Master Beekeepers Certification Program

Apprentice Beekeeper Handbook

Revision B
2012

Revision History.

June 2011, Revision A.
Added Text for the use of Hopguard and MAQS.

December 2011, Revision B.
Revised swarm section page 24
Revised hive weights and winter feeding guides page 31
Added WSU diagnostic lab page 34

WSBA Master Beekeeper Certified Text

INTRODUCTION

Honey bees play an important role in the life of man, not only for the honey and wax which they produce, but more important, for pollinating agricultural crops. Over 90 plants require insect pollination, and the most easily manipulated pollinating insect for the largest variety of crops is which man has been able to control is the honey bee. Solitary bees and bumble bees are also important for this work. Bumble bees are widely used for greenhouse pollination of tomatoes in the PNW and solitary alfalfa leafcutter bees are important commercial pollinators of alfalfa seed. However, no other insect pollinator compares to the honey bee when it comes to placing large numbers of pollinators on a specific crop at a specific time. Without the pollinating service of honey bees, the cost of fruit, vegetables, legumes, nuts, and many other foods would be many times what it is today.

Keeping bees is an interesting and absorbing hobby. Few avocations equal beekeeping in getting one into the open air, teaching about the wonders of nature, or forcing new thought processes. Honey, the by-product of this hobby is a wonderful natural sugar with many uses and the beeswax is used for making candles and polishes.

Today approximately 500 beekeepers keep about 63,000 colonies in Washington. The largest beekeeper in the state operates over 10,000 colonies. Many commercial beekeepers move their colonies several times during the year for pollination and to produce a variety of honey crops. Some go as far as California and North and South Dakota to make a crop of honey and make an increase in their number of hives.

Washington produces about 4,000,000 pounds of honey a year and imports about 8,000,000 pounds of honey to meet the needs of the household and commercial users. About 400,000 pounds of wax are also produced.

Many books have been written on Honey bees, some of the most popular are:

ABC & XYZ of Beekeeping published by A. I. Root Co.
The *Hive and The Honey Bee* published by Dadant & Sons.
American Honey Plants, by Orange Judd Publishing Co.
Queen Rearing, by Dadant & Sons. *How to Keep Bees and Sell Honey*, by Walter T. Kelly Co.

There are several good periodicals available:

American Bee Journal - Hamilton Illinois, 62431.
Bee Culture - Medina, Ohio, 44258.
The Speedy Bee - Jessup, Georgia, 31545.

Most states and many counties have beekeeper associations which meet monthly. Information about these may be obtained by contacting the local County Extension Service office, or the state Department of Agriculture, or the Washington State Beekeepers Association website www.wasba.org.

LESSON 1: THE HONEY BEE AND HER PRODUCTS

Honey bees belong to the Arthropoda branch of the animal kingdom. These animals have a body made up of a series of segments and having six or more jointed legs. This division of Arthropoda is again divided into four classes: the Crustaceans - crabs and lobsters; the Arachnids - spiders and mites; the Myriapods - centipedes; and Hexapods or Insects, to which the bees and all other insects belong. This class, Hexapoda or Insecta (both names are used), is divided into more than 30 orders of which only the order Hymenoptera is of direct interest. Members of this order have four membranous wings, with few cross veins; the forewings are larger than the hind, and the mouth parts are formed for both biting and sucking. Bees, ants, and wasps are the most prominent members of this order.

The order Hymenoptera is further divided into families. The honey bee belongs to the family Apidae, the long-tongued bees. Some members of this family are solitary in habit, living alone or making their own nests; some are guest bees, living in the nest of other bees; and some are social bees living together in colonies. In the honey bee this social habit is most fully developed. It belongs to the genus *Apis* of which there is found only one species in this country, *Apis mellifera.* The honey bee may be classified:

Kingdom .....Animal
Sub-kingdom .....Arthropods
Class ….....Hexapoda or Insecta
Order .....Hymenoptera
Family .....Apidae
Genus .....*Apis*
Species .....*mellifera*
Subspecies (Races) ... *mellifera, ligustica, carnica, caucasica,* etc.

The scientific name of the honey bee species is: *Apis mellifera.* Subspecies have a third name or "trinomial" such as: *Apis mellifera mellifera, Apis mellifera ligustica, etc.*

Subspecies (Races) of Honey Bees in the United States

Across a large natural range that includes Europe, Africa and western Asia, the honey bee developed into numerous subspecies or "geographic races" adapted for widely varying ecological conditions. All honey bees in the US are descended from original importations of various Old World subspecies. Queen breeders in the US have historically selected honey bee stocks for color and some traits that are reminiscent of these original subspecies and often sell them as different "races", although the similarity to the original subspecies may be uncertain.

Italians (*A.m. ligitstica*) are one of the yellow bee races. Races vary in color from a dark leather color to a light yellow, having three or five black abdominal bands. The Italians are the most popular bees in the USA. In general, characteristics of Italian bees are:

1. They are reasonably quiet and do not usually run on the combs.
2. They resist wax moth.
3. They are more resistant to European Foulbrood than other races.
4. Due to the almost solid yellow color the queens are said to be more easily located on the comb than the queens of the dark races.
5. Given their historical origin from a warmer Mediterranean climate, Italian honey bees have been observed to consume more winter stores than Carniolan or Caucasian honey bees.

Carniolans (*A.m. carnica*) are dark bees with gray or brown hairs., sometimes giving them a soft banded appearance on their abdomens. These bees are native to the Alps of Europe. The characteristics of Carniolans include:

1. They are the largest dark bees, well-adapted to colder climates.
2. They have a gentle disposition.
3. They are more conservative of winter stores (honey) and begin spring brood rearing later than Italians.
4. Because of their dark color some persons find it difficult to find the queen.

Caucasian bees (*A.m. caucasica*) are dark bees with gray hairs. These bees are native to the Caucasus mountains and, based on general appearance, are not easily distinguished from Carniolans. Characteristics include:

1. They are gentle.
2. They have very long tongues, relative to other subspecies of the Honey bee.
3. They winter well in colder climates.
4. They are reported to use a greater amount of propolis.
5. As with Carniolans it may be difficult to find the queen.

Russian bees are a strain of honey bees now sold in the US derived from carnica-like bees that were moved from Europe to far Eastern Russia near the turn of the 20th century. Due to isolation in Siberia and a century of exposure to V. destructor mites, these bees developed hardy winter characteristics and some resistance to parasitic mites., leading them to be imported by the USDA-ARS for stock release in the US. It is difficult to distinguish Russian from Caucasians and Carniolans by color or size. Their reported characteristics include:

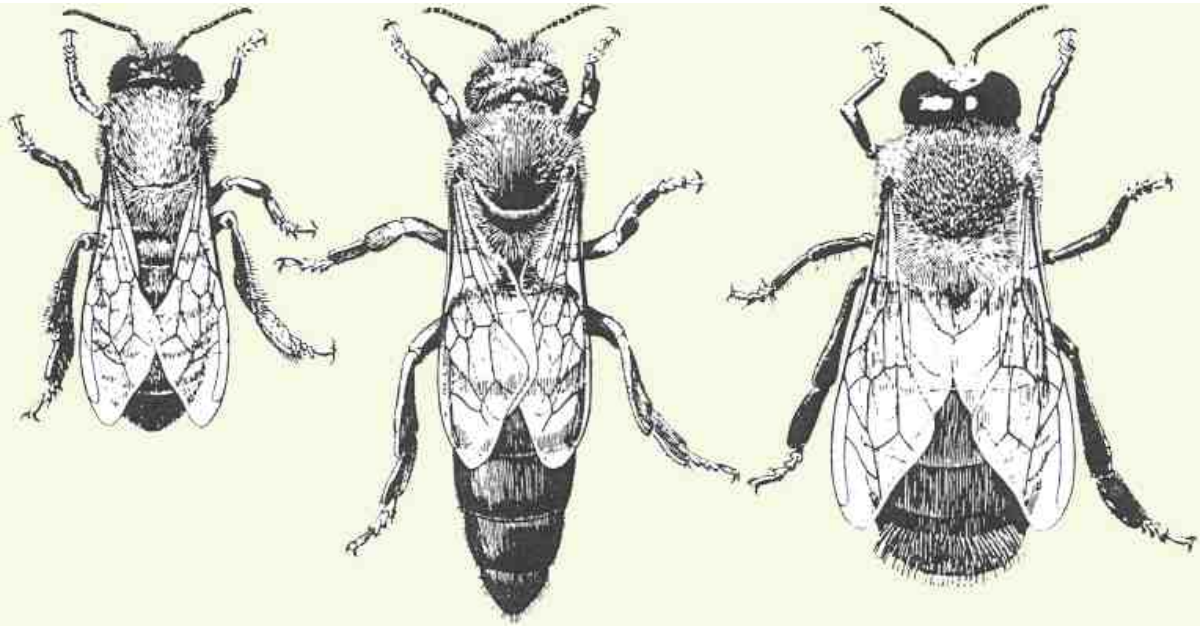
1. The are gentle
2. They have long tongues
3. They are very winter hardy and frugal in use of winter stores
4. They gather and use large amounts of propolis
5. They may exhibit increased resistance to parasitic mites
6. They were imported to the U.S. for their hygienic traits and resistance to trachea and Varroa mites.
7. As with most races, hybrid Russians may be aggressive

Several other races were introduced into this country but were abandoned for various reasons. These included Cyprian, Egyptian and Moroccan subspecies that were fell from favor due to their defensive nature. The original subspecies to be introduced into the US, the Dark Bee of Europe (Apis mellifera mellifera) was reported to be more highly susceptible to European Foulbrood and wax moth than the Italian and is no longer commercially available.

Hybrid bees, crosses of various races and strains of bees are being produced in selective breeding programs. These bees retain many of their traits while gaining hybrid vigor and additional desirable traits.

A Colony of Honey Bees

A normal colony of bees during the brood rearing season is composed of three types of individuals: a queen, several thousand workers, and a few hundred drones. These types of individuals are easily recognized by their difference in size and appearance. In addition to the adult bees, each normal colony will have brood in three stages - eggs, larvae, and pupae.



Worker Queen Drone

Time required in each stage of brood by the three types of bees in a colony is approximately:

	Eggs	Larvae	Pupae	Total time from egg to adult
Queen	3 days	5 ½ days	7 ½ days	16 days
Worker	3 days	6 days	12 days	21 days
Drone	3 days	6 ½ days	14 ½ days	24 days

The Queen

A colony normally has only one queen. However, under conditions of queen replacement via supersedure, an old queen and her daughter may be present and laying side-by-side for a short time. Normally, the queen is the only bee in the colony capable of laying fertile eggs that produce workers. She also lays infertile eggs that develop into drones. Her function is to lay eggs (from 1,500 to 3,000 eggs a day at the height of her production) and produce the pheromones that influence bee behavior. She does not have the ability to feed and care for the young, nor can she gather nectar and pollen. Her egg laying rate is controlled by the amount and kind of food she is fed by her nurse bees and by the temperature in the brood area. She normally deposits one egg to a cell, vertical to the bottom of the cell, with the smaller end down. A young queen may deposit more than one egg in a cell. Worker bees remove the surplus eggs and only one develops.

