Maintaining Genetic Stock

Good stock is essential to successful beekeeping. Such stock can be obtained from many commercial queen breeders and can be maintained, if care is used in propagation. However, production of stock better than that currently available is usually beyond the resources of the beekeeper. True bee breeding requires use of artificial insemination and a working knowledge of genetics.

In maintaining specific stock, the beekeeper must decide which characteristics are most important and confine selection to preserving them. The beekeeper also must decide how to compile traits in order to compare colonies and measure the results of selection. Selection for high honey production would automatically select for colony population size and its components, as well as for vigorous worker bee foraging.

Environment and heredity

High per-colony yield of honey is desirable in bee breeding, but it is not a simple genetic characteristic. Yield is influenced not only by management and strength of nectar flows, but it is also influenced by the numbers and activities of bees in the colony. The population, in turn, is determined by the egg-laying rate of the queen, the viability of eggs and larvae, and the longevity of adult bees. In stock maintenance, as in breeding, each of these must be considered. Other sought-after characteristics are gentleness and resistance to disease. Each trait probably depends upon heredity.

Stock maintenance

Critical selecting of parents, providing good queen rearing, and assuring an abundance of mature drones from selected mothers are essential. Careful selection of drone mothers is as important as careful selection of virgin-queen mothers. The same characteristics are essential: solid brood pattern, gentleness, and resistance to disease. If bees are to be used primarily for pollination, pollen-gathering ability may be preferred to honey yield.

Ten or more queen mothers should be used to produce queens; a similar number of drone mothers is required to produce drones. Drones in queen-mother colonies should be kept to a minimum; drone-mother colonies should be given frames drawn from drone foundation to encourage production of an abun-

dance of drones. Queens mate with 10 to 20 drones on a single mating flight, so it is important to have a great surplus of drones to assure that virgins will mate with unrelated or distantly related drones. Mating with close relatives can lead to inviable brood.

Care of queens

Frames should always be handled carefully so that the queen is not injured. (See *Managing Bees*.) Never set the frame with the queen on it outside the colony without protecting it with another frame. Do not examine a colony if it contains a virgin, a newly introduced, or a recently mated queen. Such queens are nervous, and the disturbance caused by opening a hive may cause the workers to harm them.

As a rule, the queen should not be handled. If it is necessary to pick her up, catch her from behind by all four wings with the index finger and thumb. Queens can be seen more easily if marked with a color and, by using a different color each year, the queen's age can be readily determined. Fingernail polish, typewriter correction fluid, or other quick-drying paint may be applied to the top of the thorax between the base of the queen's wings.

Requeening

Requeening occurs when a queen of poor stock or one that is aging must be replaced. Colonies can be requeened at any time during the active season, but they usually are requeened during a minor nectar flow because the new queen is more readily accepted then. Before introducing a new queen, the old queen must be removed and any queen cells must be destroyed.

Queen introduction

Queens may be purchased from bee suppliers and are usually shipped in a cage containing a few attendant bees. The cage has an opening that is plugged with bee food known as "candy." Attendant worker bees use the candy to feed themselves and the queen during shipment.

To introduce a queen from a cage into a hive body, remove the cork covering the opening containing the candy plug. If most of the candy remains, ream a small hole through it with a matchstick or small nail. The entire cage is placed in the hive body just below the top bars of two brood frames by gently pressing the bars together so that they hold the cage in place, with the screen side of the cage exposed between the combs. The bees in the hive will consume the remaining candy, releasing the queen and her attendants. This process will take long enough, however, for the bees in the hive to grow accustomed to the new queen.

Pollinating Crops with Honey Bees

Pollination is essential to most flowering plants for producing fruits and seeds, and in California the honey bee is the most important pollinator of commercial crops (fig. 6). Beekeepers rent their colonies for this purpose and place them in or around crops. Highly developed transportation techniques have been worked out for moving colonies from area to area as they are needed.

