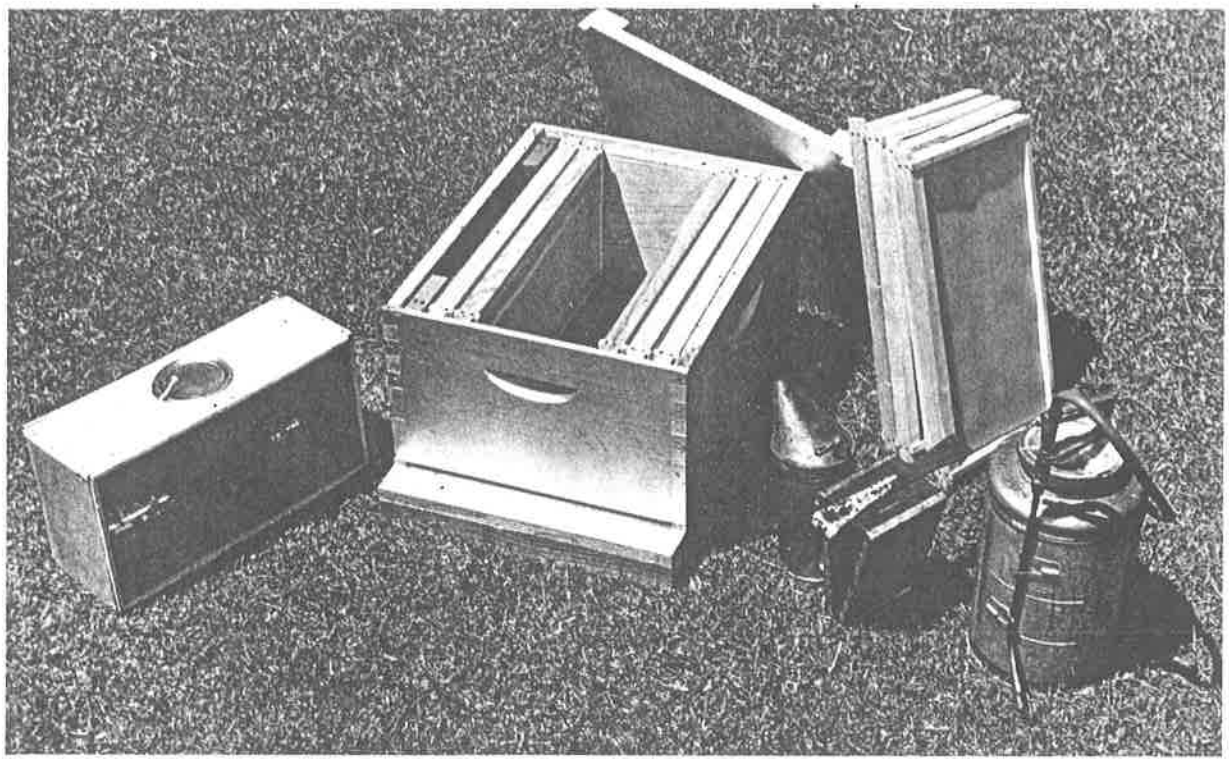


Figure 3. Open hive with four frames removed to provide space for shaking bees from package into hive. Note the division board feeder on left side inside hive. Fill the feeder with sugar syrup for feeding the bees.

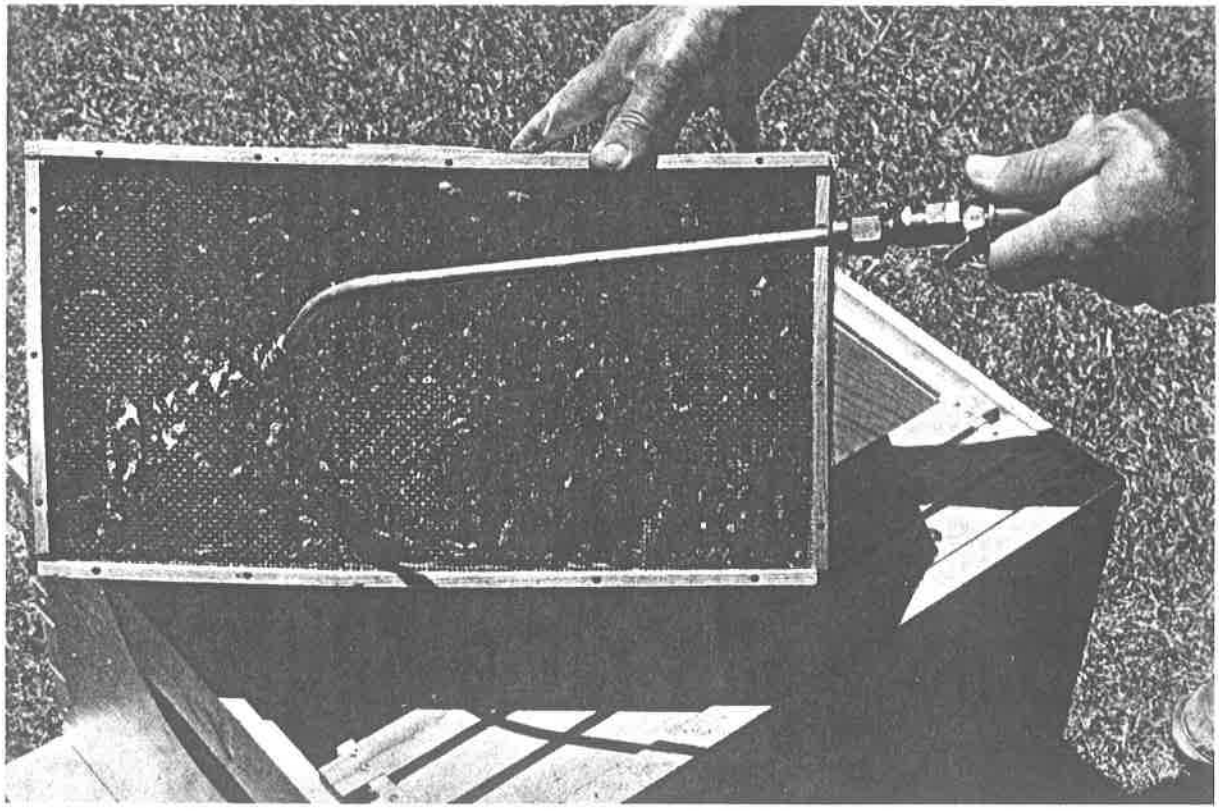


Figure 4. Spray packaged bees with sugar syrup before shaking into hive. Spray until bees are damp but not wet.

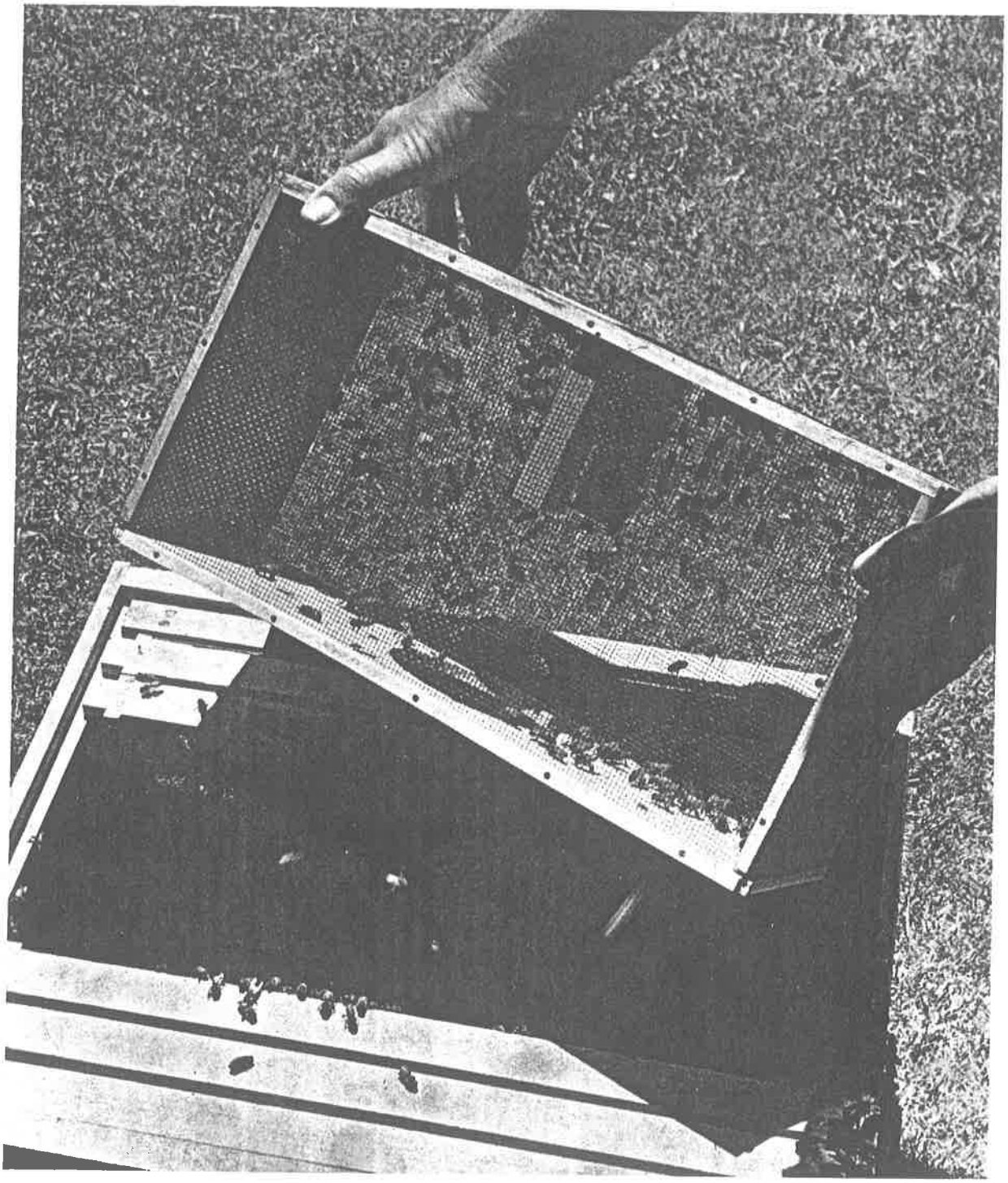


Figure 5. Shake bees from package into hive.