She produces what is called queen mandibular pheromone and several other substances that comprise her unique odor. Worker bees surround her in what is called a queen retinue and touch her with their antenna and lick her to remove these substances. These pheromones are then distributed to bees throughout the colony. A reduction in the availability of pheromones in the colony can influence swarming and supersedure.
The laying queen is the largest bee in the colony and her abdomen is longer than that of a worker. The ovaries of a laying queen are well developed, but she is deficient in some glands that the worker has, such as the brood food gland and wax glands. Her thorax is broader and deeper than a worker's. Her compound eyes are somewhat smaller. Her mandibles are well developed and are notched instead of being smooth like those of a worker. The tongue of the

queen is smaller, but her antennae are somewhat larger than that of the workers. The queen has a curved stinger, with shorter barbs than a worker's and it is not lost in the act of killing a rival queen, for which it is used almost exclusively.

The queen mates 5 to 10 days after she emerges as an adult from her cell. Under natural conditions mating takes place during several flights and she mates with numerous drones (an average of 12) before she begins to lay eggs. The spermatozoa received from the drone is stored in a special storage organ (the spermatheca) and is used to fertilize the eggs needed throughout the life of the queen or until the supply is exhausted. The queen fertilizes eggs by releasing sperm as each egg passes across the opening of the duct from spermatheca. Thus, she is able to control fertilization and deposits fertilized eggs in worker or queen cells and unfertilized eggs in drone cells. Fertilized eggs develop into workers or queens; unfertilized eggs develop into drones. Queens that fail to mate produce only unfertilized eggs that develop into drones (drone layer).

Queens can live for up to 5 years, although in modern beekeeping queens are often replaced annually. When a queen shows signs of failing she is generally superseded by a younger queen reared by the workers.

The Worker

The worker is female, like the queen, but her reproductive organs are under-developed. Workers are unable to mate, but may assume the function of egg laying should the colony become hopelessly queenless (laying worker). Their eggs produce only drones (except on rare occasions). While the sexual organs are under-developed, workers have other organs necessary to carry on the many tasks connected with the social life of the colony. The worker has a longer, more triangular head than the queen, well-developed compound eyes, and three simple eyes on the vertex. The mandibles are smooth and rounded, ideal for molding wax and cleaning cells. There are glands in the head and thorax, used in producing food and in secreting enzymes. The four sets of wax glands on the underside of the abdomen are well developed for converting honey or other carbohydrates into beeswax. The sting is barbed and is usually lost when a worker stings, causing her to lose her life. The honey stomach, an enlargement of the esophagus, is used for carrying liquids from the field. Enzymes are added to nectar to convert the complex sugars to simple sugars. This treated nectar is deposited in the comb and then reduced in moisture though evaporation. Upon completion of the evaporation process, the resulting product is properly called honey and is generally capped with wax by the bees.

Workers perform all the tasks of the colony except egg laying. They keep the hive clean, feed the larvae, secrete beeswax and construct comb, raise the queen when necessary, ventilate and guard the hive, convert nectar into honey, and store honey and pollen in the cells. They feed the queen a glandular secretion called royal jelly and they also feed the drones. When the drones are no longer needed (as the temperature drops in the fall), workers drive the drones from the hive.

Honey bees literally work themselves to death. The length of life depends upon the amount of work done. During the active season, bees spend about 3 weeks working in the hive and 3 to 4 weeks in the field. The type of work a bee performs depends upon its age, on the development of various glands, and on the needs of the colony. During the "inactive" broodless winter period, the colony of bees acts counter to most notions of a “cold-blooded” animal by clustering, moving and “shivering” to keep a temperature of over 70° F in the center of the cluster. In late winter, bees begin rearing brood in the hive and increase the core temperature of the cluster and brood to over 90 F. During the period of winter clustering, the bees consume honey for “fuel” and take occasional flights on warm days, living for several months under these conditions.

The Drone

Drone bees are the male bees of the colony and their primary function is to mate with a virgin queen; in this act the successful drones die. It is desirable to try to limit the number of drones by having mostly good worker comb in the hive.

Drones are easy to distinguish from a queen and workers because they are wider and longer than the workers but shorter than a queen. Their compound eyes meet on top of their heads. Their antennae are larger and have 13 segments rather than the 12 of the worker and queens. A drone's mouth parts are generally smaller; the tongue is smaller and the mandible chisel-like and notched. The drone lacks functional wax and brood food glands, and does not have pollen baskets on its legs. The drone has no stinger. They are tolerated in the hive during the active season, but they are driven out when the colony makes winter preparations after the nectar flow ceases.

Honey Products

Honey bees have been known since ancient times for their production of honey and beeswax. There are other products such as propolis, royal jelly and pollen that are very important to the bee. Of great value to man is their pollination of agricultural crops while in the process of gathering nectar and pollen.

Honey is the nectar and saccharine exudation of plants, which is gathered, modified and stored in the comb by honey bees. Honey contains not more than 18% water, 0.25% ash and not more than 8% sucrose. Honey varies in flavor, color, and crystallization characteristics according to the plant from which it is gathered.

Bees store honey for themselves, not for the beekeeper; it's their source of energy and heat. But honey is the major source of most beekeepers' income. A beekeeper, to be successful, must know plants and seasons as well as bees. Marketable honey must have less than 18 percent moisture or it is likely to ferment.
Pollen is gathered by honey bees from the stamens of flowers. Honey bees are equipped with special pollen baskets in that they pack and carry pollen. Pollen varies from almost white to almost black in color. It contains protein that is an essential part of the diet of brood and adult bees. A lack of pollen causes bees to cease rearing brood. Man made pollen supplements help but do not replace natural pollen in a bee's diet.

Bees manufacture wax from sugars and carbohydrates. It is secreted from four pairs of glands on the underside of the abdomen. Flakes of wax can be observed on young bees. It is translucent white in color when secreted. Seven to ten pounds of honey are required to produce a pound of beeswax. Beekeepers accumulate beeswax from old combs, cappings, burr and brace combs.

Propolis, or bee glue, is gathered from tree buds or pitch from coniferous trees. Honey bees use propolis for covering the walls of their hives, fastening the frames, reinforcing the comb, plugging holes, narrowing the entrance or sealing over dead invaders (such as mice) larger animals which they cannot carry from the hive.

Royal jelly is secreted from the hypopharyngeal glands in the head of young worker bees. It is fed to all the young larvae but the queen larvae are fed about 20% more than the worker larvae. The queen is fed royal jelly throughout her adult life. Many claims have been made on the medicinal or health qualities of royal jelly, but few of these claims have been substantiated clinically.

LESSON 2: BEEKEEPING EQUIPMENT

Clothing

A beekeepers' clothing may consist of the following:

- Long sleeved shirt and long pants
- A hat with veil to protect the face and neck
- A smock or coverall with a zippered veil attached
- A pair of white or blue coveralls with or without a zippered veil attached
- 10 inch high boots
- Gloves which protect the hands from being stung

Bee Veil

Usually made of wire screen, the veil is either closed on top or fits over a hat can be tied about the body to keep out the bees and reduce stinging. Another style has an elastic cord in the top band and bottom, with cords attached at the lower back which are placed under the arms, through a front loop in the skirt of the veil, and then passed around the body and tied. A veil may also have a zipper sewed to the bottom skirt that is then sewed to a pair of coveralls for maximum protection.

NOTE: As a beginner beekeeper, a veil should always be worn when opening or manipulating hives of bees.

Bee Hive Equipment

To be successful in beekeeping, either as a hobby or a commercial venture, equipment must be of uniform and standard size. Few changes have been made in the basic hive since 1851 when L. L. Langstroth discovered the bee space and developed the moveable frame hive. He observed that honey bees always allow 3/8-inch space between combs; any greater space is filled with additional comb and any smaller with propolis. He built his hive and frames with the 3/8-inch bee space between the combs. Over the years, experimental changes have been made in the size and shape of hives and frames. Today, frame sizes vary with the most common being 9-1/8 inches deep and 19-1/8 inches long. The ten frame hive is considered standard by most beekeepers, although size of equipment is a matter of personal preference.

The modern hive consists of a bottom board, hive body or brood chamber, a food chamber and sufficient numbers of supers to store the honey crop, sometimes an inner cover, and hive cover (migratory style cover does not need an inner cover).

The wooden equipment should be painted regularly, both to improve its appearance and to increase its longevity. White or light colors are preferred by most beekeepers for cooling in the summer, although aluminum color is also popular. Darker colors allow the absorption of more heat by the winter bee cluster, enhances colony survival, increases flight time, and decreases usage of stores. Although not essential, a hive stand helps preserve the bottom board. It should keep the hive about four to six inches off the ground and provide a stable base upon which to place the hive.

Some items of hive equipment are as follows:

Bottom Board

The bottom board is the width of the hive and is usually made longer to provide a landing area for bees. Some commercial bottom boards have rails that are 7/8-inch high on one side and 3/8-

inch on the reverse side. Most beekeepers in Washington prefer the shallow side although either side may be used. An entrance cleat or metal mouse guard may be used in the fall to restrict the entrance to keep mice out.

Screened Bottom Board

The screened bottom board incorporates old management techniques with new IPM (Integrated Pest Management) techniques. Screened bottom boards have been shown to increase brood production. As part of IPM they allow Varroa mites that have been knocked off of a honey bee to fall through the screen and be unable to climb back on another bee . They also increase the cleanliness of the hive by allowing cappings and other debris to fall through the screen and out of the hive.

To make a screened bottom board, take a standard bottom board (see above) and cut a hole in the middle approximately 12 ¼" x 15 7/8". Place a single piece of 1/8" wire screen over the hole and secure with staples. Additional enhancements include a slot in the bottom of the bottom board that will allow a sheet of white cardboard to pass under the screen. This will allow the beekeeper to do 24 and 48 hour sticky board mite drop checks.

Bovard Rack

This device was designed by Mr. Bovard of Hawaii. It has the advantages of the Killion bottom board but is easier to make and allows the use of the standard bottom board made today. It consists of a rectangular wood frame the same size as a hive body. On the inside of the two long sides a 3/8-inch dado is cut. Into these dados a four inch wide by 3/8-inch thick board is placed at one end, and then 3/8 x 3/4-inch strips are placed 3/8-inches apart to fill the inside of the rectangle. The bees will cluster in the bee spaces between the strips thus controlling the movement of air up through the hive and keeping it warmer. The Bovard rack is placed between the bottom board and the hive with the wide board toward the hive entrance. Most supply companies sell this device as their "slatted rack."

Hive Body

The hive body has several names such as: brood chamber, deep box, deep super, full-depth super, or food chamber. It holds eight to ten frames that are 19 inches long and 9-1/8 inches deep and spaced 1-3/8 inches from center to center. Nine frames, evenly spaced, are sometimes used in the ten frame hive body. Hive bodies may come with or without hand holds pre-cut. Additional handholds may be added. These are called 'cleats' and consist of two wood strips approximately ¾" thick by 2" thick and 16 ¼" long. They are attached to the hive bodies on each end about 1 ½" below the top of box. The cleats may be used to lift a hive with manual or automated cradles. They enhance a beekeeper's ability to lift heavy equipment.

Extracting Supers

Extracting supers are used for food chambers and for the storage of surplus honey. There are three common sizes of supers in use. The super holding the 5-3/8 inch deep frame is called the shallow super; it holds 30 to 35 pounds of honey. The western, or Dadant extracting super that holds the 6-1/4 inch deep frame is very popular. This super holds 35 to 45 pounds of honey. The deep super, or hive body, is often used as a super but is objectionable because of its weight which is about 75 pounds; 50 to 60 pounds of which is honey. Many beekeepers use nine frames of comb instead of ten frames in supers; this enables the bees to make combs with deeper cells for easier uncapping.

Comb Honey Supers

Comb honey or section supers are used in the production of comb honey; these hold the 4-1/2 inch frames, the 4-1/4 x 4-1/4 inch boxes, or four inch plastic round comb holders. Extra spacers and holders are needed to hold the round or square sections in place.