Many beekeepers have legal contracts with growers for pollination services. A written contract between beekeeper and grower should:

(1) State times (in relation to bloom) when bees will be moved in and out of fields or orchards.

(2) Assure the beekeeper that no pesticides harmful to bees will be used. (If pesticides are to be used, notice must be given to the beekeeper.)

(3) Assure the beekeeper of reimbursement for extra movement of colonies in and out of the field.

(4) Define population of colonies according to numbers of frames covered with bees and either numbers of frames with brood or numbers of square inches of brood.

(5) Describe distribution of colonies in fields and orchards.

(6) Include agreement that the beekeeper will maintain bees in good condition, provided they are not damaged by pesticides while under contract.

(7) State rental rate to be paid to beekeeper.

(8) State who is responsible for supplying adequate water to bees.

Fig. 6 Worker bee gathering pollen from a plum blossom.

Some of the most important factors affecting pollination follow.

Deploying colonies

The number of colonies of bees used per acre depends on the kind of crop, the population of the colonies, the weather, and the amount of competing bloom in the area of the crop. Two colonies per acre in most crops are enough to insure optimum numbers of bees during the most unfavorable conditions for pollination. For alfalfa seed crops, approximately three colonies per acre are commonly used for long-season crop production; however, alfalfa seed yields in areas of short-season production are maximized when growers rent five to ten colonies per acre. In melon pollination, one colony per acre is often used, but two to three colonies per acre are considered better.

Colony strength

In the mid-1960s representatives from the beekeeping and agricultural crop-producing industries agreed to standardize colony strength for pollination purposes: For almond pollination four frames of bees and a laying queen per colony were accepted as the minimum needed, and for alfalfa seed production the minimum acceptable level was at least nine frames of bees and 600 square inches of brood. Growers and beekeepers realize that larger units accomplish more pollination, and recently new pricing structures have been devised that offer a beekeeper bonuses for supplying colonies above these minimum strengths. Saturation pollination often means semistarvation for the bees, and beekeepers should be ready to employ supplemental feeding when necessary.

Distribution

Because bees tend to work close to their hives in attractive pasturage, hives should be distributed at 1/4-mile intervals throughout the fields. If the field is less than 100 acres or the orchard is less than 40 acres, the colonies may be placed in six to eight groups around the edges of the crop. For long-sided, narrow, rectangular fields, colonies should be grouped along each long side, with heaviest concentrations near the center of the field, to provide the best pollinator distribution.

Plant competition

Honey bees may visit plants other than those to be pollinated, if such plants provide more attractive pollen or nectar or if other fields of the same crop are more attractive due to understocking. To prevent bees from visiting competing flowers, colonies should be moved in after the beginning of bloom, when there is sufficient forage to hold bees in the crop. It may be advisable to destroy cover crops in orchards to reduce competition and pesticide hazard.

Other considerations

Weather. Bees begin to fly when temperatures reach about 55°F. They do not fly in rain, heavy fog, or in wind of more than 15 miles per hour. Temperatures above 100°F reduce flight activity for nectar and pollen, but water collection is increased.

Pesticides. Bees provided for pollination services need maximum protection from damage by pesticides. Loss of a portion or all of the foraging bees reduces the amount of incoming food; decreased brood production results. Pollen demand is reduced and pollination decreases. Economic losses to the grower and to the beekeeper are certainties. Damaged colonies may not really recover for months, even if they survive the initial effects of insecticide poisoning.

Bees placed in orchards or fields sometimes are exposed to pesticides applied directly to the bloom upon which they are supposed to be working. Often, too, an application is made to adjacent crops where a competing crop or weed bloom is attracting bees. Beekeepers can avoid or reduce loss by becoming familiar with area pesticide use practices and placing their bees when they feel it is safe. The grower may have to talk to several pesticide-using neighbors if the beekeeper believes that nearby pesticide use is endangering the crop to be pollinated.