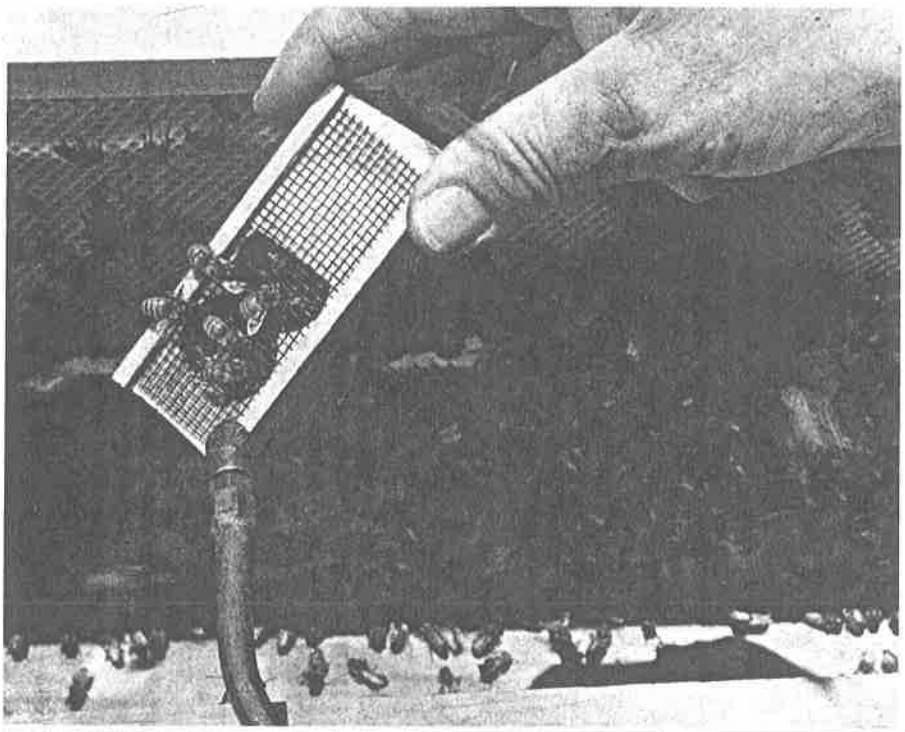


Figure 6. Lightly spray the queen with sugar syrup to prevent her from flying and to make her more acceptable to the bees.

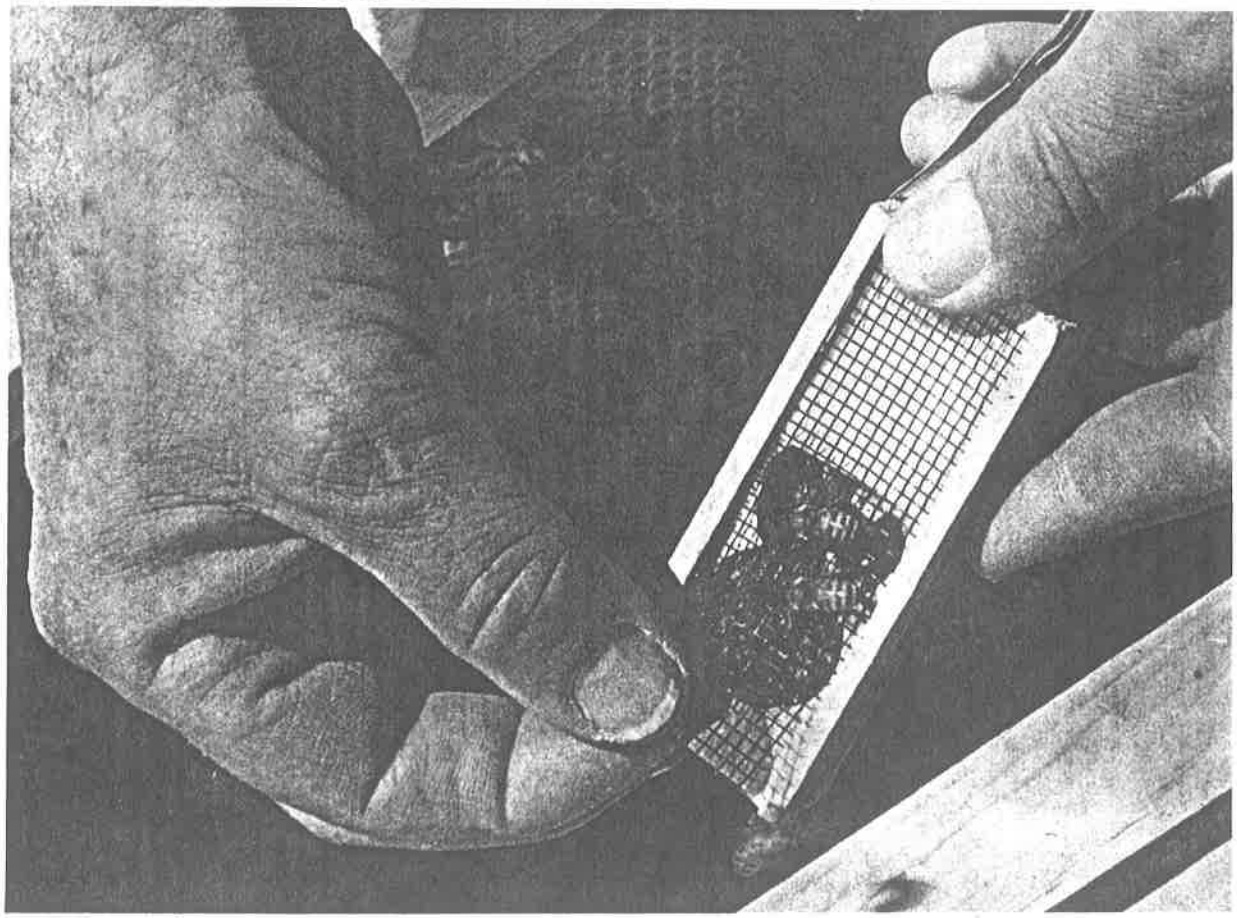


Figure 7. Remove screen from cage to release the queen into the hive. Gently move the queen onto the bee mass in the hive.

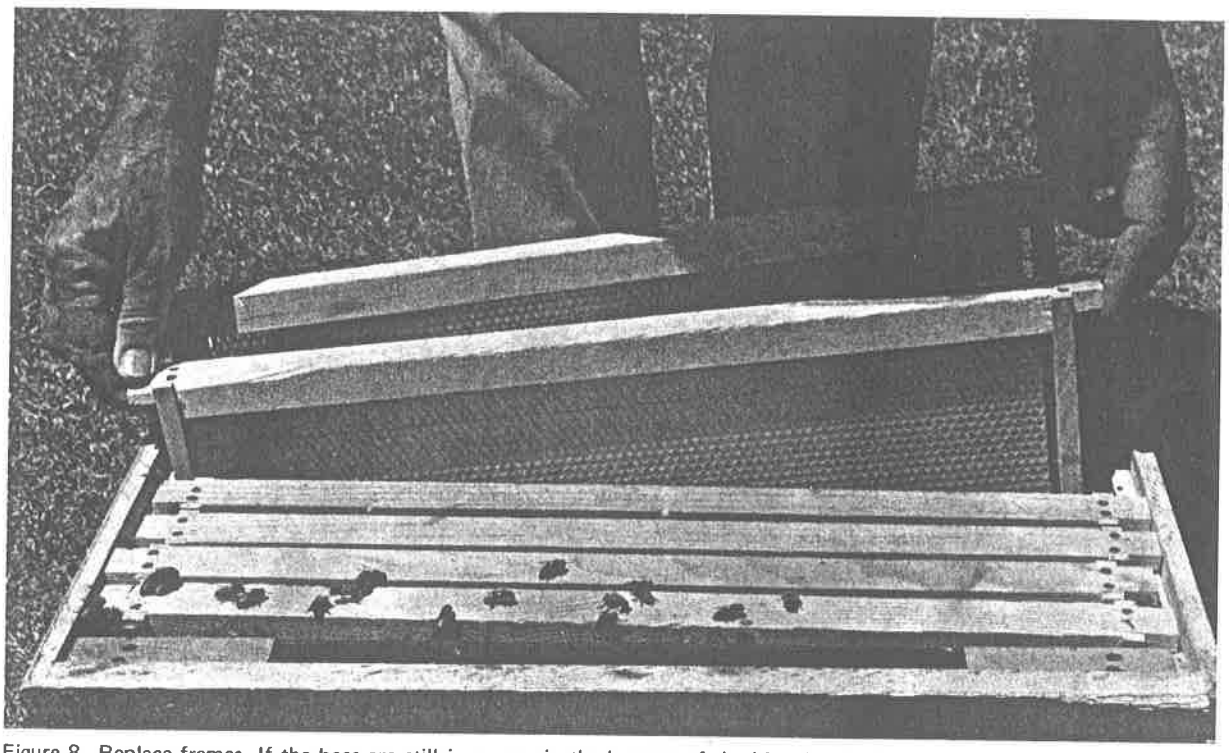


Figure 8. Replace frames. If the bees are still in a mass in the bottom of the hive, let the frames settle by their own weight so they don't crush the bees.

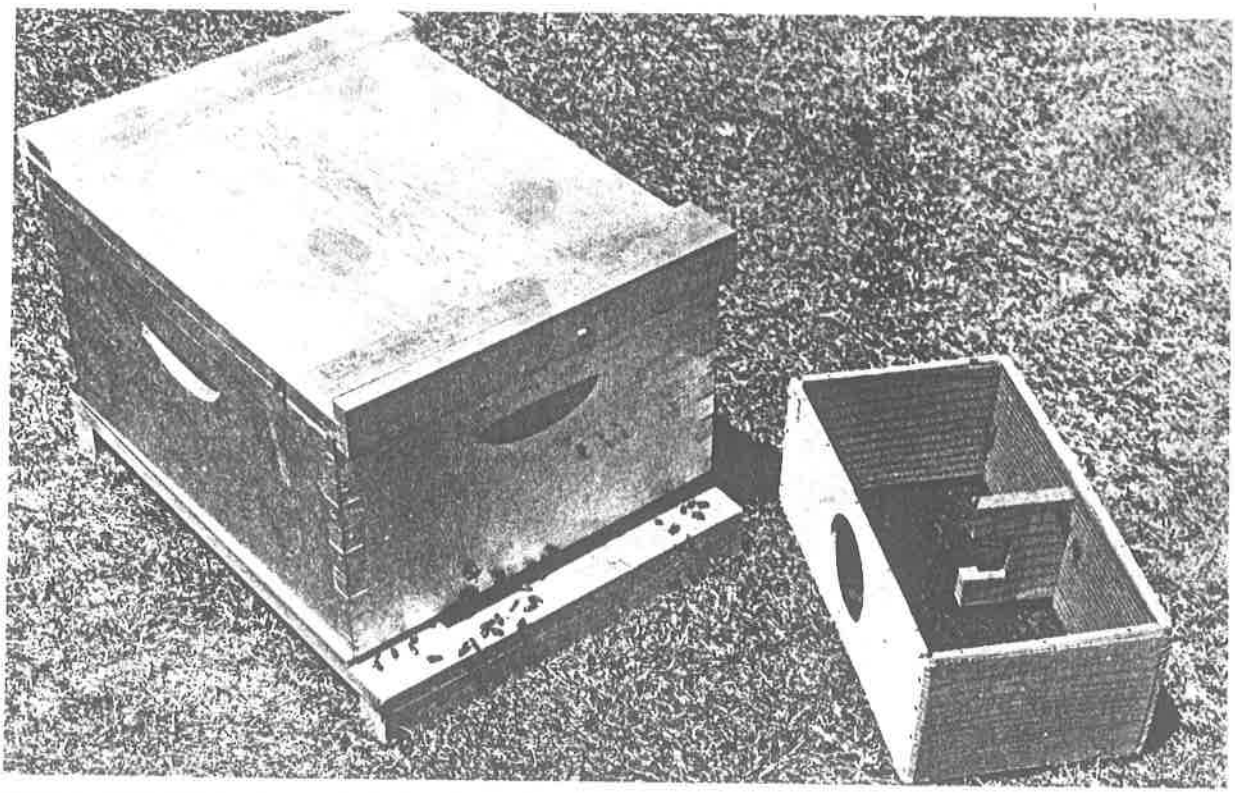


Figure 9. After installing the bees in the hive, leave the package near the hive entrance for a while so any bees remaining in the package can join the colony. Don't disturb the bees for 1 week after installing in the hive.