Inner Cover

The inner cover is used so that the outer cover is easier to remove. It is also used when removing honey by inserting a bee escape that allows bees to exit a super but not reenter it. Many beekeepers add a 2" wide opening on the front side of the inner cover allowing bees to enter and exit from the top of the hive. The benefits include: increased ventilation during the hot summer months, shorter distances for the nectar gathering bees to travel to deposit nectar in the honey supers, and improved ventilation during winter months (reduces condensation and mold growth).

Hive Cover

Hive outer covers come in two styles. The telescoping cover, which extends down over the sides and ends of the hive body or super. Hobby beekeepers and those who do not move their hives often use this cover. It is sometimes covered with galvanized metal or aluminum to protect it from the weather. An inner cover should be used with the telescoping cover. The migratory style does not need an inner cover because it extends down over only the ends of the hive. This allows hives to be placed directly in contact with one another on the long side. In cold climate areas, this is a good technique when winterizing your hives. The sides of the hives that are in contact provide an insulated wall. The bees will tend to move towards this insulated/warmer wall during the winter months. Insure that you place good food frames on this side of the hive. Do not put your frame feeder in this area. For additional discussion, see 'Winterizing your hives'.

Frames

Frames are used in the hive bodies, brood nest and supers to hold the comb in which brood is reared and honey stored. They vary in size according to the super in which they are placed. There is a size for every super and they should only be used in the proper super. They should contain full sheets of foundation. Plastic frames are also available.

Foundation

Foundation is the bees wax mid rib of the comb. It is manufactured by running sheets of pure bees wax through a roller press that embosses the base of the cell in the wax. It comes in several weights and may have reinforcing wires. The light-weight or thin foundation is used for comb honey and the medium for brood rearing or nectar storage. New foundation with a plastic center for additional strength and coated with beeswax is also available. Additional melted wax may be painted on plastic foundation to encourage more rapid comb building by the bees. Bees draw or build the foundation into comb by adding wax to the embossed cell walls.

Feeders

Feeders are of several types:

Top feeders include:

1. Single and multiple jar feeders, with screw top lids that have several 1/64 inch holes for the bees to remove sugar syrup through. These are mounted in a 1/4-3/8 inch thick

2. Miller feeders are for liquid syrup or dry sugar. These may be made from converted supers constructed so bees can pass upward to remove the syrup from the reservoir. Nylon screen may be attached to the inside of the reservoir to reduce bee drowning.
3. Sugar candy boards contain cooked sugar syrup and are used for emergency feeding of bees in the late winter.

In-hive feeders usually are frame-shaped containers that hold syrup. The bees travel down the inner sides of the feeder to the syrup level to feed. These are called frame feeders and they may take the space of one or two frames in the hive. Many beekeepers add wood strips or straw that will float on the syrup and give the bees a means of climbing out of the syrup should they fall in (as many do).

Entrance feeders consist of a Boardman feeder block with a quart jar. We do not recommend the use of this type of feeder.

Queen Excluder

The queen excluder is a device used to confine the queen to the brood nest area of the hive. It may be a perforated plastic sheet or wire grid bound with wood or metal. Spaces are large enough to allow passage of workers but not queens or drones.

Double Screen Board/Queen Introduction Board

This device is constructed for use when introducing queens to a second colony placed on top of a parent colony. It is usually made with a screened hole in the center so that air and heat from the lower colony can pass up to the upper colony and allow the mixing of queen pheromones between the two colonies, and with an entrance for bee flight at one end.

The double screen board can be constructed by cutting a sheet of ¾" plywood the same dimensions as a hive body. Place shims on the top and bottom to maintain 'bee space' (1/4" on the bottom and 3/8" on the top). Cut a rectangular hole in the plywood approximately 12 ¼" x 15 7/8". Staple 1/8" wire screen over the hole on both sides which will give you about ¾" between the screens. Hence the name 'double screen'. (Note: a single screen will not prevent the bees in each hive from reacting to each other.) Cut an entrance in the center of one of the short sides through the 3/8" shim. Add a landing board if desired.

An inner cover may be used for this purpose if the bee escape hole is covered on one side by hot gluing a piece of screen over it, and removing a 3/8x1.5 inch section from the deep side of one end to act as the bee entrance. Likewise a piece of 1/4-inch pegboard may be wrapped with a frame to act as a queen introduction board, with a space provided for the bee entrance. Even a piece of 1/4-inch plywood may be used if 1/8" saw kerfs are cut in the center to allow for air movement between the two colonies.

Queen introduction boards may also be used to winter a young but small hive, a weaker hive or a nuc by placing the small colony on top of a strong colony over the winter. Placing the entrance at the back of the parent hive reduces interaction of bees from two different queens.

Top Screen Boards

A top screen board is made up of a rectangle wood frame the size of a hive box, usually about 3/4-inch thick, with a piece of screen wire stapled on one side. The corners on one side may be strengthened with three inch triangles of 1/4-inch plywood nailed to the screened side, and a spreader board in the middle of the frame. This device is used to allow heat to escape from

hives being moved to distant apiary sites in warm weather.

Smoker

The smoker, a fire pot with attached bellows, is an essential piece of equipment for controlling the bees. Smoke which is produced by smoldering cotton cloth, rotten wood, burlap or other dried material, is puffed over the frames and has a quieting effect on the bees when used in moderation.

Hive Tool

The hive tool is a metal scraper and pry, usually flat at one end and bent over at the other. The hive tool is very useful in the apiary, and in the honey house.

Bee Escape

The bee escape is a trap used in the hole of an inner cover that is placed under a super from which bees are to be removed. Two pieces of fine spring wire in a V-shape allow the bees to leave the super but not return.

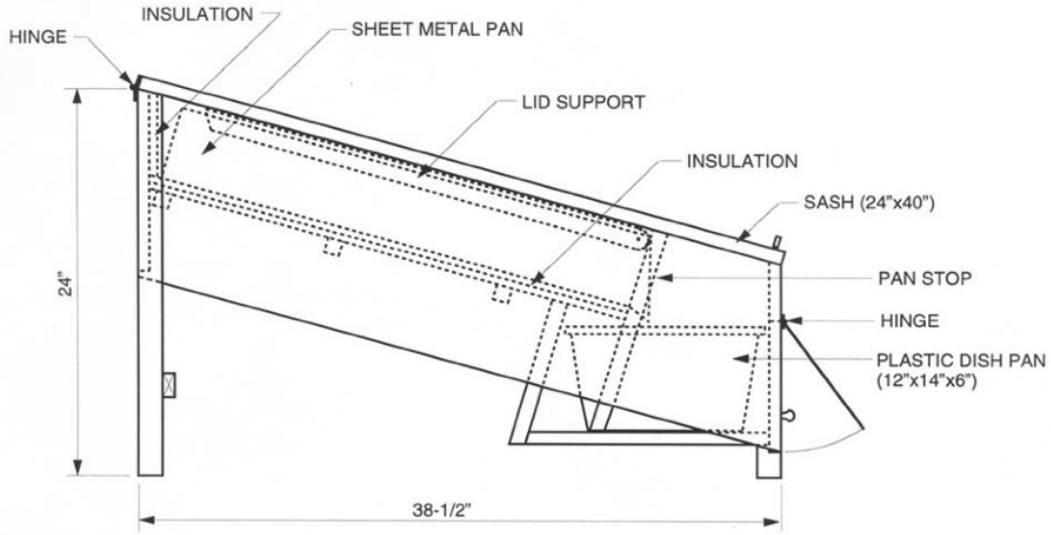
Honey Extractor

A honey extractor is a can with a revolving reel or basket. The reel spins rapidly so that centrifugal force throws honey out of uncapped combs. They range in size from two-frame, non-reversible, to the 160 frame, horizontal radial extractors.

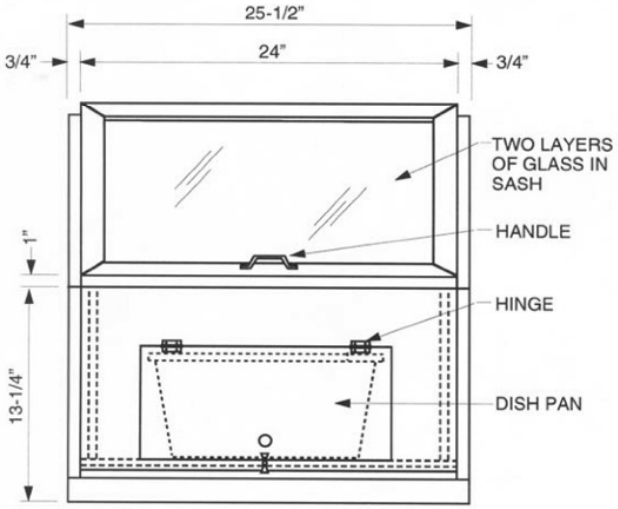
Solar Wax Melter

A solar wax melter is a box covered with glass that utilizes the heat from the sun to melt beeswax comb and cappings. The inside of the box is usually painted white or silver to reflect the sun's rays increasing the heat in the melter and contains a sloping metal tray to contain the wax or slumgum to be melted. The outside of the melter is painted a dark color to absorb heat. Its lower end is screened to minimize the amount of debris exiting the tray. Under the lower end of the tray a wax mold pan is placed to catch the clean melted wax.

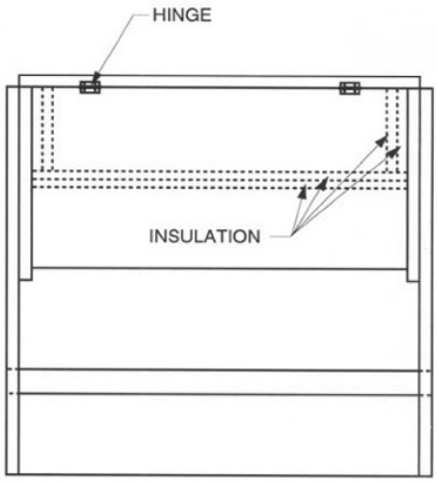
There are numerous designs for solar wax melters. In areas with high yellow jacket concentrations a closed system should be utilized.



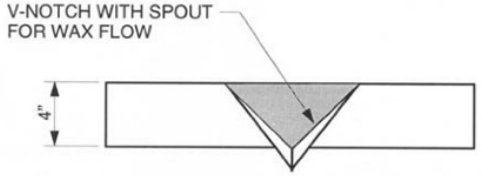
SIDE VIEW



FRONT VIEW



REAR VIEW



FRONT VIEW OF SHEET METAL WAX PAN

Penn State Cooperative Extension
in Cooperation with MAAREC

SOLAR BEESWAX EXTRACTOR

9/1/1999

LESSON 3: MAKING A START IN BEEKEEPING

For a good start in beekeeping it is important that a person be both enthusiastic and willing to study and learn about bees and their habits. Most beekeeping is based on common sense and the use of the bees' natural behaviors to aid in the manipulation and management of the colony.

The apiary location is important. It should be accessible by car or truck so the honey may be easily carried away. It should be a sunny spot and have good air drainage. There must be protection from the prevailing winds with a building, fence, hedge, or a specially made wind break.

Arrangement of the hives in the apiary is important. They are usually placed in pairs, with several feet between each pair, so that the hives may easily be worked from the side. Scattering them about the apiary helps prevent the bees from returning to the wrong hive (drifting). For maximum honey production, the hives should not be placed in a straight line. Hives should face south to east to receive maximum early morning sunlight. Colonies are more easily worked, more gentle, and stay stronger and healthier if they have full sunlight most of the day. Hives should be set on wooden pallets, boards, or concrete blocks no more than four to six inches off the ground.