The California Department of Food and Agriculture has formulated regulations to aid bee protection, but maximum protection can be obtained only when beekeepers, growers and their neighbors, pest control advisors, and applicators work closely together. Information concerning comparative toxicities of pesticides to honey bees, residual effects, best formulations, and proper timing of applications is available from the University of California Cooperative Extension.

Moving hives

There are very few places in California where colonies can be maintained year-round without encountering prolonged periods of lack of forage. Therefore, in California many migratory beekeepers have developed efficient methods for handling and moving large numbers of colonies. Generally, bees are moved during the night with little or no special precautions taken to confine bees to their hives.

Beekeepers who must spend time loading and unloading hives usually modify their equipment to ease the strain on their backs. Beekeepers with small numbers of hives may use powerlift tailgates or small booms on small flatbed or pickup trucks. Many larger operators have large mechanical or hydraulic booms capable of lifting two hives at a time (Plate I). Booms that can be leveled hydraulically or that are hinged along the boom add flexibility to the system.

In the other major method of moving large groups of hives, four or six hives are fastened to a pallet that also serves as a bottom board for the hives. Pallets of hives can be stacked two-high and loaded with a forklift onto a large flatbed truck. Forklifts are used for distributing hives in and around fields for pollination services. Small forklifts are hauled on trailers. Large forklifts, modified from four-wheel drive trucks, can handle four pallets at a time and can be towed by flatbed trucks. Diesel equipment is used when it can be afforded.

Producing and Marketing Honey

The 1967 Agricultural Code of California defines honey as: "...the nectar of floral exudations of plants gathered and stored in the comb by honey bees. It is levorotatory, contains not more than twenty-five one hundredths (0.25) of 1 percent ash, not more than eight (8) percent of sucrose, its specific gravity is not less than 1.412, its weight not less than eleven (11) pounds, twelve (12) ounces per standard gallon of 231 cubic inches at sixty-eight degrees Fahrenheit."

Honey is composed largely of two simple sugars (glucose and fructose) and enzymes, vitamins, minerals, and substances producing characteristic flavors. California honeys average about 17 percent water. Most honey sold in California is one of three types: extracted (liquid), comb section, or crystallized (creamed or spun).

To be sold in California, honey must meet certain standards as defined in the Agricultural Code (obtainable from California Department of Agriculture, Bureau of Fruit and Vegetable Standardization, Sacramento, CA 95814). Color is important in determining the market value of honey—lighter colors usually bring higher prices. Color varies from nearly colorless through shades of yellows, amber, and brown with greenish tinges, to deep red (Plate I). Honey from the same floral sources may vary in color, and variation in color may result from overheating in processing; for example, honeys darken if heated too much or too long. Color is measured by the Pfund grader or the USDA Color Comparator. These graders tell beekeepers the commercial color classification of honey: water white, extra white, white, extra light amber, light amber, amber, or dark.

Honey is classified according to floral source, method of production, and USDA grades. The two most popular floral honeys produced in California are sage and orange honey. Other major floral sources are: cotton, lima beans, alfalfa, yellow starthistle, wild buckwheat (of the genus *Eriogonum*), manzanita, eucalyptus, and bluecurls. In recent years safflower honey has been produced in quantity.

Marketing

Beekeepers can sell their honey from their homes, from roadside stands on their property, directly to a customer, to a wholesaler in 5-gallon containers or 55-gallon drums, or through a co-op. Cooperative marketing offers certain advantages to beekeepers because a cooperative can control a certain proportion of the total crop and thus increase members' chances for fair prices.

The U.S. Price Support Program (through 1989) includes a minimum base price for honey at the wholesale level. Support prices vary from year to year. For information on this program, inquire at the county offices of the Agricultural Stabilization and Conservation Service (ASCS). The state marketing order for honey is administered by the California Director of Food and Agriculture through the California Honey Advisory Board whose chief function is promoting the use of honey.

Small-scale harvesting

When combs in a super have been filled and capped (two-thirds of cells capped is adequate in a low-humidity environment), the beekeeper may remove a comb or super(s) of combs for harvesting. Be sure to leave the bees one full super of honey and stored pollen for winter feed.