Hiving a Swarm

Brush or shake the swarm in front of the new hive and smoke it heavily toward the entrance to drive the bees inside the hive. When all the bees are inside the hive, move the hive to its permanent location. When bees swarm, there's usually enough nectar and pollen available to support the colony. After installing in a hive, feed small swarms the same way as packaged bees.

Colony Established in a Hive

You may be able to buy complete hives, including bees, from a local beekeeper. Buying a hive of bees is the easiest way to begin beekeeping. Before purchase, ask the owner to have the county bee inspector certify that the colony is free of disease.

If you must move the bees more than 2 or 3 miles, do it late in the day or just before dawn when all the bees are in the hive. A short move is possible late in the day after the bees have stopped flying.

Sometimes a few bees return to the old location. To recover them, place a hive with comb at the old location. Wait until evening when all the bees are hived. Then take the hive to the new hive and set it on top of the new hive with newspaper in between. In a few days, the bees will have chewed through the paper and united with the colony.

HONEY BEES

Races of Honey Bees

Apis mellifera Linnaeus is the scientific name of the honey bee species found in the United States. Honey bees aren't native to this country; they were all imported from Europe. There are four bee varieties, commonly called races, of economic value. The races interbreed with one another. The first imported race, known as the German black, has now been replaced by the other races. Many races have been tried in California (and the United States), but only three are still in use. These are Italians, Caucasians, and Carniolans.

Italian. The Italian bee has three to five bands of yellow on its abdomen. The head, most of the thorax, and the rest of the abdomen are black with yellowish hairs. Darker strains of this race are called leather-colored or three-banded Italians. The Italians are usually gentle, very prolific, and don't commonly swarm. They produce the best appearing comb honey and have a tendency to rob other colonies.

Caucasian. The Caucasian race of bees is black with grayish hairs. Purebred Caucasians are gentle, prolific, and don't swarm excessively. They are known for their tendency to build burr and bridge combs between the frames, making the combs more difficult to remove from the supers. They also gather and use large amounts of propolis (bee glue), which the bees make from a resinous material they collect from plants.

Carniolan. The Carniolan race is native to Yugoslavia, Hungary, Rumania, and Bulgaria. These bees resemble the gray Caucasians. The segments of the abdomen are black with grayish rings on the edges and are covered with whitish hairs. Carniolans are known as the gentlest of the bee races. They quickly build up a population in the spring, which often leads to excessive swarming.

The Honey Bee Colony

A **colony** of honey bees usually consists of one queen, a few hundred drones, and several thousand workers. During the summer when the bees are collecting nectar and pollen, the colony may consist of as many as 60,000 bees. The drones are more numerous in the early spring than in the fall.

The **queen** is reared in a special cell that's usually suspended vertically from the surface or the lower part of the comb. The queen develops from the same kind of egg as the workers, but she emerges in a shorter time than either the worker or the drone. She is fed royal jelly, a special food secreted by young workers known as nurse bees. The quantity and quality of the royal jelly depend on environmental conditions.

The queen is usually much longer than either the workers or the drones. She has a slightly larger thorax and a longer abdomen, which make her wings appear shorter, than those of the workers but smaller than those of the drones. She doesn't have pollen baskets or wax glands. Her curved sting is stouter and has fewer and shorter barbs than that of the workers. She rarely uses her sting except when she emerges from her cell and finds other queens in the colony. The virgin queens battle until only one is left.

The queen's main function is to lay eggs. Within 5 to 10 days after leaving the cell, the queen usually takes one or more flights and mates with several drones while in the air. She may mate more than once before starting to lay eggs, but never after she begins laying. The queen stores the sperm received from the drones in a special organ called the spermatheca. The number of eggs laid by the average queen mainly depends on the amount of food she receives and on a favorable temperature in the hive.

The queen can lay worker (fertilized) or drone (unfertilized) eggs at will, but her activities are governed by factors that affect the entire colony. If there is a shortage of nectar and suitable pollen, brood-rearing slows or may stop entirely. In most regions of California, no brood is found in normal colonies during a short period in late fall and early winter. The queen lays unfertilized eggs in drone cells early enough in the spring and during the summer so that there are adult drones by the time a colony is ready to swarm.

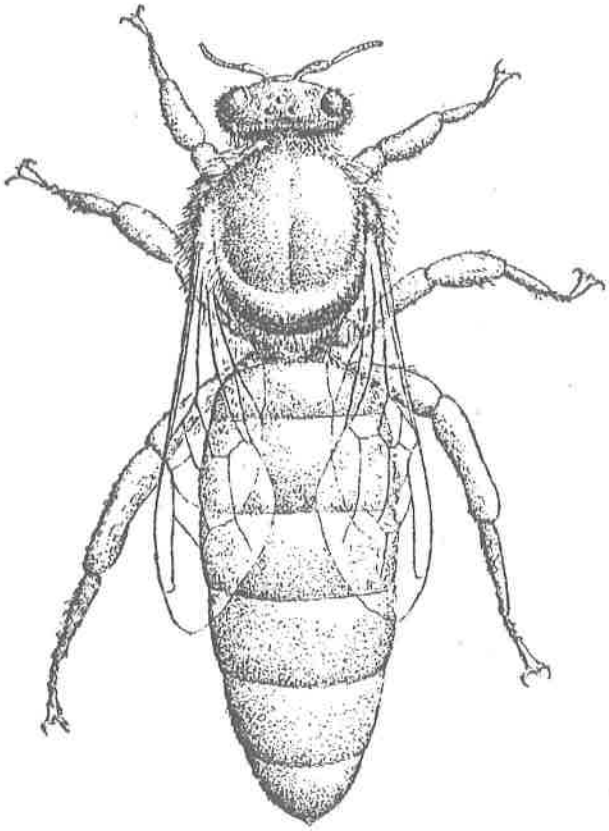
As the queen ages, she gradually uses up her supply of sperm and may lay an increasing number of drone eggs.

The **drones** are larger and heavier than the workers, but not as long as the queen. The compound eyes cover most of the head. The drones are the male bees in the colony; their only function is to mate with the queen.

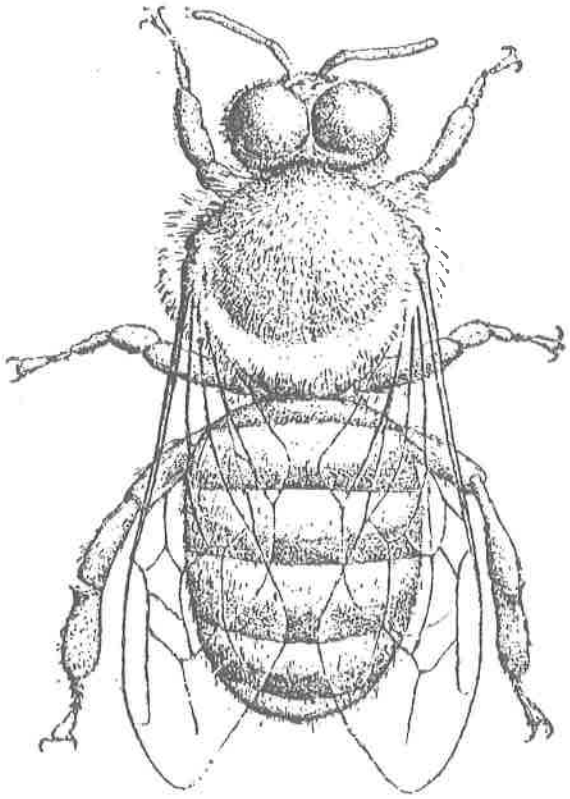
The drones have no sting and none of the many useful structures of the worker bees. The young drones are fed by the workers; the older drones feed themselves. At the approach of winter, the drones are driven from the colony to starve.

The **workers** are females, but they lack the fully developed reproductive organs of the queen. They are produced from fertilized eggs laid in worker cells. The workers perform all the labor of the hive. Immediately after emerging from the cells, they groom themselves and eat honey and pollen to gain strength. As they grow older and become acquainted with the hive, the workers may clean out the cells, the hive, feed the older and then the younger larvae, take orientation flights, evaporate nectar, build comb, and act as guards and ventilators. During the latter half of their lives, they become foragers, carrying water, pollen, nectar, and propolis.

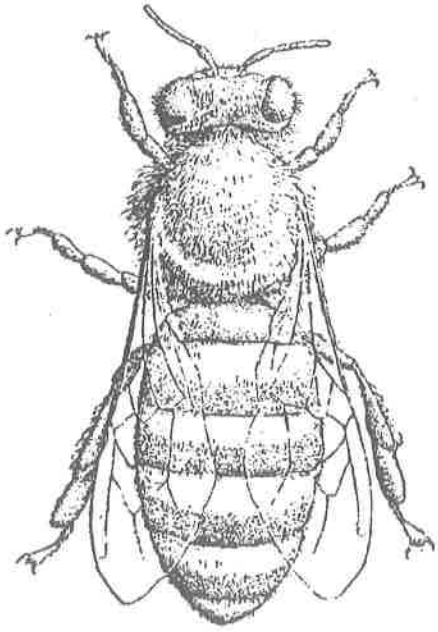
Worker bees may live for 6 to 8 weeks during the pollen- and nectar-gathering season. However, in winter when they're less active, they may live for several months. Enough workers usually survive the winter until others are reared in the spring to take their place.



QUEEN



DRONE



WORKER

Bee Food

Pollen, honey made from nectar, water, and salt are the natural food materials for bees. Pollen supplies the protein and fats bees need for growth; honey provides sugars for energy. Both pollen and honey provide minerals and other substances important to the bees' diet.