Pick the race of bees with which you think you would like to work. All races in this country are considered gentle and easy to handle. Strains of bees within the races vary greatly. Testing frequently and requeening with queens from different breeders gives good indication of the race and strain that suits you best. The Italian race is the most available, but beginner management results in many swarms. Caucasians or Carniolans are more forgiving in this regard.

Standard equipment, which is interchangeable from one hive to another, is a basic requirement for a proper start in keeping bees. Home made equipment is not considered standard equipment because it too often does not have the correct dimensions. Always buy from a reputable dealer or beekeeper, and seek a second opinion if possible. **Caution**: If purchasing used equipment, it is important to make sure that the comb does not contain larval brood disease or miticide residues.

Working The Bees

When inspecting the colonies, comfortable clothing made of tightly woven cloth. Light tan or white cotton is best though dark blue works best at night. Tie pant legs around your boots so bees don't crawl up your legs.

Use a good smoker and keep it burning. Light a piece of paper or burlap and drop it in the bottom of the smoker. Squeeze the smoker bellows and add fuel until it is smoking well and will remain lit. Dry rotten wood, clean burlap sacking, pine or cedar wood scraps, wood shavings, beauty bark, or pine needles make good quantities of smoke. **DO NOT** use oily rags, synthetics, or any material that might discolor or add flavor to the honey, or easily fall out of a smoker and cause a fire.

Use only enough smoke to keep the bees below the top bars of the frames. Once they are in the air, you have little chance of controlling them. Once the smoker is well lit, it will not go out if the bellows are given an occasional squeeze. Stand it upright when not in use; the draft will keep the fire going. Lay it down on its side when you have finished and plug the top opening with a cork or stopper so it will go out. Use the charred fuel for subsequent smoker use because it is easier to start than new fuel.

When beginning to work a colony, blow one or two puffs of smoke across the hive entrance to

discourage the guard bees, then blow another puff or two under the lid. Use a puff or two as you remove frames or replace them. This keeps the bees under control and out of the way so few bees are killed. Work the bees when they are flying, on clear warm days above 55° F. between 10 a.m. and 4 p.m. During this period most of the old bees are in the field gathering nectar or pollen. Bees are easiest to handle when there is a nectar flow. Work bees slowly and with care; unnecessary roughness results in irritated bees and stings.

Some stings are inevitable, but with care most of them can be avoided. Even though one becomes accustomed to bee stings they always hurt. When stung, the best thing to do is scrape the stinger out of the skin as soon as possible. Bee stings do not affect some people while others may have a severe reaction from a single sting. Those with no reaction can usually forget the sting; those with a severe reaction should see a physician. He may prescribe an antihistamine that may be kept on hand for future stings. Beekeepers who do not build up a natural immunity to stings may get a series of treatments from their physician to overcome the allergy.

Buying Bees

Spring is the best time to start with bees. The beginner will probably learn more by starting with package bees and new equipment from a local supplier. When purchasing over-wintered or established colonies have them inspected by someone capable of recognizing bee diseases before you buy them. In Washington you may call the State Department of Agriculture apiary program, or your local beekeeper association to contact a specialist. Weak colonies and poor equipment or hives of bees without frames are a bad investment and should not be purchased. Swarms provide another way to get started in beekeeping.

Package Bees

Package bees are produced in the southern states and shipped to northern beekeepers or trucked by bee equipment suppliers for sale and delivery to local beekeepers. It is recommended that beginners purchase bees from their local supplier so that they can get the instruction and other services they provide.

Bees may be purchased by the pound in a package of two to six pounds of bees plus a queen and feeder. Each pound represents about 3,500 bees. The three-pound package (10,500 bees) is usually the best buy. Package bees should be ordered in January to insure delivery at the desired date, usually the middle of April to early May. Package bees are shipped from a California supplier by parcel post or express and arrangements should be made to pick them up immediately at the post office when they arrive.

As soon as you get the bees home, evaluate the amount of syrup remaining in the feeder can by partially removing the can to assess it weight. If the can is empty, sprinkle syrup on the bees through the package screen. The syrup is made of one part sugar to one part water. Sprinkle the syrup liberally on the package screen and into the bee cluster, but do not drown the bees. Feed them again in the apiary before introducing the bees into the hive. Protect package bees from extremes in temperature. Both extreme heat and cold are detrimental to the bees. Heat is the most damaging. If necessary to hold for a time, store them in a dark room with temperature between 50° F and 60° F.

A complete hive with frames of foundation, or comb known to be free of diseases, should be prepared before the bees arrive, along with an empty super, a screw top glass jar (see feeder under equipment) containing sugar syrup. Drill 4 to 6, 1/64-inch holes in the lid of the jar, through which the bees will feed.

Place the bees into the hive toward evening. This is the best time to introduce package bees because there is less chance of robbing or of having the bees drift into another hive.

To hive-the bees:

- Remove four or five frames from the center of the hive.
- Sprinkle a little syrup onto the bees through the screen sides of the package.
- Shake the bees to the bottom of the package by bouncing it on the palm of your hand.
- Remove the feeder can and the queen cage, and then replace the feeder can just enough to plug the hole.
- Remove the cork from the end of the queen cage and replace it with a mini-marshmallow **being careful not to release the queen**.
- Hang the queen cage with the metal tab from the middle of the top bar of the frame in the open space, or place it on the bottom board. The bees will remove the marshmallow and release the queen in 24 hours.
- Again shake the bees to the bottom of the package and remove the feeder can.
- Pour the bees out of the package into the hive over the queen cage and into the space between the frames. It will be necessary to shake the package from end to end to get all the bees out of the hole.
- Carefully replace the frames, and set the inner cover in place.
- Invert the feeder jar and place it into the plywood holder or over the hole in the inner cover. A little syrup will run out but a vacuum soon forms and bees can get the syrup only by sucking it out through the small holes.
- Put on an empty super to protect the feeder and set the hive cover in place.
- The entrance should be reduced to 1.5 inches with an entrance cleat, cloth, or burlap. Additionally crumple two squares of toilet tissue and use it as a plug in the hive entrance. Bees will remove the paper over the next few days.

Feed the bees as necessary to keep a constant supply available. Do not use an entrance feeder, use a top feeder. If foundation is used, continue to feed until all but two or three foundation sheets are drawn into comb in the bottom box. If comb is used, feed until there are 6 or 7 frames of brood (about 30 days).

Do not disturb the bees for six or seven days, and then check to see that the queen is laying. Work carefully, with a minimum amount of smoke. She will probably be near the center of the bee cluster. If eggs are seen, the queen is present and the hive can be put back together. If neither the queen nor eggs are found, another queen must be ordered and introduced as soon as possible. If available, add a frame of older larvae and capped brood from another colony at this time, since bees will accept a queen more readily when brood is present.

When all but 2 or 3 frames of foundation are drawn into comb, add the second brood super. Exchange 1 or 2 frames of drawn or partially drawn comb from the sides of the bottom box with frames of foundation from the center of the top box. This is called "baiting" the foundation with comb. Sometimes bees will swarm rather than move into a new super of foundation and a bait comb will entice them to move up. Also, bees will often ignore the last frame of foundation next to the wall of the hive. As the center combs are finished, move these last frames in, near the edge of (not into!) the brood nest.

Continue feeding until 18 frames of foundation are drawn into comb, or until the bees quit using the feeder. It will take between 20 and 40 pounds of sugar to properly start a colony. A few early spring flowers do not make a nectar flow and feeding must be done to develop a strong colony by mid-summer. When feeding is stopped and the foundation is mostly drawn into comb, add a super above the hive bodies. Add another super on top when the bees have stored nectar in 5 or 6 frames of the one previously added. Be sure to bait each super with comb whenever

foundation is added.

A colony started from package bees, if given ample space, seldom swarm the first year. If swarm cells (queen cells) are found, they should be removed and additional super space provided. Swarm cells usually appear on the bottom of the frames in the second brood box, or along edges of the comb. Supersedure queen cells are usually found on the upper 2/3 of the face of the comb. These cells indicate a failing parent queen. As a rule **DO NOT REMOVE** these cells unless a new queen is available to introduce into the colony.

Swarms

Swarms are another way to get started in beekeeping. If a swarm is placed in front of any empty hive, it will usually walk right in and take up housekeeping. Best results are obtained if the bees are managed the same as package bees. Less syrup will be needed and they will probably build up more quickly than a package of the same size.

Lesson 4: SPRING MANAGEMENT

Whether or not you produce a crop of honey during the season may depend on how well you manage bees in the spring. As a matter of fact, spring management is often dependent upon what happened in the apiary since the previous fall.

Check Over-wintered Bees Early

Make the first visit to the apiary on a warm day in late February or early March to see whether the bees are alive. The bees should have started rearing brood by early March, depending on your location. Pick up dead colonies and return the hives to the honey house to be cleaned. Check the amount of food stores at the same time by lifting one end of each hive to estimate its weight. Colonies short of food will be very light and easy to lift. If necessary feed one to one sugar/water syrup (1 pound sugar and 16 fluid ounces water). Entrances and bottom boards should be cleaned to remove bees that have died during the winter. Remove mouse guards or entrance cleats.

Hives that contained colonies of bees that died should be examined by someone who recognizes bee diseases. If infected, the comb and equipment should be disposed of properly. A more complete examination of the hives can be performed at 55°F. when bees are flying. Open the hive and examine the combs close to the sides of the hive. If the honey in these combs amount to two or three frames full of honey, feeding is probably not needed at this time. Check the hive again in two weeks.

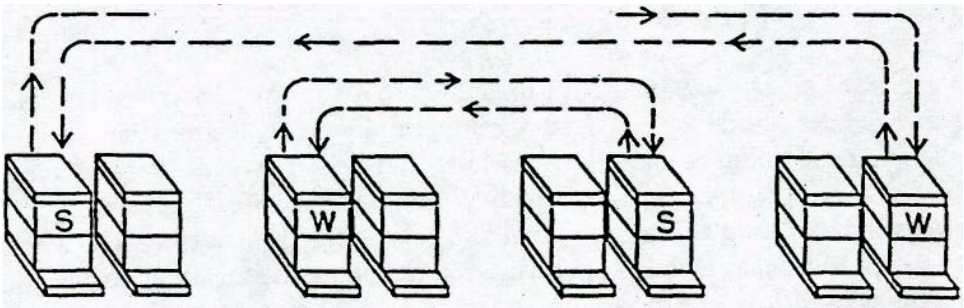
Develop Strong Colonies

Make the next hive check when the bees are having frequent flights. The outside temperature should be above 55° F. At this time another check should be made for dead colonies. Examine the brood to see if the larvae are pearlescent in color and the cappings are slightly convex without perforations. The food supply is again examined; if the colonies are short of food, feed sugar syrup using one part sugar in one part water by volume. Feeding should be done inside the hive with a top feeder jar as described in the section on starting packages (lesson 3). Bees are typically at the top of the hive and they will not go down for food at the entrance if the weather is cold.

Weak colonies, with 6 frames or less covered with bees at the end of April, should be united with strong colonies having 10 combs of bees or more. To unite colonies, place the one with the

queen you wish to save on top of another colony with a sheet of newspaper between the two colonies. The bees will chew their way through the paper and unite without fighting. The two united colonies will out-produce the total crop of two hives on individual hive stands. One good colony is better than several weak ones. There is no need to find either queen before uniting because they may live together for some time but one will soon disappear. Usually the queen in the top colony survives. A queenless colony can be handled the same way. In this case, put the colony with the queen on top of the queenless one and place a sheet of newspaper between the two.