Bees may be removed from each frame by shaking and brushing the bees (with a special bee brush) back into the hive. Frames should be placed in an empty super, sitting on a pallet to keep the combs clean, and covered with a damp cloth to exclude robbing bees.

When there are too many combs of honey to handle individually, bees will remove themselves from supers of fully capped honey in a day or two through bee escape (one-way exit) boards (fig. 7). Place the honey supers above the escape board and smoke the bees gently to get them moving. Two precautions:

(1) Be sure all cracks and holes are sealed or the honey will be robbed.

(2) Be sure outdoor temperatures will stay below 100°F or unattended combs may melt in the hive.

Beekeepers who wish to remove large amounts of honey rapidly should refer to the section on large-scale harvesting.

Preparing honey for storage. Beekeepers without access to extracting equipment can still prepare their honey in manners attractive to consumers. With thin foundations, combs can be cut (called "cut comb honey") easily with a warm, sharp knife into shapes that can be placed into special honey cartons or clear plastic bags after draining on each

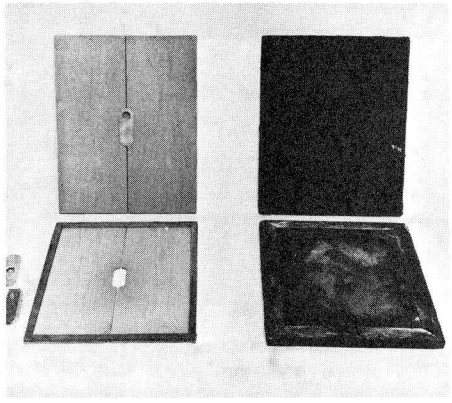

Fig. 7 *Left:* Top and bottom of bee escape board; bees enter round hole in bee escape and exit through narrow ends. *Right:* Top and bottom view of acid board, showing burlap lining on bottom section.

side for 24 hours. These pieces of cut comb or comb sections (that are produced in special square or round compartments placed in the hives—see the section on honey products below) and whole frames of honey can be held without granulation in a deep freezer for long periods. Pieces of cut comb can be placed in bottles and surrounded with extracted honey; these are called "chunk honey" packs.

Beekeepers who wish to extract liquid honey from combs should use an extractor (fig. 8). Other methods involving chopping, squeezing, or heating combs to the melting point of beeswax usually are considered too messy and wasteful to be worthwhile. Honey produced by 20 colonies usually can be handled by a two- to four-frame extractor operated by hand or by a small electric motor.

Before centrifugation in the extractor, cappings must be shaved from the combs with a heated knife. Thermostatically controlled electric knives are available. The cappings, half wax and half honey, may be bottled and consumed as is (reported useful by some people for hay fever relief) or rendered to save the wax.

Honey flowing from the extractor should be strained first through a coarse mesh, and then through a fine mesh (such as a clean nylon stocking) to remove visible particles of wax, propolis, or other matter. For best appearance, the honey should flow along a flat surface leading to