Worker bees can live on honey or on syrup made from sugar and water. They apparently require little pollen except in the first few days of life and later to rear the brood. The nurse bees use honey, pollen, and water to produce royal jelly, which they secrete in the food glands located in their heads. All the developing forms of bees, known as larvae, are fed royal jelly the first 3 days after they hatch from the eggs. Thereafter, the worker and drone larvae are fed a mixture of honey and pollen. The queen is fed royal jelly all during her lifetime.

The Colony

Within 10 to 14 days after installing a 2-pound package of bees in a single-story hive, check to see if the bees are developing normally. If all is well, many frames will be filled with comb that contains brood, pollen, and honey. Some frames will have brood in the center, surrounded by pollen, and honey in the area between the pollen and the frames. Some frames will be filled with pollen and honey only. All the frames with foundation only should have comb built into them. The pollen will be concentrated in the outside combs of the brood chamber.

After 21 days, the first fertilized eggs laid develop into worker bees. The workers cut their way out of their cells. Other workers then polish the used cells so the queen can deposit more eggs in them. That's why the same frame may contain two or more cycles of brood, ranging from eggs to emerging bees.

A good queen lays her eggs in a compact arrangement, leaving few cells empty. She attaches an egg to the bottom of each cell.

The pearly-white larvae that hatch remain coiled in the bottoms of the cells until they finish the feeding stage. As the larvae enter the next stage (pupal), they extend lengthwise in the cells and are sealed in by a finely porous cap of wax material provided by the worker bees. The larvae line their cells with a silken cocoon and change into pupae.

Capped **brood** cells in the new comb are light straw-yellow. These cells become darker as they are used for rearing more generations. Cells that contain honey have white caps. Sometimes the caps may become stained with propolis and pollen or they may look water-soaked if the caps touch the honey in the cell. Pollen cells are seldom sealed; they are usually only partly filled. Sometimes pollen cells may be partly filled with honey and then sealed so that, on the surface, they look like cells of honey. The walls of old cells thicken somewhat. The brood comb can be used for many years without any noticeable effect on the size of the bees produced. Old brood comb is very dark, sometimes almost black. Although darkened with use, these cells don't affect the color of honey that may be stored in them.

Drone cells are usually found on the lower edges and corners of the frame. Parts of the comb that are stretched or injured may also produce larger cells (drone cells).

If the space for brood-rearing is limited to one or two stories by the use of a queen excluder, some frames may be entirely filled with brood and the honey and pollen crowded into the outside combs.

The Cycle of the Year

In the spring, brood-rearing begins in the center of the bee cluster some weeks before the first spring flowers bloom. When the first spring flowers start to bloom, the bees collect pollen, nectar, and water to use for making larval food. The first pollen and nectar of the year stimulate brood-rearing.

New bees are produced faster than the old ones die so the population of the colony increases. The increase in production of bees and storage of honey leaves fewer cells of the comb in the brood chamber for the queen to lay eggs in and the colony may become crowded with bees. When this occurs, the bees prepare to divide the colony by swarming.

Before swarming, the bees first prepare queen cells along the bottom and sides of the brood combs. Days before the swarm leaves the colony, the nurse bees feed the old queen less and less. The queen gradually reduces the number of eggs she lays to prepare for flight with the swarm.

Scout bees begin to search for a new home. More workers remain in the hive. The colony begins to loaf and many bees cluster on the front of the hive. Anytime after the first queen cells are sealed (and sometimes before), the field bees and many of the hive bees fly in front of the hive, producing a characteristic roar. The air in the vicinity of the hive is filled with excited, swirling bees, creating a high-pitched tone, which, once heard, is seldom forgotten.

Small groups of bees begin to cluster here and there after a few minutes of flying, finally forming a large cluster in one place. The old queen leaves the hive with the swarm unless her wings have been clipped; then she may be found on the ground in front of the hive. The queen and the swarm hang in a cluster for a few minutes or an hour or more before taking wing. Then they fly to their new home in one continuous flight. Sometimes they remain clustered overnight or even build combs where they have clustered. In the hive that the old queen left, there are many frames of brood, some bees, and several queen cells from which queens may be ready to emerge.

The first queen to emerge usually goes to the other queen cells, tears a little hole in the side of each, and stings the queen inside before she can leave the cell. The worker bees then tear down the queen cells and carry the dead queens from the hive. The new queen takes her mating flight within 5 to 10 days and then returns to the hive to lay eggs.

As the nectar flow draws to a close in the fall, the drones are starved and driven out of the hive by the worker bees. The bees no longer have excess moisture from the evaporation of nectar to use for rearing brood and cooling the hive, so they seek more watering places. Brood-rearing usually ends as fall approaches. The old bees die and the colony gradually dwindles from about 60,000 bees to 20,000 or 30,000. This reduction in colony population extends over several months. The worker bees seem to sense the coming of winter; they collect large amounts of propolis to fill the cracks and make the hive tight for the winter.

As the days grow colder, the bees become less active. They gather close together to form a tight cluster when the air temperature around them drops. As it becomes colder, the bees form a tighter cluster to maintain a temperature of 57° F. The bees usually cluster on combs containing honey. After using up the honey in a comb, the bees move to another comb of honey. In most areas of California, bees are seldom confined to the hive for more than a few days at a time during the winter.

TABLE 1. Average Number of Days in Developmental Periods of Honey Bees.

	Egg	Larva	Pupa	Total
Queen	3	$5^1/_2$	$7^1/_2$	16
Worker	3	6	12	21
Drone	3	$6^1/_2$	$14^1/_2$	24

HANDLING BEES

Working with bees is fun if you're careful and follow the rules for good handling of the hive.

- First light up the smoker. Burlap sacking is the most common fuel, but you can use shavings, excelsior, or other materials. Get a good smoke coming from the smoker.
- Securely tie the legs of your coveralls or pants.
- Put on a bee veil. Be sure to securely tie and arrange it to protect your head and neck.
- Put on gloves. Even the most experienced beekeeper uses gloves if the bees are exceptionally cross. However, as you gain experience in handling bees, you may find that you don't need them.
- If the weather is unsettled or if a storm is threatening, it's best to delay working with the bees until the weather improves.

Approach the hive from the side. Be sure to keep out of the line of flight. Blow a puff or two of smoke into the hive entrance to disorganize the guards. Remain at the side of the hive and pry up the cover. Before removing the cover, blow a little smoke across the frames under the cover. If the smoke doesn't drive the bees down into the hive, puff more smoke down between the frames and replace the cover for a few seconds. Use only a little smoke to subdue the bees. Too much smoke disorganizes the colony and it may take a long time for the bees to settle down again.

Remove the cover and lay it upside down behind the hive. Remove all the supers above the hive body and place them across the upturned cover so the supers are resting on the raised edges of the cover only. That avoids crushing the bees.

To separate the frames in the hive body, insert the hive tool between the outside frame at the front, rear, and the hive wall and pry toward the center. Then loosen it from the other frames by prying it back again before trying to take the frame out of the hive. Lift out the second frame from the hive wall first. Insert the straight end of the hive tool under the top bar and pry the frame upward at both ends.

When you remove the first frame from the hive, set it on one end against the side of the hive. To make it easier to take out frames, use only nine frames equally spaced in a ten-frame hive body (super) instead of the usual ten.

Hold the frames by the protruding part of the top bar to examine the comb so that sunshine or strong light falls on the part you want to inspect. To turn the comb over to examine the opposite side, revolve the frame so the top bar is on the bottom.

If the bees seem to become unsettled while you're working with them, use a puff of smoke across the frames to quiet them down again. Don't jolt or jar the hive. Replace the frames in their original position unless you can improve the condition of the hive by changing the arrangement. **Never drop a frame** into a hive; it may kill bees. Injured bees give off an odor, which often causes the other bees to sting.

Handle the frames carefully so you don't injure the queen. If you find the queen on a frame, don't set that frame outside the hive. The queen may drop off the frame and be lost. If you must set the frame with the queen outside the hive, place two frames together so the queen is on the inside surface.

The normal temperature of the brood nest in a hive is about 92° F. When examining a hive, only keep it open long enough to make your inspection so the brood doesn't become

chilled. Record what you see and the results of your examination. Keep a special notebook where you can note the date and your observations. This book will become a source of valuable information.

Finding the Queen

It's more important to recognize the work of a good queen than to find her on the combs. If the combs contain adequate brood (including eggs) in all stages for the season, the queen is doing a good job.

If you must find the queen, open the hive as gently as possible. Don't use any more smoke than necessary. If there is likely to be brood in two supers, set the upper super on the overturned cover and examine the lower super or hive body first. Carefully examine the comb that contains eggs; the queen is usually on or near this comb. If there are no eggs or young larvae in the hive body, the queen will be in the super on top of the hive body. Examine the frames in this super before setting it back on the hive body.

If you jar the hive or if you use too much smoke, the queen may hide or run to the side of the hive or to the bottom board where she will be difficult to find. If you can't find the queen, shake the bees into a super over a queen excluder and use smoke to force them to run through the excluder into the super below. The queen will remain on the excluder.

It's much easier to find a queen if you mark her with a spot of bright color on the top of the thorax. Use a quick-drying, enamel-like fingernail polish to mark the queen. If you're going to mark the queen or lift her from the comb, use your thumb and forefinger to pick her up by the wings; don't put any pressure on her abdomen. Queens rarely sting a handler.

BEE MANAGEMENT

Swarm Prevention

Swarming is a major problem and is caused by one of the following factors.

Overcrowding in the brood nest.

Lack of honey and pollen storage space.

Presence of old queens.

Lack of ventilation in the hive.

Cold or rainy weather that confines the colony to the hive during the nectar flow.

You can reduce swarming during a heavy nectar flow if you provide the colony with ample comb space in which to rear brood and store honey. The following is one method you can use to make new colonies and perhaps stop bees from swarming.

Once the nectar flow has started, move the queen excluder from the top of the hive body to the top of the second body (full-depth super). That will eventually give you a hive that contains brood in both stories. When there's brood in both stories, the colony will soon need additional comb space. To provide more comb space, lift off the second story (super), place the queen excluder on the first story with a super of frames containing empty combs on top, and then put the former second brood chamber on top of that. Destroy any queen cells.

After 9 to 10 days, examine the hive again. If the queen is in the top story, set that chamber on a new bottom board and supply a cover to form a new colony. If you find eggs in the comb you added 10 days before, place this comb and any frames of sealed brood in the story (super) set aside with the queen. Don't shake the bees from these combs.

If the queen is in the lower chamber, leave it on its bottom board and put the top story on a new bottom board. The lower chamber then

becomes the new colony. Be sure there is sealed brood in the two hive bodies. Destroy all queen cells. Introduce a young, laying queen into the queenless portion.