Another way to strengthen a weak colony is to exchange its place with that of a strong colony in the apiary. This is best done during a nectar flow. As a result of this manipulation, the field bees from the strong colony enter the weak colony and give it strength to develop. Exchanging locations may also help the strong colony since it retards swarming. Adding brood to a weak colony may not be a successful method if there are not enough bees to take care of the additional brood.



S = Strong W = Weak
Exchange of Strong and Weak Colonies

A good colony at fruit bloom should have the following:

1. Productive queen: one which lays eggs resulting in concentric bands of brood of the same age.
2. Eight pounds of bees: enough to cover about 8 frames.
3. Four to six frames of brood: these are the bees that produce honey in June.
4. More than 15 pounds of honey: this is about three full deep or five western frames full of honey.
5. A continuous supply of pollen or pollen supplement: About one frame of honey and one frame of pollen are required to produce one frame of brood.
6. Adequate space for the storage of honey and rearing brood: A good colony of bees will often gain over five pounds of weight per day during a good dandelion bloom. This requires about two shallow frames per day for honey storage. Also, a good queen may lay up to 3,000 eggs per day, so she can fill a full depth frame with eggs in about three days.

It is possible to disturb a colony too often, but examinations in the early spring are very important to let the beekeeper know what they are looking for and then take steps to correct irregularities. Spring syrup feeding is sometimes necessary to save colonies from starvation. It also stimulates brood rearing. Once you start feeding, continue until a source of nectar is available. Never feed honey, except your own, since disease spores are carried in honey.

Bees must have pollen and natural pollen is best. If it is not available (either stored from the previous year or from flowers in bloom), supplements are needed. A mixture of soybean flour (expeller processed, low fat), brewers yeast, and powdered milk seems to be beneficial. The usual mixture is three parts soybean flour, one part dried brewers yeast, and one part powdered

skim milk. Add 10% or more dried natural pollen. The supplement may be made into patties by mixing with a heavy syrup (two parts sugar, one part water) and placing it between two pieces of waxed paper. Traditionally pollen supplements were made from locally obtained ingredients, however, today most leading beekeeping supply houses have premixed supplement available. This supplement is available in pre-made patties or by bulk and is very easy and cost effective for the hobbyist beekeeper. Place the patties on top of the frames over the brood nest or between the first and second hive bodies.

Managing Hives To Minimize Miticide Chemical Contamination

If the beekeeper chooses to use chemicals or other materials to control Honey Bee Tracheal and Varroa mites those treatments are necessary at the present time. The use of beekeeper applied mite controls will be necessary until some level of tolerance to mites can be genetically bred into honey bees. **It is extremely important to use all miticides and chemical treatments by reading, understanding, and following all label directions**. Beekeepers should not use unregistered chemicals or home made remedies to control mites. To date none of these remedies have been shown to adequately control mites.

With the use of most chemical treatments some amount of the chemical is transferred to the beeswax comb by the bees and by direct contact leaving what is called a residue. Other chemicals leave residues because the formulation is absorbed into the wax. Nectar placed in the wax cells by bees absorbs some of the chemical residues from the wax. The result is that honey destined for human consumption may become contaminated with chemicals.

It has become necessary therefore to develop a hive management system that will minimize contamination of combs used for the production of honey. The following guidelines are strongly recommended:

a. Only treat colonies for mites or other diseases when supers are not on the hive.
b. When it becomes necessary to alleviate crowded conditions in a brood nest in the spring, add a third deep brood nest (or fourth western super). **Do not move brood or honey combs from the brood nest up into the honey supers**.
c. When reducing the size of the brood nest in mid summer (July 1st), remove one of the brood nest supers with combs and place it in the warehouse for use the following year. Remove the poor combs in the brood nest at this time and identify them for later disposal.
d. Honey, pollen, and brood combs removed from the brood nest should be saved for making spring splits and nucs, or transferred to the brood nest of other colonies needing pollen, honey or good combs.
e. Old brood nest combs (typically 3-5 years old) should be burned or wrapped in a garbage bag & thrown in the trash, rather than melted, to prevent the blending of chemical contaminated wax with pure honey comb and capping wax.
f. Identify all brood nest supers by painting the hand holes or hand cleats a contrasting color to distinguish them from honey supers.

Note: As of March 2011 two new mite treatments have been approved for use in WA. MAQS a formic acid treatment and Hopguard a beta acid treatment made from hops. Both of these treatments have been approved for use in the hive year round, including during the honey flow.

Spring Management Manipulations

Use the first really warm (60° F plus) and windless day in March to give your hives their first thorough inspection of the year. The inspection should accomplish the following:

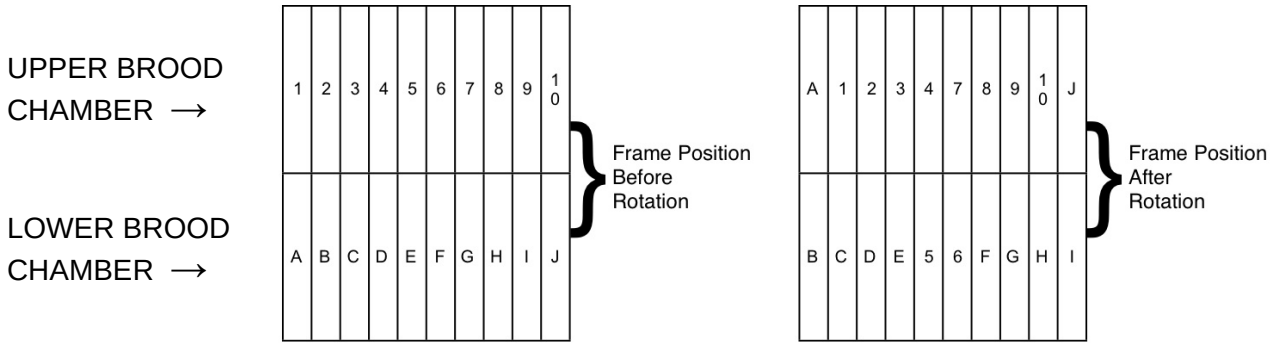
1. Discovery of possible disease problems and insertion of preventive medication
2. Inventory of honey stores and addition of feed
3. Assessment of the queen's productivity
4. Reorienting brood combs and thorough cleaning of hive components

Because the colony has been living in the upper box for most of the winter, it is a good practice to move two or three combs of open brood to the lower brood box or alternately reverse the two boxes. This relocates the queen and most of the open brood into the lower box, and places open combs into the second box between the capped brood and the honey stores. The queen tends to move upward during the year and needs some encouragement to stay in the lower two boxes. While making this comb rotation, scrape the bottom board to remove the winter's accumulation of trash and dead bees.

Each frame should be inspected for evidence of disease and amount of honey stores. Hold the frame directly over the hive so that if the queen happens to fall off the frame you are inspecting she won't be lost. It's not necessary to find the queen to assess her quality; the quantity and pattern of her egg laying and bee behavior are sufficient evidence. Also, scrape off excess propolis and burr comb from the frames and hive bodies to make future frame manipulation easier.

Frame Rotation

Frame rotation helps reduce swarming by providing empty combs to the center of a brood nest and enlarging the brood rearing area in a hive. It also benefits the hive by moving the combs where bees will clean them of possible disease while under medication. A word of caution: don't rotate the frames in such a manner that empty comb is placed between combs of brood. See the sketch for the correct rotation pattern that should be repeated at each inspection during spring and summer manipulations.



Making Divisions/Splits

Dividing colonies is another valuable spring management manipulation. New colonies are

sometimes made by beekeepers to increase hive numbers or to fill empty equipment from dead colonies. This is usually done at the time of fruit or dandelion bloom. There are many ways to make the divisions. One of the easiest is to remove two or three frames of capped brood with emerging bees, adhering bees, pollen and honey, and place them in a new hive. Fill both hives with frames of comb and move the division to a new apiary. Reduce the entrance and feed as you would package bees. A new queen is introduced to the new colony. If this division is properly done, and with some cooperation from the weather, both colonies should develop and produce a honey crop.

Requeening may be necessary in the spring. A productive colony must be headed by a young vigorous queen. To requeen, first find and kill the old queen by crushing her on the screen of the cage containing the new queen. If the cage contains candy in one end, remove the cork from that end of the cage. Then place the cage with the new queen, candy end up, with the screen facing to the front of the hive, between two frames of brood. The bees will release the new queen in about three days. If the cage does not contain candy replace the cork with a mini-marshmallow and proceed as above. There seems to be some improvement in queen acceptance if the attendant bees that come with the queen are released before placing the queen cage in the hive. Queens in the early spring must be purchased in the South or from a local supplier; later in the season it is possible to buy northern-bred queens. In seven days remove the queen cage and look to see if there are eggs present in the surrounding brood comb. If so, your efforts were successful, if not further action may be necessary.

Lesson 5: SWARMING

Swarming is an instinctive part of the life of the honey bee colony. The tendency is usually greatest in the spring when bees increase their population rapidly before the major nectar flow. Swarming is undesirable from the beekeeper's standpoint and every effort should be made to understand the conditions in the colony which lead to swarming and the steps to follow to prevent it. Swarming was used to increase the number of colonies by many old-time beekeepers, but it is easier to increase them by dividing colonies without the problems of chasing and hiving or possibly losing swarms. The only good swarms are those hived from another beekeeper.

Little is known about why a colony swarms but some of the conditions that lead to swarming include: poor queens, crowded brood nests, and lack of storage space. Most of these conditions occur prior to the main nectar flow which, in Washington, begins in early to mid-June. Colonies should be checked briefly every two weeks for queen cells during the swarming season. This examination is performed by sliding the second story forward, tipping it up, and looking for queen cells. Swarm cells are normally found along the bottom bars of the frames of the second brood super, and are often the first sign of the colony's intention to swarm.

When swarm cells are reaching maturity and when few field bees are leaving a strong colony on a clear, warm day, even though other colonies are busy, a swarm may be expected to issue. A swarm usually leaves during the middle of the day from 11 a.m. to 2 p.m.

The swarm that leaves the hive with the old queen, is called the "prime swarm" and it may contain more than half of the adult bees from the colony. They fill their stomachs with honey before leaving so they are prepared to start their new home. Usually the swarm settles on a nearby tree limb, post, etc., after its flight from the hive. Scout bees are sent to find a permanent home. Scout bees use a dance similar to the foraging dance to report their finding of a suitable new location. Once this location is decided on, the swarm flies directly to its new home. The new queen in the parent colony will probably not emerge from her queen cell until four or five days after the swarm leaves.

In some colonies, about a week after the prime swarm leaves, more bees swarm out apparently when the virgin queens take their mating flight. There may be several virgin queens in these "after-swarms" and the colony may continue to swarm as more queens emerge until the population is almost depleted. After-swarms are even less desirable than the prime swarm.

Queen Supersedure

Since supersedure is most apt to take place during the period just before the nectar flow, swarming and supersedure may occur together. The location of a queen cell on the comb is an indication as to whether it is a swarm cell or a supersedure cell. Supersedure cells usually appear on the face of the comb while swarm cells appear on the edges of the comb or usually on the bottom bar. In a two-story colony swarm cells are usually found between the two stories. The colony always seems to have a few queen cell cups on hand, and when conditions are right for swarming, the bees draw out the cups and the queen lays an egg in them. Swarm cells should be destroyed if the old queen is still present. Supersedure cells are built around existing eggs or larvae to replace a failing queen. You may either remove the old queen and allow the cells to develop, or remove the queen and the cells, then requeen the colony.