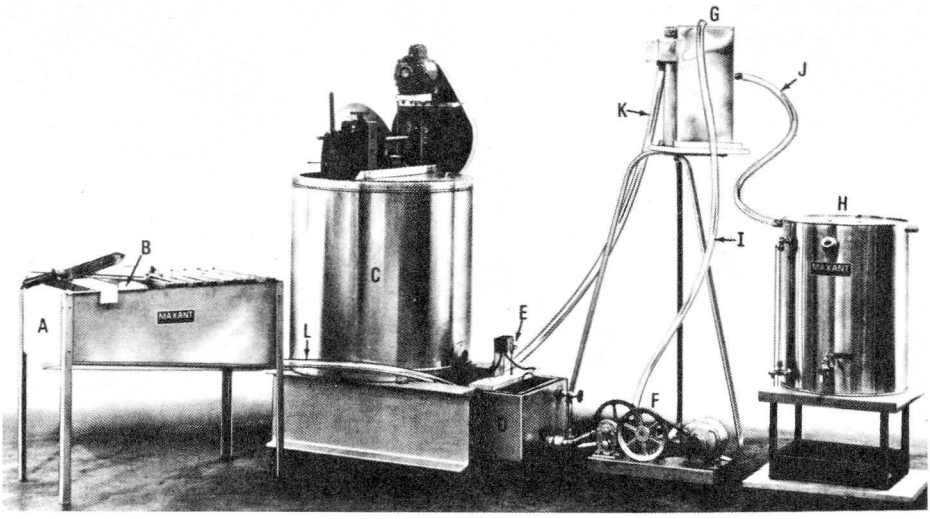

Fig. 8 Honey extracting equipment for a small- to moderate-sized beekeeping operation. *(A)* uncapping tray: *(B)* uncapping basket; *(C)* extractor; *(D)* clarifier; *(E)* float switch; *(F)* pump; *(G)* filter unit; *(H)* bottling tank; *(I)* plastic pipe-pump to filter; *(J)* filtered honey to bottling unit; *(K)* overflow from filter, and *(L)* pipe from tray to clarifer.

the bottom of the containers. Honey that flows as a stream or drips into itself incorporates air and appears somewhat cloudy. Honey handled properly has a clean appearance, full flavor, and all its nutrients intact.

Rendering beeswax. For small operations, a solar wax melter is the simplest and most economical way of rendering wax from well drained cappings and chunks of comb that accumulate over time.

Large-scale harvesting

Most beekeepers in California who remove large quantities of honey use "acid boards," named for carbolic acid which no longer may be used for that purpose. Now, benzaldehyde (oil of bitter almonds) or diluted butyric anhydride is used to moisten the acid board (fig. 7) that is placed directly on top of the super to be emptied. Benzaldehyde is said to work better at lower temperatures (60° to 80°F); butyric anhydride is better on hot days (80° to 100°F). Five minutes should clear the super. Stupified bees signal overdosing; residual bees indicate under-dosing. Be sure to follow label directions and avoid contacting the chemicals or allowing them to contaminate the honey.

A few beekeepers prefer to use bee blowers to empty the supers of bees. A large volume of low velocity air is used to blow bees down a chute onto the ground by the hive entrance. Very few bees take flight, become injured or angered, and fully capped supers are cleared very quickly.

Extracting honey. Supers of honey frequently are stored in a "hot room" in the warehouse before being extracted. Thick, western honeys flow much better when extracted at temperatures between 90° and 100°F. Nearly all beekeepers use mechanical uncappers of one type or another. Uncapped frames are moved by chains to the vicinity of the extractors. Radial extractors, which spin in a horizontal or vertical plane and hold 100 to 350 frames, are most common.

Proceeding from this point in the process, "variety" best describes how the cappings and extracted honey are handled. With one method, all the wax and honey are combined and pumped through a heater and honey separator, which spins the honey away from the wax. Knives in the spinner shave the wax into bits that fall into a barrel.

In many operations, the cappings are routed one way by augers, conveyor belts, or gravity, while the honey is strained and pumped through a second system into settling tanks. The honey is left in the tanks a day or two to allow wax and bubbles to rise to the surface; then it is drawn off from the bottom of the settling tanks into drums, cans, or bottles. Honey stores best at temperatures around 70°F. All types, except sage, will granulate in containers over time, especially at temperatures around 55°F.

Cappings contain valuable beeswax, so various methods are used to separate the wax from the honey and slumgum. One method is to uncap the combs directly into a cappings melter, a water-jacketed tank with heating coils inside and sometimes heating coils in the cover. The object is to melt the wax at about the same speed it is being uncapped. The wax floats above the honey and slumgum, and the levels of honey

and wax are adjusted by opening and closing taps leading from the melter.

Most of the honey can be removed from cappings by a cappings spinner, which is similar to a radial extractor but contains a wire-mesh basket. Cappings are added gradually, until the wax builds up to the point that it has to be removed. Lining the basket with pieces of nylon fabric eases wax removal.