Dividing a hive usually solves the swarming problem for the rest of the season, besides increasing the number of colonies. You may want to **unite** the two colonies at the beginning of the nectar flow in the summer or later.

Preparing Colonies for Fall and Winter

For a colony to be in good condition for fall and winter, it must have a young queen and 5 pounds or more of bees. The colony also needs enough honey and pollen to last until the spring supply becomes available. In most areas of California, 50 pounds of honey (a full-depth super full of honey) is sufficient. (Leave the second story full of honey.)

Unite weak or queenless colonies with queen-right colonies. Make sure that each colony has a watertight cover fastened or weighted down so that it can't be blown off during winter. Provide protection from winds, but don't place the colony in the shade during the winter. Make sure the tops of all hives are watertight.

Last, but most important, be sure that each colony is free of disease and has a good queen.

Introducing a Queen

The purpose of requeening a colony is to replace a queen of poor stock or one that may become a drone-layer. It's possible to requeen colonies anytime, but it's common to introduce queens near the close of a nectar flow or in the spring. The best time to requeen is usually during the spring nectar flow. Before requeening a colony, remove the present queen and destroy any queen cells. Leave the colony queenless for a day or so before introducing a new queen.

There are several ways to introduce a queen. Most beekeepers use a queen cage composed of three compartments. One compartment, as well as the hole leading into this compartment from the outside, is filled with queen candy. The hole is covered on the outside with a small piece of cork or a plug of soft paper.

To introduce the queen into the colony, remove the cork or paper in the hole at the candy end of the cage. Push a small nail through the hole and candy into the compartment where the queen is living. Place the cage between two top bars with the wire side facing the bottom board. The bees are able to feed the queen through the wire. Other bees will eat the candy in the end of the cage and, in the process, will release the queen and become adjusted to her presence. The bees usually accept the queen when she leaves the cage through the opening that was plugged by the candy.

Introducing a queen when installing a package of bees in a hive is shown in figures 6 and 7.

HOW TO HARVEST HONEY

To harvest your honey crop, first remove the bees from the combs of honey. You can do that by: 1) shaking and brushing the bees from the combs; 2) using a bee escape board; or 3) using benzaldehyde, known as oil of almond.

The bee escape board may fit your operation best. This device allows the bees to leave, but not enter, the super. Place the escape board between a super of honey and the hive entrance so the bees can leave the super but not return. The super will usually be free of bees by the following morning. This method disturbs the colony very little. Make the super above the bee escape board bee-tight so other bees can't rob the combs. Don't use a bee escape board during hot weather because the combs may melt.

Another method for removing bees from combs of honey is to shake the combs with a sharp downward motion and brush the remaining bees off the combs. As combs are freed of bees, place the combs in an empty hive body and cover to keep the bees from robbing them.

You can use oil of almond (benzaldehyde) to repel the bees from the supers before removing the combs. Oil of almond works best at a temperature of 80° F. or slightly below; it has a tendency to scatter the bees when used in warmer weather. Put oil of almond on a special cover made as described.

Nail together 1- to $1^1/_2$-inch-square boards to form a frame the same size as a super. Place the frame on a board that has the same outer dimensions as a super. On the side of the board with the frame, tack burlap to the flat board. Sprinkle oil of almond on the burlap. Put this special cover, burlap side down, on the hive in place of the hive cover. After a few minutes, the chemical will drive the bees out of the super and you can remove the super of honey from the hive for extraction.

HONEY PRODUCTION

Extracted Honey

To produce extracted honey, provide each colony with a two-story brood chamber (two full-depth supers). Use a queen excluder to separate the bottom two chambers from a third super placed on top of the two-story brood chamber. Harvest the honey from this third super.

To establish a two-story brood chamber, put a super full of frames of comb on top of the hive body. This ensures that there are enough empty frames of comb and sealed brood to give the queen room to lay eggs. Move most of the uncapped brood into the super above the hive body. That reduces the possibility of swarming and may give the colony enough room in the hive body for brood-raising for 2 or 3 weeks. Put the queen in the hive body where the combs are mostly empty. Then place a queen excluder on top of the hive body.

When the hive body is nearly filled with brood and bees and before queen cells are formed, move the excluder to the top of the super on top of the hive body. Fill this super with empty comb to allow the queen to establish a two-story hive body. If the nectar flow is heavy, place a super for honey above the excluder.

If you don't have enough supers for all the honey crop, you can extract each super when the combs are three-fourths capped. Then replace the combs for storage of additional honey. In the early spring or late fall unless most of the cells are sealed, there may be some uncapped honey that's unripened. Don't extract unripe honey; it will sour.

A honey extractor is commonly used to remove honey from the comb. It's possible to buy two- and four-frame extractors from most bee supply houses. Use an uncapping knife to remove the caps on the cells full of honey. Then place the frames of comb in the extractor. Revolve the baskets containing the frames of honey by turning a crank. The centrifugal force created causes the honey to move out of the comb into the extractor. Take the honey from the extractor and put it into containers for sale or storage.

If an extractor is not available and you only have a few combs to harvest, you can cut the comb from the frame and mash it in a double boiler or in a kettle set in a hot water bath. The wax melts and forms a deposit on top of the honey. Cool the honey and lift off the hardened wax layer on top. Then strain the honey through fine-mesh nylon cloth. Allow the honey to settle overnight before bottling.

When processing honey and beeswax, beware of fire since beeswax catches fire easily.

You can use the honey at home or sell it to friends and neighbors. The California Honey Advisory Board, P.O. Box 32, Whittier, California, has a large supply of literature on honey and its uses.

Comb Honey

It's more difficult to produce comb honey than extracted honey. The colonies have to be crowded almost to the swarming point and the nectar flow has to be fairly constant and large enough to produce quality combs of honey. To be salable, all the cells must be sealed. The cost of sections, equipment, and labor is greater than for the production of extracted honey. Unless you have had some years of experience with bees, produce extracted honey first and learn about bee behavior and how to manage bees before producing comb honey.

BEESWAX PRODUCTION

Beeswax is an important product of honey bees because it's used in the manufacture of about 125 products. Candles, cosmetics, adhesives, crayons, molds for metal castings, waterproofing, and lubricants are a few of its many uses.

Honey bees are wax factories. When a worker bee is about 2 weeks old, it secretes beeswax from glands located on the underside of the abdomen. When workers are secreting wax, they form chain-like clusters by holding onto each other's legs. Other workers collect the wax scales as they appear on the abdomens of the secreting workers and, using the strong chewing action of their mouths, mold the wax into honey comb.

You can collect beeswax from cappings, broken comb, and pieces of comb scraped from hive bodies and frames. Melt the wax in a solar wax extractor. Melting wax over an open flame or on a stove is very hazardous. Therefore, a solar wax extractor is suggested for safety and good quality wax.

The solar wax extractor has a pan in a box with a glass top. The pan slopes so that the melted wax drains to the lower end of the pan and into a collecting container (bucket). The pan is covered with $^1/_2$-inch-mesh hardware cloth held about 2 inches above the bottom of the pan by metal or wooden strips. Place the wax to be melted on the hardware cloth. The sun shining through the glass cover generates enough heat to melt the wax. The melted wax drains into a pan and, when cool and solid, can be removed as a cake.

You can sell this wax to bee supply houses where it will be melted and processed into foundation.

REARING QUEENS

To rear queens, you need a supply of queen cell cups, which you can obtain in one of several ways. You can cut off and use the few incomplete queen cell cups that are built by the bees in most colonies. Or you can make good cups from strips of drone comb. Shave the comb down to within $^1/_4$ inch of the midrib and mash down every third cell.

You can also buy pressed wax cups or make cups by dipping a single cell-cup forming stick into molten beeswax. You can make the forming stick or buy it from supply dealers. The stick, made of round hardwood, is about 3 inches long and $^3/_8$ inch in diameter at a point $^1/_2$ inch from the tip, tapering to between $^1/_4$ and $^5/_{16}$ inch at the tip. Round the end to give the bottom of the wax cell a concave form. To test the stick for size, fit it into a natural queen cell cup.

NOTE: Melting beeswax is an extreme fire hazard. Use only enough heat to melt the wax.

Use clean wax to make the cell cups. Melt the wax in a water-jacketed tray or double boiler. Keep the water at a temperature **just above** the melting point of the wax. When the wax is melted, dip the forming stick into cold water and shake off the excess. Then dip the stick into the wax to a depth of about $^3/_8$ inch. Quickly remove the stick and hold it in the air until the wax is solid. Dip it into the wax again and quickly remove it. Repeat this process four or five times. After the final dipping, immerse the mold in cold water and leave it there for a few minutes. Then gently twist with the thumb and index finger to remove the cell cup from the stick. Dip the stick in water again before you form the next cell.

You can fasten cell bars made from regular frame bottom bars into a modified standard frame. To modify a standard frame, nail blocks $^1/_4$ inch thick, $^3/_4$ inch wide, and $1^1/_2$ inches long to the inside of the end bars to form ledges on which the cell bars can rest. Place the lower blocks so they touch the bottom bar. Space the lower ends of the second bar blocks about $^3/_8$ inch above the top of the first bar. Place the lower ends of the third pair of blocks the same distance above the second bar. This modified frame can hold three bars of cells—about 45 cells.

To attach the cell cups to the bars, pour some melted wax on one of the widest sides of the bar to form a base for the cells. Pick up each wax cup by inserting the forming stick into it. Dip the end of the cup into melted wax and tightly press the cup bottom into the wax on the bar. Space the cups about $^3/_4$ to $^7/_8$ inch apart; measure from the center of the cups. When the bar is filled (it should have 15 cells on it), pour melted wax along each side and between the cell cups to securely attach them to the bar.

Place a small drop of royal jelly in the bottom of each cell cup. (You can get a supply of royal jelly from natural cells.) It's also possible to graft larvae without royal jelly. Use a grafting needle to place a young, 12- to 24-hour-old worker larva in each cup. Do the transferring (grafting) in a warm, humid, draft-free room. Place the grafted cells on the bars in the frame so the cells hang down. Put the frame into a strong colony, known as a cell-builder colony, that has a large population of worker bees.

Before you make the queenless cell-builder colony, feed the bees honey or sugar syrup for at least a day or two. Add pollen if there is not enough available in the field. You can feed pollen in cakes, candy, sugar syrup, natural pollen combs, or by filling the cells of an empty comb about half full of pollen pellets and spraying the pellets with a thin sugar syrup.

To make a cell builder, dequeen a colony and leave only sealed or emerging brood except for two frames of very young, uncapped larvae. Place the two frames of young larvae in the middle of the hive. Place a comb full of pollen next to one of the combs of larvae. Be sure the combs outside the center combs are well filled with pollen and honey. Make sure both stories of the hive are well filled with bees. If you need to make the colony very strong, add more bees by shaking additional bees into a screen cage and supplying them with sugar syrup. Several hours or a day later, lightly spray them with sugar syrup and put them in the cell builder. After dequeening, continue feeding the colony unless there is a reliable nectar flow.