Hiving Swarms

Most swarms are easy to hive. The bees are usually docile and ready to go into a new, clean hive. The easiest way to hive a swarm is to place the bees in front of the entrance to a hive that contains clean, disease-free combs or new foundation. A frame of brood in the center of the hive may make it more attractive. If the swarm is on a nearby post or the bees do not enter the hive fast enough, smoke may be used to drive them in. There is no need to remove the branch on which they are clustered except to get the swarm near the hive. Be sure to get the majority of the bees that usually contain the queen.

Swarms in high places are more difficult to handle but a light-weight box fastened to a long pole and containing comb may be pushed up to a swarm. The limb may be jarred resulting in the bees falling into the swarm box. The box and pole may be left close to the swarm location until all the bees enter it or it may be lowered to the ground and the bees shaken into a hive containing frames with comb. A cloth sack, which has its open end sewed to a wire hoop and fastened to the end of the pole, may be used in the same manner. Work the sack over the swarm and jar the limb. Most bees will be trapped in the sack. They may then be lowered and carried to the place where they are to be hived. A plastic garbage bag taped to a wire loop can also be used. If using plastic, immediately transfer the bees to a hive body. If you leave the bees in the plastic bag for more than a few minutes they will over heat, suffocate and die.
Some beekeepers use decoy or bait hives to attract swarms. A decoy hive contains combs previously used by bees and is placed in the crotch of a tree or any other place where a swarm is likely to settle, usually in the vicinity of an apiary or bee tree. If scouts locate the decoy hive, the swarm may enter it.

A swarm divides the strength of the parent colony and may result in two weak colonies resulting in the loss of some honey production. Thus, it may be important to return the swarm to its original colony after one or two weeks. There are several ways that this can be accomplished.

The first is:

a. Return the swarm in its new hive to the parent colony's stand.
b. Add one deep or two western supers.
c. Eliminate the conditions that caused the swarming in the parent hive.
d. Place the parent hive on top of the swarm over a queen excluder or an inner cover

e. Remove the inner cover after one week.

The colony thus regains its full strength. Further swarming may be unlikely if contributing factors have been eliminated, or if the colony is requeened.

A second method may be used if more hives are desired at the expense of some loss of honey:

a. Place the swarm hive on the stand of the parent hive and place supers on it as previously described.
b. Set the parent colony alongside the swarm hive. The field bees return to the swarm colony, and the parent hive.
c. One or two middle aged queen cells should be left in the parent colony. Middle aged cells are capped but light in color.
d. When the queen has emerged, mated, and started laying eggs, the parent hive may be moved away from the swarm hive or to a different apiary.

A third alternative often used with one story hives that swarm is to:

a. Correct conditions which led to the swarming such as crowding, poor queen, etc., and remove all queen cells or another swarm will soon leave.
b. Return the swarm to the original colony.
c. Shake it in front of the entrance, and allow the bees to re-enter the parent hive.

This method is the least successful in preventing swarming and is the most disruptive to normal bee behavior. The prime swarm hived using the first or second method develops into a strong, productive colony.

Small swarms (football size or less) and/or swarms collected after late July should be united with other swarms or with weak colonies using the newspaper method described in lesson 4.

Feed swarms with 1:1 sugar/water syrup if they are placed on foundation. Feed until all foundation has been drawn out as comb, or until the bees no longer take the syrup. Medication for American Foulbrood may be added to the syrup. If needed, after testing, treat with miticides for control of Honey Bee Tracheal and Varroa mites.

Swarm Prevention

Populous colonies with the best queens often develop a problem with a congested brood nest if the beekeeper does not conduct adequate comb manipulation and hive management to provide enough space for the colony. This causes the bees to build queen cells in preparation for swarming. The colony may even become crowded even though it has empty supers. It is recommended that you correct this condition by moving frames of honey and maybe capped brood out of the brood nest and replace them with empty combs or foundation. The brood is placed into the center of a third brood super and the honey is placed on both sides of the brood combs. Combs that are removed are replaced with drawn comb or foundation placed to the sides of the brood rearing area so as not to split the brood nest. **NOTE: Care must be taken not to move miticide contaminated brood nest combs into honey supers.**

The use of a queen excluder on top of the second brood box may lead to a crowded brood nest and result in swarming if the beekeeper does not manipulate combs as needed to create space for the queen to lay eggs.

Colonies with old queens swarm more readily than colonies with young queens. When the old

queen slows down in her egg laying, the bees take matters into their own hands and raise queen cells to supersede, or replace her.

One of the most effective methods of swarm control is called the Demaree system, so named for the man who developed it. In this system, the brood of the colony is transferred from the brood nest to a hive body at the top of the colony above a queen excluder. One comb of unsealed brood and eggs is left in the lower hive body with the queen and the remaining space is filled with empty combs. Supers are added under the top story. If queen cells develop in the top story, they should be destroyed about 10 days after Demareeing so a young queen cannot emerge.

Switching locations of weak and strong colonies in the spring also helps prevent swarming in over-populated colonies (see Lesson 4) if supers are added as appropriate.
Divisions made by taking frames of brood and bees and a queen cell and setting up a new colony may help prevent swarming. Additional frames of brood and bees may be taken from other strong colonies to make divisions into strong colonies.

Lesson 6: SUMMER MANAGEMENT & HONEY PRODUCTION

Day to day guidelines for honey production do not exist but knowledge of the principles of beekeeping serve as a guide to good hive management. Ultimately, the goals of bee management are: a) winter survivability, b) minimal swarming behavior, and c). honey production

Honey is marketed in four ways: 1) comb honey; 2) extracted honey; 3) finely crystallized (creamed honey), and 4) chunk or cut comb. Beekeepers decide which they will produce and then equip their apiaries with the necessary equipment for this type of production. Production of comb honey requires close attention to details and more frequent manipulation of bees than the production of extracted honey. Generally, beekeepers produce extracted honey in western Washington since nectar flows are generally light or interrupted by poor weather. Bees do not work efficiently in section supers during light nectar flows.

Extracted Honey Production

Full-depth, western, and shallow supers are used in the production of extracted honey. A full-depth super is simply a hive body filled with frames used for the production of honey rather than as a Brood chamber. The western and shallow supers make it is easy to keep the various flavors of honey separate in areas where different colors or flavors of honey are obtained. They are also easier to handle since they weigh less than deep supers. Both the deep and western supers can be used for the brood nest and honey supers. Using the same size for both allows for the movement of combs throughout the hive. Three western supers may be used for the brood nest which will make hive manipulation easier for persons who don't wish to lift the heavy deep supers. **NOTE: Care must be taken not to move chemical contaminated brood nest combs into honey supers. Many beekeepers place a mark on the top of each frame that is used in the brood nest.**

Many beekeepers use only nine frames in each extracting super. The bees draw the cells deeper making the comb easier to uncap for extraction. If foundation is used, 10 frames are placed in the super until they are drawn into comb, then one is removed. The bees will add wax to the cells as they store honey in them.

When sixteen combs in both deep hive bodies are covered with bees a new super should be added. The first empty super above the brood nest, used for surplus honey production, is placed

on shortly before the beginning of the spring nectar flow, usually when cherries are in bloom. Frames in these supers may be filled with drawn comb, with three or four drawn combs in the center with foundation on the sides, or with all frames containing foundation. If even a few empty drawn combs (wet with honey from last year) are used in the center of the super, bees enter the supers quickly. If foundation only is used, they hesitate because the weather and the amount of the nectar flow are not conducive to drawing foundation.

Additional deep supers (or their equivalent in westerns) are added every two to three weeks. Usually this is done by what is called top-supering, or placing the new empty baited super on top of the previous super which will have honey in the center combs. (Tabor recommends bottom supering of colonies, or placing the new super close to the brood nest.) This results in a two story deep over-wintered hive being five stories high by June. Continue baiting supers of foundation with honey from the previous super. When adding western supers, each new super may be placed just above the first super. This takes advantage of the bees' preference to store honey closest to the brood nest. A three western brood nest hive can be 7 or eight supers high by June.

It is not necessary that you use a queen excluder on your hives. But it is important in the spring to prevent crowding and swarming by ensuring that the queen and bees have access to all the space they can use. The queen excluder, if used, should be added above the brood nest when the first super is added. The supers should be baited with wet extracted honey combs or combs of honey from the previous year to draw the bees up out of the brood nest which will minimize crowding and swarming. When bees are baited above the excluder as described, they usually continue to work even through a queen excluder. Some beekeepers create an entrance above the excluder to make it possible for the bees to enter the supers without going through the brood nest and excluder. Others move the excluder back from the front of the hive one inch or so to create the entrance.

Some beekeepers extract honey after several supers are filled and then return them to the hives. Instead of doing this, the beekeeper should own enough supers to manage the hive as described above. The supers are removed in mid August and the honey extracted from the combs as soon as possible. Extracting should not be postponed until cool weather. Some honeys will crystallize quickly making it impossible to extract the honey. Cold honey is more difficult to extract unless it is warmed to a temperature of 80 to 95° F in a heated room. If hives are located in an area that has light and dark nectar flows, light honey should be extracted as soon as the honey is ripe after the flow is over. Light honey is kept separate because it is normally a honey with a more delicate flavor and may be sold at a higher price.

Comb Honey Production

Comb honey production hives require special equipment and more intensive management to prevent swarming because the bees must be quite crowded to encourage them to draw the comb and store nectar in comb honey supers. Beginners should not attempt to produce comb honey. This activity requires some book reading and the observation of successful management techniques used by beekeepers that have produced comb honey for several years. An excellent book to get started is *The Comb Honey Book* By Richard Taylor.

Removing Honey

Removing combs of honey from the hives and freeing them of bees may be difficult. The bee escape is the best way for the small beekeeper to remove bees from full supers. Lift off the supers filled with honey and place them aside. Place the inner cover over the brood chamber with a bee escape inserted in the center hole. (Some equipment suppliers sell a board containing drone escape funnels that also works well to remove bees from supers, and does it

more quickly.) Then replace the filled supers above the inner cover. Tape or plug all openings above the escape. Bees pass through the escape into the brood chamber below and are unable to return. If all goes well, the honey-filled supers are cleared of bees by morning.

It is also wise to cut a piece of cardboard, the same size as the inner cover and place it on top of the super and under the lid. If the lid is uneven, the cardboard may prevent robber bees from getting to the honey. Remove the supers of honey the day after the bee escape was put into place. If the honey is left above a bee escape too long (more than three or four days) it may take up moisture and lower the quality of the honey. If there are bees still on the combs, they may be brushed off with a bee brush or disposed of at the honey house.

Repellents drive bees out of supers in 2 or 3 minutes if the ambient temperature is in the 70s F. Fume boards the same size as inner covers are fitted with cloth under a metal covering painted black to absorb the sun's rays. A squirt or two of BeeGo, or Honey Robber (N-Butyric anhydride) is sprinkled on the cloth and the board placed metal side up on the honey-filled supers. Bright sun soon warms the chemical and the evaporating fumes drive bees out of the supers in a minute or two. The chemical should not drip off the cloth onto the frames or combs or the honey will become contaminated.

Bees can also be removed from supers by shaking individual combs. Frames are lifted one at a time and shaken by a quick up and downward motion with the ends of the top bar between the fingers and the base of the thumb. Brush off the remaining bees with a bee brush. Each comb is placed in an empty super when free of bees. If there is no nectar flow, the super should be covered after each frame is placed into it to minimize robbing. Wood smoke from a hive smoker is often used to drive bees from supers. Care must be used not to use smoke from materials that may contain or release chemicals or odors that may flavor the honey.