A number of beekeepers just collect the cappings in barrels and eventually move them into the oven, a thermostatically controlled, large, insulated box built in the warehouse's hot room. The temperature is maintained at about 150°F and the wax and honey separate in the barrels. The beeswax can be ladled off in a relatively pure state.

A few commercial operations have heated wax presses to extract wax that otherwise would adhere to cocoons in brood combs. Area beekeepers bring barrels of slumgum and old wax to these operations periodically for processing.

Commercial beekeepers should use stainless steel equipment to process honey. Honey is acid, even if it does not taste acidic, and can rapidly corrode many metals and unprotected cement floors.

Honey products

Comb honey. This product is produced in basswood square-section boxes sized $4\frac{1}{4} \times 4\frac{1}{4} \times 1\frac{7}{8}$ inches, in rectangular boxes $4 \times 5 \times 1\frac{3}{8}$ inches, or in round plastic rings that are placed in special comb-honey supers (normal frames are not used in these supers). The exposed surfaces of wooden sections should be painted with hot paraffin after they have been positioned in the supers to prevent bees from staining the boxes with propolis. Overlapping honey flows of light and dark honey should be avoided for comb honey production because combs partly filled with dark and light honey are less attractive to consumers.

HONEYDEW HONEY

Honeydew honey, which is not true honey, originates from a sweet liquid excreted by scale insects and plant lice or aphids. In California, one kind of honeydew honey is derived from a scale insect on incense cedar. Another honeydew honey in California is derived from galls on valley oaks. These galls secrete a sugary material on their exterior walls that is collected by honey bees and stored in the same manner as honey. Major honeydew honey crops have been recorded periodically from valley oaks in the foothills on the west side of the Sacramento Valley for 50 years. Germany is the major market for this hive product.

Comb honey production is difficult because the nectar flow has to be constant and abundant to produce combs of good quality, and because colonies have to be crowded to the swarming point before bees will go into the comb-honey boxes. For best results, there should be enough bees in the colony to fill at least a hive body and a full-depth super, but all should be shaken into a single box; a super of empty comb-honey section boxes should then be added so that the bees can deposit honey in the boxes. After the bees have started to build comb in the super containing comb-honey boxes, a second comb-honey super can be put on top.

When the first combs are about half filled with honey, the two supers should be reversed to finish the first combs (this usually increases honey production). A third comb-honey super may be placed on top, if the honey flow is extremely good and the bees need more space. This can be repeated as long as the nectar flow continues and as often as is needed to give the bees more room in which to work without providing more sections than the nectar flow warrants. (If queen cells are present in such a colony, they should be removed to prevent swarming; the colony that continues to produce queen cells may be indicating that it is attempting to supersede the old queen. Therefore, it may be necessary to kill the old queen and introduce a new one.)

Supers full of comb-honey boxes should be removed as soon as the sections are completely filled and the cells are sealed. Near the end of the nectar flow the comb-honey supers should be removed to permit the colony to store enough honey in the hive for winter. Comb section boxes full of honey should be separated into groups by weight and appearance, and the weight and grade of each section must be listed on its label. The boxes should then be individually wrapped in plastic wrappers and sealed against dust and insects (plastic wrappings are available from bee suppliers). Comb honey is graded according to weight, condition of cell caps, cleanliness, and fullness of combs. Federal standards divide the grades into U.S. Fancy, U.S. No. 1, and U.S. No. 2. Descriptions of these grades are available from the United States Department of Agriculture.

Creamed or spun honey. The objective in producing creamed or spun honey is to induce honey to granulate into such fine crystals that they are undetectable when eaten. Light-colored honeys appear even lighter when processed by this method, so removal of all particulate contamination is mandatory.