Place the first grafted cells in the colony the day after making it queenless. Shortly before inserting the first grafted cells, remove the center comb of larvae and allow the bees to cluster in the space between the comb of pollen and the comb of larvae. Put more grafted cells in the center at 3- or 4-day intervals, moving the older ones aside.

Bees in cell-builder colonies often build queen cells. Examine all the brood combs once a week and destroy any natural queen cells. Shake enough bees from each comb to expose cells that may be hidden.

To maintain the queenless cell builder, replace combs from which bees have emerged with combs of sealed or emerging brood. Do this once a week. Replace the comb of larvae with a comb of younger larvae a few hours before each graft. Shift the other cells to a new location in the hive. Remove the completed queen cells 9 to 10 days after grafting.

After removing completed queen cells from the hive, use a thin-bladed knife to cut them from the bars by stripping off the layer of wax fastening the cell cups to the bar. Separate the cells and discard small or poorly formed cells.

Hold each completed queen cell before a strong light and slightly tilt it to one side until you can clearly see the outline of the queen within. Many breeders candle their cells in this way, thus making sure they get only cells containing live queens. Be extremely careful when candling so you don't damage the queen.

Queens emerge from the cells approximately 13 days after hatching from the egg, or 11 days after grafting. Take the queen cells from the cell builder 1 or 2 days before the queens are due to emerge. Put each queen cell into a new colony, called a nucleus, so the bees become used to the queen before she emerges from the cell.

Hang queen cells in a normal manner in the nucleus—between the top bars of two frames next to the brood, or gently pushed into the surface of the comb near brood, or where the bees are clustering. If the weather is cold, it's better to place the cells an inch or so below the top bar or where the bees can cluster around the cell and keep it warm. Always leave the cell end free for the queen to cut her way out.

Two main types of nuclei are used for mating queens. One is the divided hive—a standard hive body divided into two five-frame nuclei or three three-frame nuclei, each with a separate entrance. The partitions are usually made of wood. In some nuclei, the partitions are fitted into grooves cut into the end walls of the hive. The compartment tops are closed with canvas tacked to the partitions to permit opening one compartment at a time.

Arrange the nuclei entrances on the ends and sides so that no two are on the same side of the hive. This arrangement helps the queens and the bees mark their own entrance and reduces the danger of bees drifting from one nucleus to another.

You can form a nucleus by using a comb of honey, partly filled frames of brood, and bees taken from colonies with large populations. The interchangeable frames make it easy to add or remove bees, honey, and brood to keep the nuclei at the right strength. To prevent the bees from drifting back to the parent colonies, make up the nuclei in one yard and then move them to another location. Close the entrances with wire cloth or green grass while moving the nuclei.

The second type of nucleus is known as the baby nucleus. Baby nuclei contain frames approximately 4 by 5 inches. These nuclei vary considerably in construction and size, but a typical baby nucleus is about $5^{3}/_{4}$ inches deep, $4^{3}/_{4}$ inches wide, and $5^{3}/_{4}$ inches long on the inside and has walls $^{3}/_{8}$ inch thick. The box holds two or three frames and a feeder. The entrance is a $^{7}/_{16}$-inch hole in the front near the alighting board. The entrance can be closed with a wooden latch. The cover may fit down over all sides or just over the ends. A 1-inch screen opening in the back provides ventilation.

The best food for nuclei is honey stored in the comb. (When combs of honey aren't available, the best substitute is heavy sugar syrup in a feeder enclosed in the nucleus.) A nucleus must have ample food stores at all times. It's difficult to rear queens when the mating colonies are short of honey and pollen. There is also danger of robbing during seasons when nectar is scarce or when the nucleus is too small to be self-supporting.

After the queen emerges, takes her mating flight, and returns to the nucleus to lay eggs, place her in a cage for shipment. Before caging the queen for use or shipment, be sure she is laying normally. The presence of eggs and brood in the combs in the nucleus usually means that the queen is laying.

For more details, refer to *Queen Rearing* by Harry H. Laidlaw, Jr. and J. E. Eckert.

POLLINATING

In some cases, it may be possible for you to arrange with a commercial beekeeper to include your colonies with his when he moves them. In this way, you could rent colonies for pollination and work with the commercial beekeeper to learn more about beekeeping.

DISEASES OF BEES

Some bee diseases, particularly those affecting the brood, are highly infectious. When you buy bees, request a certificate of inspection that shows freedom from disease.

Regularly examine your colonies to determine their condition. If you think any disease is present, contact your county agricultural commissioner.

The diseases of honey bees are divided into those that affect the brood and those that affect the adult bees. The major brood diseases are outlined in table 2.

Brood Diseases

American foulbrood is the most common, serious brood disease. It kills the larvae soon after the cells are sealed. The disease becomes apparent when the cappings on a few cells of sealed brood have sunken and show a greasy appearance and irregular perforation. The dead larvae may be brownish-yellow to coffee-brown. The dead larvae are always stretched out lengthwise in the cell. They retain their normal shape for only a short time after death; then they become a flat mass. At this stage, if you use a toothpick to stir a diseased larva in a cell and slowly withdraw the decayed material, it often forms a thread 1 to 4 inches long (ropy) before breaking. The dead larva eventually becomes a scale that adheres tightly to the lower side and bottom of the cell. This scale is difficult to see.

If the disease is well advanced, pupae also die. The remains of the pupae may show their tongues extending upward, sometimes attached to the top of the cell. The cells with scale are usually uncapped. The worker brood is most susceptible to the disease. In rare instances, drone and queen larvae are also infected.

Spores of the disease can survive in honey for an indefinite length of time. One of the main ways the bees spread the disease is by robbing honey from diseased combs. Swarms from diseased colonies may carry the disease. Beekeepers also spread the disease by transferring equipment from diseased colonies to healthy ones. To prevent that, always clean the hive tool between hives by washing with water and scouring with soil.

If you think this disease is in your colonies, contact the apiary inspector at your county agricultural commissioner's office; he will help you with control measures.

TABLE 2. Summary of Symptoms of Brood Diseases of Bees.

	American Foulbrood	European Foulbrood	Parafoulbrood	Sacbrood
Causative organism	*Bacillus* larvae	*Bacillus pluton*	*Bacillus para-alvei*	Filterable virus
Age of larvae attacked	Usually die after cell is capped.	Usually die while coiled in cell before cell is capped.	Mostly unsealed; more in sealed cells than with European foulbrood.	Usually die after cell is capped.
Appearance of brood combs	Sunken and perforated cappings. Dead brood in capped or perforated cells, or in cells uncapped by bees.	Many open cells that contain yellowish to dull-gray larvae. A few cell caps may be perforated.	Resemble combs with European foulbrood, although more sealed cells affected.	Slightly irregular; usually only a few cells affected. Dead mostly in perforated or uncapped cells.
Position of infected forms in cell	Stretched lengthwise; stick to lower sides and bottom of cell.	Various positions; may be on bottom or side near cell opening.	Usually irregular, as in European foulbrood, or fully extended.	Stretched lengthwise with head prominently raised.
Color of infected forms	Light brown to coffee brown; finally turn dark brown to almost black.	Yellowish-white; finally change to brown or black.	Reddish-brown to dark brown. Scales in the unsealed cells are lighter in color.	Grayish to straw-yellow, becoming grayish-black to black; head end is usually black.
Odor	Smell of rotten milk, especially in ropy stage.	Sour smell similar to that of decayed meat; not always present.	Slight odor in unsealed cells, but very putrid odor in sealed cells.	Slightly sour smell.
Cuticle	Becomes soft and loses form.	Remains entire; turns translucent with tracheae visible.	Becomes soft and may be translucent.	Remains entire and tough, but contents are watery. Does not adhere to cell.
Consistency	Sticky, roping out 2 to 4 inches in viscid stage.	Unsealed larvae watery or pasty; seldom sticky. Some sealed larvae may rope slightly.	Dead larvae often soft and watery. Sealed dead may be ropy.	Watery to granular; never ropy.
Pupae	Sometimes affected so tongue sticks up and across opening of cell, a sure sign of the disease.	Rarely affected.	An occasional pupa is killed, but not as many as in American foulbrood.	Seldom affected.
Characteristics of the scales	Brittle, dark brown, adhere tightly to cell wall; can be removed easily by bees.	Tracheae and segmentation often visible. Tough, rubbery; dark brown to black; easily removed when dry.	Easily removed from cells. Segmentation and tracheae are sometimes visible.	Tough, brittle, easily removed. Head end remains prominently tilted upward.
Sex of larvae attacked	Usually only worker brood; rarely drone and queen larvae.	All sexes.	Usually only workers and drones.	Mostly workers, but occasionally drones.

European foulbrood only occurs in some sections of California. The disease usually doesn't appear in either strong or weak colonies until there is a second or third cycle of brood in the spring. The colony then gradually weakens until there are not enough bees to store a maximum amount of honey. With the beginning of the nectar flow, the disease may disappear or it may continue in somewhat less serious form throughout the season.

European foulbrood may result in the death of a colony. The larvae are attacked while still coiled in the bottom of the cells, usually in a very early stage. They frequently turn whitish-yellow, lose their well-rounded form, and become so translucent that the breathing tubes can be seen through the body wall. The diseased larvae sometimes become light to dark brown in color. The dead larvae are usually found in almost any position in the cells—on the side, bottom, or near the front of the cell. The bees can remove the scale formed in the final stages in the cells.

It's believed that this disease is caused by a mixture of bacteria that results in the variety of symptoms and may vary with the types of bacteria present. European foulbrood is sometimes confused with some stages of American and parafoulbrood.

Parafoulbrood usually attacks the larvae before the cells are sealed, but occasionally kills larvae in sealed cells and young pupae. The dead brood first appear grayish-white and then become light brown, brown, reddish-brown, or dark brown. Scales that form in the cells are usually removed.

It's easy to confuse the symptoms of parafoulbrood with American or European foulbrood. Contact the apiary inspector if you see something that resembles disease.

Sacbrood describes the main symptom of this disease. The skin of the infected larva remains intact, but the body contents are watery and flow to the rear portion of the larva when it's held in a vertical position outside the cell. The larvae are usually infected in the late larval or pupal stages. Therefore, they are often found in sealed cells or in cells that have been uncapped by the bees. The dead larva is located in the cell with the head lying outward and extending upward. The tip of the head is usually black; the rest of the body varies from gray to brown in color.

The disease is caused by a virus, which is mildly infectious. Although sacbrood sometimes reduces the strength of the colony, it's rarely serious. No definite treatment is recommended. However, don't rear queens from a colony containing sacbrood because some strains of bees seem more susceptible to the disease than others do.