The bee blower is a machine for removing bees from a super. This can be made with a leaf blower that has 1/8” screen covering the inlet. This is used to create a blast of air that will dislodge the bees from the combs of honey while the frames are still in the super. Supers are placed on a frame with a chute to direct the bees in front of the hive from which honey is removed. A large volume of air moving at high speed is required; a vacuum cleaner is not adequate. Only a few seconds are required to clear a super of bees.

Store the honey in a warm, dry room or honey house until it is extracted and or packaged.

Honey Extraction

Cappings on the comb indicates that the honey in the cell is "ripe." Ripened honey has had the moisture reduced to 16 to 18.5 percent making the sugars more concentrated. When the combs in a super are more than three-fourths sealed, it is safe to extract. Uncapped honey should not be extracted until the nectar flow has been over for at least ten days. Unripe honey has poor flavor and ferments. . If there is some doubt about the ripeness, there is a quick way to check. Hold the frame by the end bars, near the top of the frame, with one comb surface horizontal over the hive. With a quick flick of your wrists, try to vigorously shake the uncapped honey out of the comb. If there are no drops on the top bars in the hive, the honey is ripe.

The size and style of extractors affect the time and convenience of extracting. For a small apiary, a four-frame tangential extractor serves the purpose. For larger apiaries four-frame reversible basket extractors save time, while 60 or more colonies may require a radial extractor holding 12 to 72 frames. The smaller type extractor should be placed in the honey house in a convenient place and on a platform high enough to allow a four or five gallon bucket to be placed below the honey gate or outlet of the extractor. Honey runs from the extractor into the bucket and is then poured through a strainer above a settling and bottling tank.

Before extracting, cappings must be removed from the cells. Use a bevel-edged knife, uncapping fork, or a hot knife. There must be a receptacle provided to hold and strain the cappings as they are removed. A square or rectangular galvanized or plastic tub with a one-inch drain hole cut in one end fitted with a honey gate serves as a receptacle for the cappings. A square or rectangular wooden frame, bisected with a center board, the same size as the inner dimensions of the tub is covered with one quarter inch hardware screen and supported several inches above the bottom of the tub. Cappings removed from the comb fall on the screen to drain. A two-inch wide strip of white pine, cut longer than the width of the tub and having a sharpened bolt pointing upward in the center of the board, is fastened across the middle of the top of the tub. Combs are placed on the point and can be rotated to uncap both sides of the comb.

Tilt frames toward the knife and cut the cappings with a back and forth motion of the knife. Cappings from the whole side of a comb may be removed at one stroke if the knife is hot and the surface is fairly even. Cut off as much of the capped surface as possible with the first stroke and take off any small patches that are left later, rather than trying to work into the corners while taking off the main surface of cappings. The comb is cut even with the top and bottom bars of the frame. To uncap perfectly takes practice. Use the back and forth motion when cutting; be careful that the hot knife doesn't slip and burn the hand holding the frame; the knife must be sharp. The knife should be warm, but not hot enough to burn the honey. Both steam and electrically heated knives are available.

The uncapping tub should be large enough to hold all the cappings that are put into it in one day. A large wash tub holds the cappings from 500 pounds of honey. The honey drains from the tub into a bucket and is then emptied into a strainer above a settling or bottling tank. The wax in the cappings may be placed in a solar wax extractor (see drawing, Lesson 2) where the heat of the sun is used to melt the wax. There may be considerable honey mixed with the cappings even after they have drained for a day or two. Previous warming of the honey supers reduces the amount of honey remaining in the cappings. A one quarter inch screen basket can be made to hold the cappings. The basket is then placed in the extractor, balanced with weight on the opposite side, to extract the remaining honey from the cappings.

Uncapped combs are placed against the tangential sides, or in the baskets, of the extractor. Combs of nearly equal weight should be placed opposite each other so they balance in the extractor. If combs don't balance, the extractor vibrates. The machine should be started slowly and run at about 200 revolutions per minute until most of the honey is thrown out from the first side of the combs. Combs are then reversed and the extractor turned at about 400 revolutions a minute. After all the honey is thrown from the second side, combs are again reversed and the remaining honey is thrown from the first side. If combs are turned too fast before they are reversed the first time, the weight of the honey from the opposite side will break the comb. When combs are partly filled and lightweight, there is not much danger of breakage. Empty combs are removed from the baskets and replaced in the supers. Supers with the wet combs are stored over the winter to be used as baited supers the next year.

A strainer and tank with a honey gate at the bottom are needed to clear honey of small particles of wax and other debris. Stretch 100 mesh nylon over the top of the tank and secure firmly, or fit the cloth into a straining basket, or purchase a nylon paint strainer sack. Extract honey at 80°F and it readily goes through the nylon mesh. Leave the honey in the settling tank for a day or so to allow bubbles and small pieces of foreign material to rise, then skim the foam off and bottle the honey.

Extracted honey is not injured by cold weather or freezing but a temperature between 50 and 60°F. speeds up crystallization and the honey becomes hard and sugary. There is some

demand for crystallized (creamed) honey but most people prefer it in the liquid form. A finely crystallized honey may be re-liquefied by gradual heating. Place bottles of honey in 160°F. hot water or a hot, dry chamber at 145°F. for a few hours to prevent crystallization. Don't heat the honey above 150°F. or it will lose its delicate flavor. Remove honey from the heat source as soon as it is clear, as excessive heat will darken it and spoil the flavor. **NOTE**: Protect the hot honey containers from cold surfaces or drafts that may cause glass containers to break. Some honeys, such as wild aster and dandelion, crystallizes more readily than others.

Chunk Honey Production

Chunk honey is produced and sold extensively in the southern states and to a lesser extent in the north. Shallow supers with thin foundation in the frames are used in its production. The foundation is held in the top bar of the frames with a wooden wedge or with melted beeswax. The bees are managed the same as when producing extracted honey except that supers are placed above a queen excluder. A wet or baited extracting super is placed above the excluder to encourage the bees to work through the excluder. One or two western or shallow supers with frames containing thin foundation are placed on top of the extracting super. Additional extracting or chunk honey supers are added as needed to prevent crowding the colony. Place the empty super on top of the stack until the bottom one is three-fourths full then reverse them. Continue to add additional supers in this way. Bees are removed from supers placed above a bee escape board and swarming is controlled in the same manner as for colonies run for extracted honey. The comb is cut from the frame into chunks and placed directly into glass or plastic honey jars and the empty spaces around the comb filled with liquid honey that was previously heated to 160°F. and cooled before it is poured over the comb. These containers are then labeled and sold as chunk honey. Heating the liquid honey poured around the chunk honey retards crystallization for several additional weeks. Types of honey such as alfalfa or dandelion that crystallize quickly are not well adapted to chunk honey production since they crystallize on the grocer's shelves unless the product is purchased quickly by consumers.

Cut Comb Honey

Cut comb honey is produced the same way as chunk honey but the honey comb is cut to size, drained over a screen in a warm room for several hours, and then placed in plastic boxes or wrapped in plastic or cellophane for the consumer market.

Wax Production

Beeswax is a valuable by-product of the beekeeping industry. The beekeeper should save all discarded comb from the supers which can be melted and traded for new foundation from the supplier. Good beekeepers check their extracting supers each winter and replace old or defective combs with foundation. Large areas of drone cells, stretched worker cells or moldy combs are some common defects. A solar wax melter is convenient for melting cappings and combs producing wax of top quality. **NOTE: We recommend that you do not render old brood combs that may contain residues of chemicals used as miticides. Those combs should be tossed in the garbage.**

Honey Vinegar

Vinegar can be made from high moisture honey, or honey washed from the cappings. Water sweetened with honey at the rate of one and one-half pounds of honey in a gallon of water also makes a good vinegar. Bring the honey water mixture to a boil, let cool, then add both yeast and mother of vinegar to the solution following one of the available recipes. Left-over cider may be added to the honey solution to improve the vinegar's quality and taste.

Lesson 7: FALL MANAGEMENT

Hives of bees must be prepared for winter in the fall according to the severity of weather expected. Proper fall care is the first step in getting ready for the honey crop the following year.

Here are the necessary steps involved in fall management, followed by an explanation of each activity:

1. Remove empty or partially filled honey supers.
2. Remove queen excluders.
3. Unite weak colonies in the late summer or early fall.
4. Colonies with old queens may be requeened.
5. Do not try to winter weak or diseased colonies.
6. Provide each colony with adequate food.
7. Food quality should be favorable for successful wintering.
8. Provide each colony with top and bottom entrances.
9. Raise the back of each hive about 1 inch.
10. Locate the apiary to provide good wind protection during winter.
11. Wrap with black roofing paper only if they must be wintered in a very cold or windy location (typically eastern Washington), but provide good top ventilation. If hives are painted or stained a dark green or brown they absorb more ultraviolet heat from the sun and the colonies winter more easily.
12. Protect the hives from mice with a mouse guard.

This fall management program should make it possible for any beekeeper to winter bees successfully.

Remove Empty or Partially Filled Honey Supers

Colonies can be wintered in two deep hive bodies, or three or four westerns. Check the brood nest to see that it-has adequate winter stores (10 deep combs of honey, or 15 western combs). If necessary, place full combs of honey from stored brood supers, or from supers" on the hive, into the brood nest, and put the brood nest combs that are removed into storage. Mark them as brood combs or place them in marked brood supers. Remove remaining full or partial honey supers to the honey house for extracting.

After extracting, supers should be stored in a dry place in the garage, basement, or an outbuilding. Brood supers may be stored in separate stacks from honey supers or at least identified so that brood combs are not interchanged with honey combs. The top and bottom of each stack of supers is covered tightly to exclude mice. Supers should be fumigated with paradichlorobenzene to kill wax moths (typically sold in hardware stores as Moth Crystals). Do not use moth balls made of Naptha as this is poisonous to bees.. After the temperature in the storage area goes below 25° F, wax moths cannot develop, unless many supers are stored together in a pile.

Remove Queen Excluders

Remove all queen excluders. If excluders are left on the hives over winter, some of the queens get caught below the excluders and die when the cluster moves up through them to the top super of honey, or the bees may refuse to move away from the queen and starve with honey above them.

Unite Weak Colonies

If any colonies are weak in the fall, it is generally best to unite two weak and healthy colonies, and try to save one rather than lose both weak ones. To unite two colonies, remove the lid and inner cover from one, place a single sheet of newspaper over the frames, punch a few holes in the paper with a hive tool and place the hive body with bees of the second colony on top of the first. The bees will chew through the paper and unite quietly. If one of the queens is preferred, place the colony containing her on top since she is more likely to survive. **CAUTION**: If colonies are weak because they are diseased or have mites, do not combine them with healthy colonies.

Requeen Colonies That Have Old Queens

A young queen in a colony has a strong influence on success or failure the following year. A young queen introduced during the late summer nectar flow normally builds up a strong colony of young bees for winter. She should still be at her best for the following spring to produce a colony of maximum strength for the nectar flow. Colonies generally accept a higher percentage of queens during the nectar flow. Queens sometimes do a good job of egg laying the second year; however, annual requeening is preferred.

Do Not Keep Diseased Nor Spray Poisoned Colonies

Any colonies weak from disease should be killed in the fall and the combs disposed of as their condition indicates. Combs infected with American Foulbrood should either be burned or placed into a plastic garbage bag, tied at the top, and disposed in the household garbage.