For best results, adjust moisture level of honey to 17 or 17.5 percent. Heat honey in a water bath to 140°F to dissolve any natural sugar crystals and to destroy naturally occurring yeasts. Pour the honey through a fine-mesh strainer (equivalent to a nylon stocking's mesh) and cool quickly to 80°F to avoid darkening the honey. Add 10 percent starter, which is good creamed honey, and stir to blend evenly. Try to avoid incorporating air into the mixture because bubbles will cause craters on the surface of the creamed honey later. Pour into containers, cover, and let stand at 55°F. In a week the honey will become very firm. To soften, place at 80°F. To store for a length of time, refrigerate or freeze creamed honey.

Commercial Queen Rearing

Rearing queens

Rearing queen bees on a commercial scale is centered primarily in the Sacramento Valley, which produces approximately 600,000 queens and 900,000 pounds of packaged bees annually for U.S., Canadian, and foreign markets. Skilled beekeepers with many years of experience rear queens, but the following common commercial procedures can be modified to suit smaller operations.

Queens are produced by placing (grafting) 1-day-old larvae into queen cell cups made of beeswax or plastic (fig. 9), and then putting the cups into a functionally or literally queenless cell-builder colony. Young worker bees will feed royal jelly to the larvae until they become pupae, thus assuring that they will develop into queens, not workers.

Almost any colony can be induced to build queen cells, but the quality of queens depends on the care the developing larvae receive. To produce good queens, a colony must have an abundance of nurse bees, pollen, and honey or sugar syrup. Nurse bees can be provided by making sure the colony has a comb of emerging brood a week before grafted cells are given to it. An ample supply of royal jelly can be assured by removing much of the current young brood a few hours before grafting. A day or two before grafting, a comb with pollen should be placed in the colony next to the space to be occupied by grafted cells. Sugar syrup can be fed in a Boardman feeder or by inverting a friction top pail with several small holes in the lid over the occupied frames and inside an empty hive body.

To start this procedure, up to 15 empty cell cups are attached to wooden bars approximately $17\frac{1}{4}$ inches in length, which fit into $\frac{3}{16}$-inch slots cut in the interior sides

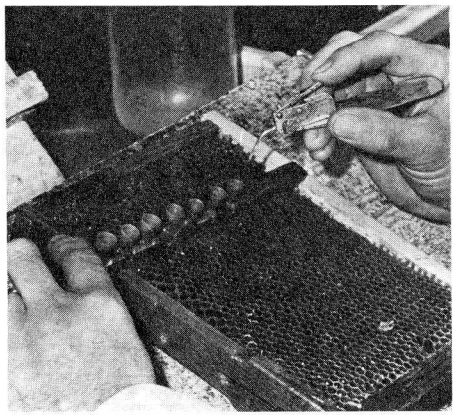

Fig. 9 Grafting larvae from comb into queen-cell cups. Good lighting, temperature, and humidity control are required.

of end bars of a standard frame. The cell cups on the bars then are taken to a well lit room with environmental conditions suitable for the grafting. Room temperature should be at least 75°F and the humidity around 50 percent to prevent larvae and royal jelly from drying out. Bright light is important to locating and removing larvae from the combs. A supply of royal jelly (diluted with an equal volume of warm water and stirred until it has an even consistency) and a comb of day-old larvae should be available. A small drop of diluted jelly is placed in the bottom of each cell cup and a larva is placed on the drop. Be sure not to roll the larva over. This operation is repeated until each cell cup contains a larva. The diluted royal jelly keeps the larva moist and well fed. Up to 45 grafted cell cups are placed in the cell-builder colony, which should be well supplied with sugar syrup or honey, and pollen.

After 9 days in the cell-builder colony, the cell cups, containing capped queen pupae (fig. 10), are placed in an incubator (a modified chicken-egg incubator will do) kept at about 91° to 93°F and a relative humidity of about 50 percent. Ten days after grafting, the queen cell is placed in a small mating hive (nucleus or "nuc") containing at least a quarter pound of bees. The bees will take care of the cell until the queen emerges. About 7 days after emerging, the queen flies out and mates with at least ten drones. When the queen mates (in flight), semen from the drones is deposited in her oviducts. The sperm migrate into the spermatheca during the next 15 hours and remain there until used or until the queen lives out her life. The movement of the sperm from the oviducts to the spermatheca is slowed by temperatures below 80°F. Therefore, it is important that the nuclei or colonies be strong enough to maintain a temperature at least this high in the brood area after the queen returns from her mating flight. Newly mated queens begin to lay eggs in 3 or 4 days. The beekeeper then removes the queen from the nucleus and cages her for shipment to a customer.