Adult Bee Diseases

Nosema rarely causes great losses of bees in California. It's caused by a protozoan parasite, *Nosema apis*, that affects the lining of the intestines. The colony population is seriously reduced in the spring when it should be increasing. Nosema is most common during the late spring and usually disappears when the weather turns warm.

Trembling and crawling bees may be seen in front and inside a hive infected with this disease. Sometimes the wings of the bees appear dislocated. Infected bees may be unable to fly and appear greasy and shiny with bloated abdomens and dysentery. Diseased bees often die away from the hive so losses aren't apparent until the disease has become general throughout the apiary. When that occurs, it's too late to control the disease.

Prevention is the most important protection against Nosema. Prevention consists of keeping the colonies strong and overwintering them where they are sheltered from winds and receive maximum sunshine without becoming overheated. Prolonged rains, queen-

lessness, chilling, pollen and honey shortage, and disturbing the colonies by opening them too often during bad weather all cause Nosema to increase. Feeding the bees Fumidil-B®, which is registered for this purpose, also helps prevent Nosema.

Paralysis occurs in most regions of California. Bees that tremble and are unable to fly or walk are typical victims of paralysis. Their bodies are hairless, greasy, and have a bad odor. The cause of paralysis is unknown. Requeening seems to give the most consistent control. Occasionally paralysis affects large numbers of colonies in southern California, but they usually recover.

Acarine disease has never been found in the United States or Canada. It's mentioned because there is an embargo against the importation of honey bees into the United States from any country except Canada. That is a precaution against the introduction of this disease. The disease is caused by a mite, *Acarapis woodi*, that invades the breathing tubes of adult bees.

Diagnosing Diseases

If there appears to be a mixture of symptoms, or if symptoms don't appear typical, it's advisable to submit samples to: Apiary Inspection, California Department of Agriculture, 1220 N Street, Sacramento 95814. Diagnosis is free.

To take samples of diseased brood, make a smear by stirring the cell contents with a clean toothpick. Transfer the smear to a small piece of paper along with the toothpick. Fold the paper to prevent contamination and place it in an envelope together with a letter requesting diagnosis. Samples of scale pried loose from cell walls may be submitted in the same way.

®Registered trade name.

Samples of dead adult bees must be fresh; dried specimens are of little value. Carefully select samples that include bees that appear to be affected. Mail samples in a container that protects them from crushing. If correctly caged, you can also send live bees. Satisfactory diagnosis can be made from a sample of 10 to 20 bees.

Comb samples are difficult to handle and are unnecessary for diagnosis.

ENEMIES OF BEES

Wax moth larvae attack comb and destroy it by burrowing through the wax. The wax moth feeds on pollen and wax in the cells. The adult female lays her eggs in small crevices inside the hive. These hatch within 5 days or more, depending on the temperature. As the larvae feed on the combs, they form a mass of webs and leave waste material behind. After the feeding period, the larvae spin their pupal cases in the combs or on the frames or walls of the hive.

In California when food and temperature conditions are favorable, wax moth larvae, pupae, and adults may be present anytime during the year. If the colony is strong, the wax moth is not very successful. The presence of wax moth in a colony usually indicates that the colony is weak.

The simplest and safest method for controlling the wax moth is to fumigate with paradichlorobenzine (moth crystals). Stack five supers of empty combs as tightly as possible on a hive cover to prevent gas from escaping from the bottom of the stack. Then put a piece of paper on the top bars of the top super and sprinkle 6 tablespoons of moth crystals on the paper. Put a hive cover tightly in place on top of the paper. For long storage (such as during the winter), seal joints with masking tape and add more moth crystals every 2 to 3 weeks if no crystals are present.

After fumigation, air the combs for a few hours before using. Don't fumigate combs that contain honey intended for human food.

Ants are a nuisance. In a small apiary, protect individual colonies from ants by setting the hives on stands or benches with the legs in cans of oil. Inspect these cans often to see that leaves or grass have not made bridges over the oil.

NOTE: It's difficult to protect bees from many of the ant poisons, so take every precaution if you use such poisons in an apiary.

Mice may destroy combs in the hive or in storage during the winter. If you place a queen excluder between the brood chamber and the bottom board during the fall and winter, mice can't injure the combs in the colony. A wire guard made of $^3/_8$-inch mesh over the entrance also protects the hive against mice.

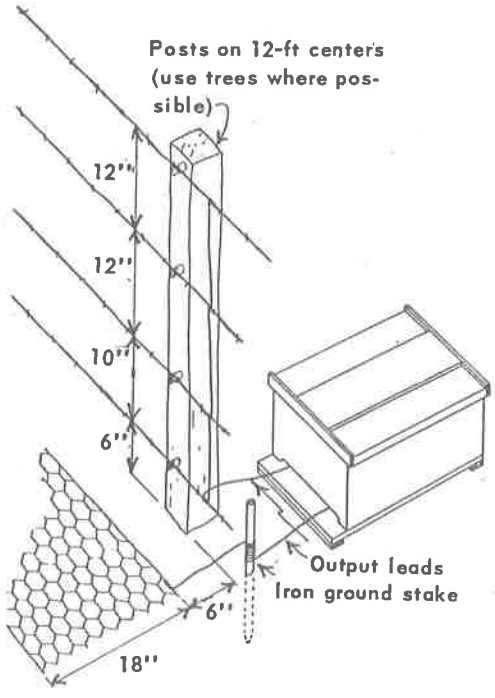


Figure 10. Fence to keep bears out of apiary.

Skunks visit hives at night, scratch the dirt in front, and eat the bees that investigate the disturbance. A 3-foot fence of chicken wire keeps skunks out of small apiaries. To be effective, the fence must extend 6 inches below the ground and then be folded so it extends 6 inches horizontally underground.

Bears may be destructive in mountainous areas. Consult your county farm advisor about protecting your apiary from bears.

APIARY RECORDS

A good beekeeper keeps records for many reasons. Records are the only way to find out if you're making or losing money. Records on the origin and age of each colony's queen help you improve your stock. Records make outstanding colonies obvious and you can use queens from these colonies to develop more colonies.

Records on the variations in the weight of a hive and the blooming dates of the various flowering plants that yield nectar and pollen reveal many factors that influence the behavior and production of colonies. These records also make it possible for you to plan ahead what work you need to do during the winter months.

DEMONSTRATIONS

A demonstration is a planned presentation that teaches something by illustration or example. It may include: an introduction (why the topic was chosen and why it is important); the body (how the job is done); and a summary (what was accomplished, its meaning to the demonstrator and the audience). Plan and give at least one demonstration each year—either by yourself or with other members.

The following are some ideas of topics you can use for demonstrations.

- How to introduce packaged bees into the hive.
- How to use a hive tool.
- How to graft 1-day-old larvae into queen cells.
- How to candle queen cells.
- How to make a nucleus for mating queens.
- How to introduce a queen into a hive.
- How to remove bees from a super to harvest honey.
- How to get liquid honey from combs with an extractor.
- How to open the hive.
- How to dress to work with bees.
- Safety in the apiary.

SERVICE TO OTHERS

You can help others by removing bees from places where they might be dangerous to people and animals. List your name with the agricultural commissioner or other county agencies as a 4-H member who would be glad to pick up stray swarms.

Service clubs and other groups are always interested in hearing about 4-H projects. Perhaps you can talk to local service clubs or other groups and acquaint them with the bee industry in California.

EXHIBITS

Compare bees, honey, and beeswax with those of others by showing them at 4-H exhibit days and county fairs. To prepare exhibits, closely follow the requirements for exhibitors given in the county fair premium book. Each entry needs special preparation for exhibition. The following are guidelines for showing bees, honey, and beeswax.

Display bees in an observation hive. Plans for making an observation hive are available from your county 4-H office.

You can exhibit honey as comb honey in sections (section boxes), in an extracting frame, chunk or bulk comb, cut-comb, and extracted. Check the fair premium list to find out the amount of honey you need for an exhibit.

Label all entries; indicate whether the honey is from a specific floral source or is a blend. If you label an entry as being from a specific floral source, it must taste like that kind of honey. For example, orange honey has a flavor found only in orange honey. Any entry labeled as orange honey must have the flavor accepted as that of orange honey. Honey entries labeled as blended means that the honey bees mixed nectars from more than one type of flower. A blended entry may be labeled mixed flower, mountain flowers, or other words that indicate a blend.

Regulations for labeling honey for sale and exhibit are given in the *Agricultural Code of California*. The grades of honey are defined in the *U.S. Standards for Grades of Extracted Honey and Comb Honey*, published by the U.S. Department of Agriculture, Consumer and Marketing Service, Washington, D. C. Refer to these publications or request a copy of the parts of the agricultural code about honey and bees from the California Department of Food and Agriculture, 1220 N Street, Sacramento 95814.

Follow the regulations when selling honey because, if you don't, you may be fined. To learn the regulations, follow them when you label your entries for exhibits. For information on the USDA grades for honey, write to Chief, Processed Products Standardization

and Inspection Branch, Fruit and Vegetable Division, Consumer and Marketing Service, USDA, Washington, D. C. 20250.

You may exhibit beeswax in 1-pound blocks. To prepare beeswax for exhibit, pour enough melted wax into a cottage cheese carton to give a 1-pound chunk when it hardens. When the wax in the carton is hard, peel off the carton; don't exhibit it in a carton. The wax may be natural or sun-bleached in color.

GLOSSARY

Brood - the eggs, larvae, and pupae of the honey bee.

Brood nest - that part of the hive devoted to rearing brood. Usually considered to be the super (hive body) placed on the bottom board.

Brood-rearing - the act of feeding and caring for the brood.

Cell - one of the compartments of the honeycomb where the brood is reared or the food is stored.

Cluster - a number of bees clinging together to form a solid mass.

Colony - a community of worker bees and a queen living in close association and contributing to their mutual support by their labor.

Comb - a mass of cells composed of beeswax and built by honey bees in the hive to contain their brood and stores of honey and pollen.

Drone - a male bee.

Drone cell - a cell, larger than a worker cell, in which a drone is produced.

Egg - the first stage of development of the bee. All eggs are laid by the queen.

Foundation - a thin sheet of beeswax, imprinted with the cell bases of the honeycomb, placed in a frame to shorten the time of comb building and increase comb uniformity.

Hive - a man-made dwelling for honey bees.

Honey flow - that period when bees gather nectar from flowers and produce an abundance of honey.

Larva - the immature and worm-like form between the egg and the pupal stages.

Larvae - more than one larva.

Nectar - a sweet liquid secreted by flowers of plants; the chief source of honey for bees.

Nucleus - a small colony used to mate queens.

Nuclei - more than one nucleus.

Package - a wire cage that contains bees; usually shipped from southern and western bee producers to northern honey producers.

Pollen - the fine, many-colored grains found on the stamens of flowers. The bees gather and use pollen to feed the larvae.