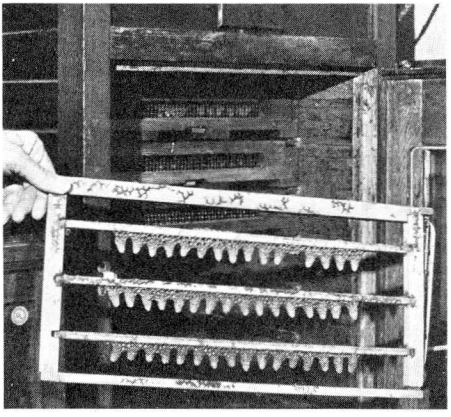

Fig. 10 Capped queen cells are kept in an incubator overnight for protection and ease of handling.

During shipment to a customer, the queen can be in a cage, along with a few attendant bees and a supply of queen "candy" for food. In a shipment of a queen and enough bees for a colony, the queen is sent alone in an empty cage placed in the package full of bees. The package contains a can of sugar syrup. The bees will feed the queen through the wires that enclose her cage.

Packaged bee production

Packaging bees is an enterprise for experienced beekeepers, but the procedures described below can be modified for hobbyist operations.

Colonies expected to produce bulk bees should be fed well in late summer, fall, and early spring. This stimulates longer and better brood production, which results in large bee populations that can take maximum advantage of early spring blooms. With such strong colonies a beekeeper who places bees in almonds in February and near wildflowers in March can maintain strong colony populations even though many pounds of bees may be removed for packaging.

Removal of bees is referred to as "shaking." To shake bees, one or more frames are removed from each hive and shaken with a downward jerk over a funnel that empties into a "shaker box." However, beekeepers now smoke the bees up through a queen excluder into a screen-topped box with vertical panels on which the bees cluster. The clusters are jolted down through the funnel into the shaker box. The filled box is then carried to where the packages are weighed; here the bees are shaken from the shaker box into a weighing vessel that transfers the bees into packages built for bee shipping (fig. 11). Two to 4 pounds of bees may be shipped in the packages, each of which contains a can of sugar syrup (except when shipped by air). The packages are nailed together with laths in groups of five; this makes them easier to handle and provides space for adequate ventilation when they are stacked. A 2-pound package is considered the minimum for starting a new colony; a 4-pound package with two queens may be divided into two potential colonies.

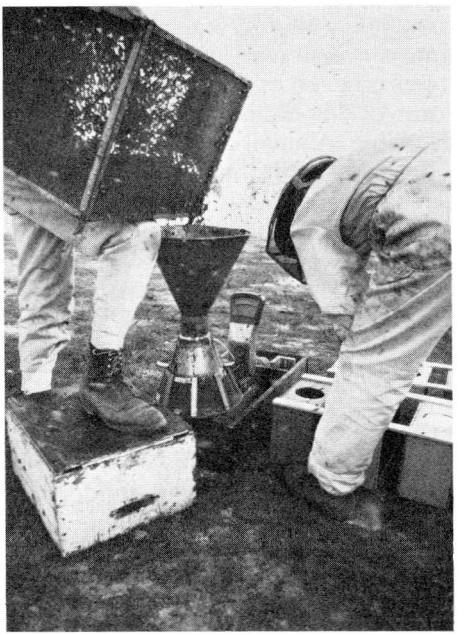

Fig. 11 Bulk bees are weighed and poured into wire-screen boxes containing caged queens. With a can of sugar syrup in the hole, the packaged bees are sent to beekeepers to populate empty hives.