Propolis - a many-colored, resin-like material collected by bees from the buds of trees and used as a cement; also called bee glue.

Pupa - the form assumed by bees after the larval stage. The adult form appears during this stage.

Pupae - more than one pupa.

Queen - a female bee that has fully developed ovaries and other reproductive organs.

Royal jelly - a food extremely rich in protein that the worker bees secrete and feed to the larvae that are destined to become queens.

Super - a wooden box that, with frames containing foundation, is added to the hive above the brood nest.

Worker - a female bee that has organs adapted for performing the labor of the colony.

USEFUL PUBLICATIONS

Some of these books may be available from your public library or from local book dealers.

Books for Beginners

ABC and XYZ of Bee Culture. A. I. Root. 1962. Medina, Ohio: The A. I. Root Company.

Beekeeping. J. E. Eckert and F. R. Shaw. 1960. New York, New York: The Macmillan Company.

Fundamentals of California Beekeeping, Manual 42. Ward Stanger *et al.* 1972. Berkeley, California: Division of Agricultural Sciences, University of California.

The Hive and the Honey Bee. Roy A. Grout. 1975. Hamilton, Illinois: Dadant and Sons.

Other Valuable Books

American Honey Plants. Frank C. Pellett. 1930. Hamilton, Illinois: American Bee Journal.

Anatomy of the Honey Bee. R. F. Snodgrass. 1956. Ithaca, New York: Comstock Publishing Associates, Cornell University.

Bees: Their Vision, Chemical Senses, and Languages. K. von Frisch. 1956. Ithaca, New York: Cornell University Press.

The Dancing Bees. K. von Frisch. 1965. New York: Harcourt, Brace and Company (paperback book).

Life of the Bee. M. Maeterlinck. 1954. New York: New American Library, Inc. (paperback book).

Queen Rearing. H. H. Laidlaw, Jr., and J. E. Eckert. 1962. Berkeley and Los Angeles, California: University of California Press.

The Complete Guide to Beekeeping. Roger A. Morse. 1974. New York: Dutton Press.

Monthly Publications

Gleanings in Bee Culture. The A. I. Root Company, Medina, Ohio 44256.

American Bee Journal. Hamilton, Illinois 62341.

From the U.C. Apiaries. Cooperative Extension, University of California. Available free from your county farm advisor.

BEE SUPPLY HOUSES

Jerry Clement and Jim Caviglia III
17300 Avenue 324
Visalia, California 93277

Jerry Clement and Jim Caviglia III
16240 W. Whitesbridge
Kerman, California 93630

Diamond International Corporation
P.O. Box 1070
Chico, California 95926

El-Kay Hives
327 Linden Way
P.O. Box 105
Pleasanton, California 94566

Lenn's Bee Service and Supplies
1810-A Cliff Drive
Santa Barbara, California 93109

Los Angeles Honey Company
1559 Fishburn Avenue
Los Angeles, California 90063

Los Angeles Honey Company
15598 Road 29
Madera, California 93637

Heinz A. Michels
1880 Agnew Road
Santa Clara, California 95051

Miller Honey Company
P.O. Box 500
125 Laurel Street
Colton, California 92324

Montgomery Ward
Catalog Department
2825 East 14th Street
Oakland, California 94616

Sears Roebuck
Department 142
2650 East Olympic Blvd.
Los Angeles, California 90051
request: *Farm Order Book*

Walt Turner
8721 Jonnie Way
Fair Oaks, California 95628

SCORECARDS

Bees Exhibited in Observation Hive

1. Hive: well made, clean, ventilated	25%
2. Queen: brood concentrated in small area; few empty cells among sealed brood. No drone brood in worker cells	25%
3. Workers: cover brood frame	20%
4. Brood: all stages present	30%

Comb Honey and Cut-Comb Honey

1. Correctly labeled	25%
2. General appearance: all cells filled; no weeping, no color variation, clean wax	50%
3. Well wrapped: clean, clear wrapper	25%

Extracting Frame of Honey

1. Frame: clean and free of propolis; no weeping honey	25%
2. Cells: very few unfilled cells; all honey cells capped	25%
3. Honey: uniform color in all cells	25%
4. General appearance: comb not cracked or sagging; no burr comb	25%

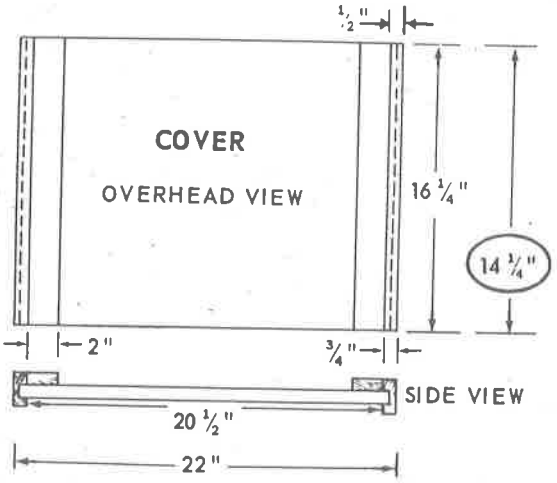
Extracted Honey

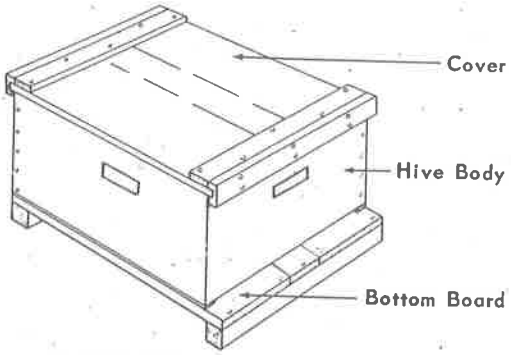
1. Correctly labeled	25%
2. Flavor: floral flavor must be that flavor claimed on label	25%
3. Appearance of honey: clear, good body, color associated with floral source	25%
4. Honey fills 85% or more of container (not "slack-filled"); container filled to within 1 inch of top	25%

Beeswax

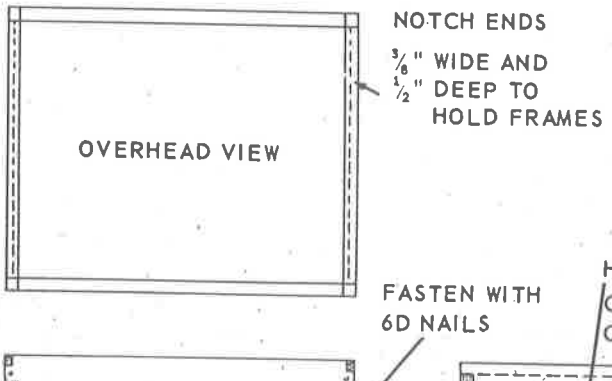
1. Well-formed sample: no air bubbles	33%
2. Free of foreign material	34%
3. Color: light colors score highest	33%

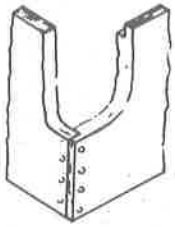
HIVE BODY and SUPERS





COMPLETED BEEHIVE

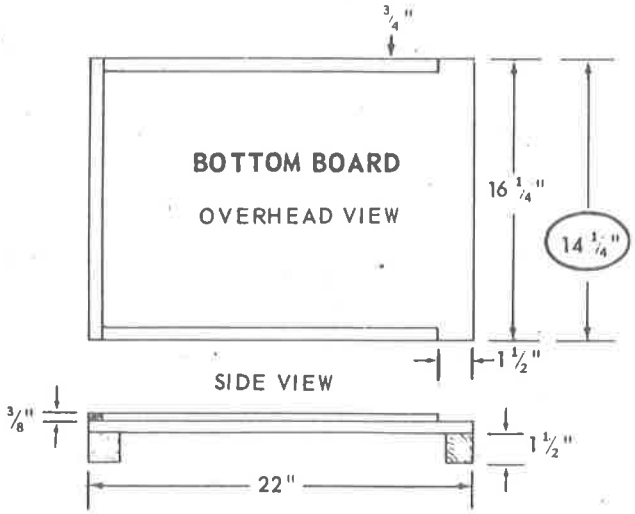




JOINT DETAIL

Dimension A

Hive body or full depth super	= 9 5/8"
Three-quarter depth super	= 6 5/8"
Shallow super	= 5 3/4"
Comb honey super	= 4 5/8"



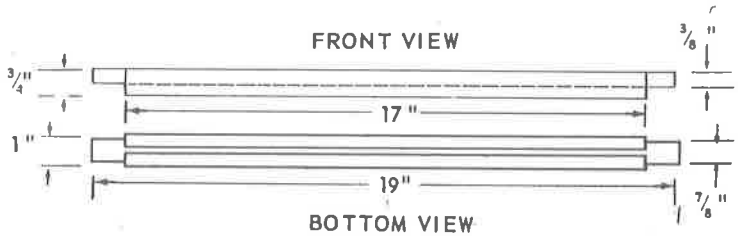
Use 1" milled lumber (¾" actual thickness) for construction.

Dimensions are given for a 10-frame unit.

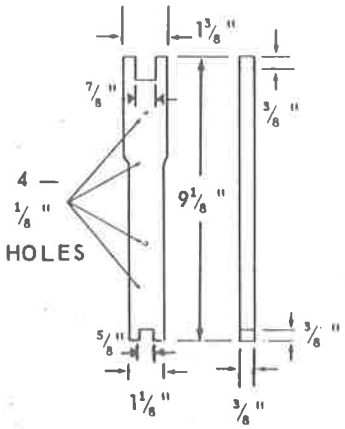
Alternate dimensions are circled and are for an 8-frame unit.

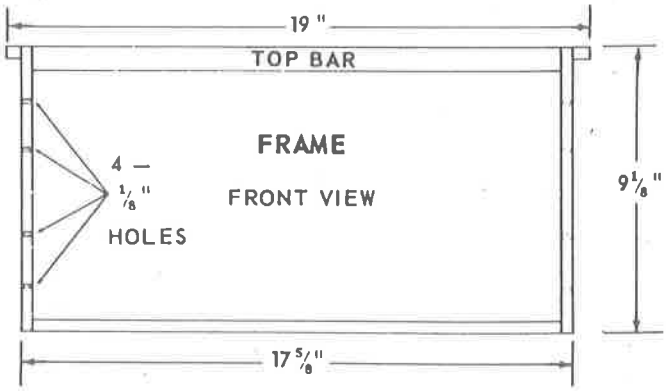
FRAME FOR FULL SUPER

TOP BAR



END BAR





Depth of frames to fit:

9 5/8" super	=	9 1/8" frame
6 5/8" "	=	6 1/4" "
5 3/4" "	=	5 3/8" "
4 5/8" "	=	4 1/2" " or
		4 1/4" comb sections

BOTTOM BAR