Provide Each Colony With Sufficient Food

Under western Washington conditions, each colony needs about 80 pounds of honey to generate enough heat to keep the colony warm during winter and to supply food for young bees to build up a large colony in the spring. This amounts to eight full deep combs of honey in the second brood nest box of the hive and two to four frames in the lower brood chamber. Hives with western supers as a brood nest need 10 full honey combs in the third box, six in the second, and two in the bottom super. Honey is not only feed for the bees but also acts as a temperature equalizer to modify sudden changes of temperature in the hive.

In estimating the amount of honey in a hive, the beekeeper must remember that each colony normally stores from three to five frames of pollen some of which may be covered with honey and then sealed with wax and may resemble combs of honey. A colony ready for winter should have a total weight of about 120 pounds (includes weight of woodenware)

High Quality Food

Quality of winter food is very important. Honeydew, fruit juices, or off-grade honey may cause dysentery in bees during a long cold spell and result in the death of part, or all, of the colony. Most nectar gathered from flowers makes good quality food for winter. Thin or unripe honey in the fall may cause dysentery because bees are not able to ripen the nectar due to cold weather. If stores are short, one may feed sugar syrup. To make sugar syrup for fall feeding, use two parts sugar to one part hot water. Stir the mixture thoroughly to dissolve the sugar. After it cools to room temperature, it can be fed to the bees in a frame or top feeder. Fall feeding of syrup should be completed once average daytime temps are below 60 degrees.
For feeding later in the year use either plain sugar or fondant

Top and Bottom Entrances

Provide each colony with a 3/8x1 inch top entrance under the hive cover in addition to the entrance at the bottom. The top entrance provides some ventilation and also a means of escape from the hive should the bottom entrance become clogged with debris and dead bees.

Tilt Each Hive Toward The Front

Raise the back of each hive about 3/4 to 1 inch to tilt the bottom board toward the entrance. This keeps rain from running in and pooling in the back. It helps the bees keep the bottom board clean and dry.

Sheltered Winter Location

Wind protection to prevent cold winds in the apiary is an important factor for successful wintering. Natural protection from woods, a hill, or evergreen hedge is desirable. However, a building, board fence, or similar protection breaks the cooling effects of prevailing winds. A sunny location on a side hill with a southern or nearly southern exposure is most favorable for the successful wintering of bees. Bottom land, especially near a stream where damp cold air settles at night, is very unfavorable and leads to heavy winter losses.

Bees located in a warm southern exposure may be able to fly for a short time on a winter day whereas colonies in a cold location remain confined to the hive. Since bees do not evacuate accumulated body wastes (defecate) until they fly from the hive, these extra flight days may mean the difference between successful wintering or the loss of part or all the colony from dysentery.

Dysentery is caused by the accumulation of waste beyond the ability of the rectal sac to expand and hold this material. Bees normally can hold accumulated waste for eight to ten weeks without a flight. However, when they start to rear brood in the spring more frequent flights are required.

Wrap With Roofing Paper

It is not necessary to pack bee hives with insulation in western Washington. However, in colder locations, especially in eastern Washington, some added protection to the hive helps them winter successfully. Some beekeepers in eastern Washington wrap bees with black roofing paper called 15 lb. felt. A piece of burlap or corrugated cardboard may be placed over the top brood chamber (under the lid but away from the top entrance) to absorb moisture before the colony is packed. The roofing paper is wrapped snugly around the hive and held in place with a strong cord or stapled to the hive. The top edges of the paper are folded over the top and then covered with a second sheet of paper to make the hive top watertight. This sheet of paper is also held in place with cord. A top entrance is provided through the paper by cutting the paper to match the upper entrance just under the hive cover. The paper is then stapled around the hole.

Mouse Protection

Keep mice out of the hives during winter by placing a mouse guard of 5/16 or 3/8-inch screen over the bottom entrance. If mice get inside during winter when the bees are clustered, they will eat the combs of pollen and chew large holes in the combs to make a nest. Damaged combs must be replaced since bees build drone comb in the holes. Bees chase mice from the hives when the weather becomes warm, but by that time, the damage is complete. **CAUTION**: Wear protective equipment and dust masks when handling floor sweepings or debris containing mice droppings; they may contain Hantavirus.

Winter Care

If properly cared for in fall, no winter management is necessary. Even snow around the hives is beneficial and should not be removed. It acts as insulation. Make periodic checks to make sure hive entrances are not plugged with dead bees.

Lesson 8: DISEASES & PESTS

Honey bees, like other forms of life, are attacked by diseases, parasites, and pests. This makes it impossible to keep bees without constant (frequent diligent) care and attention.

American Foulbrood in a hive makes it difficult to keep bees alive unless the disease is prevented or controlled. Since the disease spreads by bees robbing contaminated honey or by beekeepers moving disease from hive to hive, it is necessary for all beekeepers to prevent, recognize and properly control the disease with a medication program. The hives of negligent beekeepers are a source of infection to the bees of the careful beekeeper. These contaminated hives make possible and probable the appearance of disease if a recommended treatment program is not performed. Negligent beekeepers' hives are a source of re-infection to the bees of the careful beekeeper and make possible and probable the reappearance of the disease if recommended treatment programs are not performed.

Most states have laws prohibiting the keeping of diseased colonies, selling, or moving any infected bees or equipment. State and county inspectors are authorized to enter any place where bees are kept and examine hives, bees, and equipment. Inspectors are authorized to prescribe treatment for diseased colonies and order the abatement of those in which the disease is too far advanced to warrant treatment.

It is unwise to buy or use equipment unless it has been properly examined for diseases. The best "deal" could be no deal at all if the equipment contains a disease. Inspect all equipment for cleanliness and learn to visually detect diseased bees and combs. Ask the seller if he or she followed a medication program before buying. Have used equipment fumigated or inspected before buying. If a fumigator or inspector is not readily available, It is better to start with fresh foundation or known healthy comb, but if you cannot determine whether a comb is healthy and still wish to use it, a sample of brood comb can be sent to a bee disease lab for diagnosis. Cut out a four-inch square from the center of the brood area, without honey or pollen, wrap it in newspaper then a plastic bag, and pack the comb in a sturdy cardboard box and mail to:

Beneficial Insect Lab, Bldg. 476
Beltsville Agricultural Research Center
Bee Research Entomologist
Room 211
10300 BALTIMORE AVENUE
BLDG 476 BARC-EAST
BELTSVILLE, MD, 20705
Phone: (301) 504-8821
Fax: (301) 504-8736

Be sure to put your return address inside the package as well as on the outside.

Also see WSU Diagnostic Center, Info can be found at www.wasba.org

BROOD DISEASES, CONDITIONS

American Foulbrood

American Foulbrood (AFB) is caused by a bacterium, *Paenibacilits larvae larvae*, and affects only the larvae and pupae in the cells, not mature bees. It kills young larvae and immature bees just after cells have been capped. Combs of brood infected with AFB have scattered open cells, and many cappings are dark, sunken, and perforated. The dead larvae and prepupae first turn light brown, then dark brown, eventually drying down to a scale on the bottom horizontal side of the cell. An occasional pupa dies with its tongue sticking up as a thin thread towards the top wall of the cell. Just before the dead brood dries into a scale, it is a sticky, glue-like mass that will rope, or string out 1.5 inches when a toothpick is stirred in it and withdrawn.

The bacterium causing AFB starts to grow in the live tissue of a larva. When all the living material is destroyed, at about the pre-pupal stage, the bacilli no longer grow and multiply, but instead form spores. The spores go into a resistant stage, in which they can live for fifty or more years, and become impervious to almost anything except prolonged, high heat as when put into an autoclave, and a few chemicals such as ethylene oxide gas.

Brood infected with AFB has a distinct foul and offensive odor. The bees try to remove the larval remains and, if not removed, it dries down into a scale that sticks tight to the bottom of the cell. The bees cannot remove the dry scale, so it remains in the comb. Honey in the brood nest may become contaminated with spores and will infect any larva to which it is fed. The bacteria enter their vegetative stage and the cycle begins anew. Dried scales are difficult to see, since they are very thin and the same color as old brood comb. In looking for them, the comb should be held so that light coming over the observer's shoulder strikes the bottom side of the cell. The scale appears as a residue on the bottom side of the cell only. (Consult *Honey Bee Diseases & Pests* from the Canadian Association of Professional Apiculturists for pictures.)

AFB spores may be spread between hives of bees in honey combs and diseased brood combs or supers, or by bees drifting to nearby hives. Robbing in one form or another also spreads the disease organism. Diseased colonies become weak and unable to defend their hive and they usually die. If bees are placed in equipment that contains AFB spores, they generally get sick within 1 or 2 years, but treatment with Terramycin (Oxytetracycline hydrochloride) or Tylan (tylosin) will delay or prevent loss of bees. An unprotected hive is open to robbing by all hives within about a 2 mile radius. Feeding bees honey extracted from diseased combs will also spread disease.

Preventative Treatment of American Foulbrood

Because American Foulbrood (AFB) is very contagious, virulent, and persistent, all combs containing disease residues in a hive should be burned, or placed in a plastic garbage bag and placed with household garbage or taken directly into a landfill. Scrape all inside surfaces of the hives, top and bottom boards, with a sharp hive tool to remove propolis and wax. Also remove propolis and burr comb from wooden parts of the remaining frames being careful not to damage the comb. Hives, bottom and top boards, which are over ten years old or beyond economic repair, may be burned with the wax, propolis scrapings and diseased combs. Colonies that have deteriorated to three or four combs of bees may be burned with the diseased combs. **They should not be combined with healthy colonies**.

Honey from an AFB hive is safe for human consumption and may be extracted since the

disease is specific to honey bees. Extreme care must be taken that no AFB contaminated honey is left where bees from other colonies can get to it. The extracted combs are returned to the diseased hive for cleaning by the bees while they are being treated for the disease.

To burn hives, diseased combs, and small colonies, dig a pit about 3 feet deep and big enough to contain all the burned material. Place everything to be burned in the pit, ignite, and stir the fire to ensure thorough burning. If honey is found in the pit after the equipment is burned be sure it is covered with soil so that it will not be subsequently disturbed. (**NOTE: Check with your local fire department about burning restrictions.**)

Prevention is the best treatment for AFB. Terramycin® is given in sugar syrup, a powdered sugar dust, or a sugar/shortening patty during the spring and fall nectar dearth and robbing periods. TM breaks down when in contact with moisture; in syrup it is viable for about 3 days; in dust it absorbs moisture and is good for about a week; in patties the shortening prevents moisture absorption and the TM is protected until the patty is used.

Medication Recipes

Syrup: Recommended for swarms and packaged bees if fed within the hive. Use 2.5 tablespoons of TM-25 in one gallon of syrup.
Dust: 1 part TM-25 to 5 parts powdered sugar. Place two tablespoons of the mix on the ends of the frames in the brood nest. Repeat the treatment 3 times, a week apart.
Patty: Place the patty on top of the frames of the bottom brood super, in the center, and with brood above and below the patty.

a. One part TM-25, 5 parts powdered sugar, and 5 parts Crisco or other vegetable shortening. Mix TM with powdered sugar first, then warm shortening to soften and add to TM/powdered sugar mix. Make patties by placing 1/4 pound of completed mix into a waxed paper sandwich bag or between two pieces of waxed paper.
b. One 6.4oz. package of TM-25 to two pounds powdered sugar and two pounds Crisco or other vegetable shortening.

Make sure all medication is stopped at least 2 weeks before adding honey supers.

European Foulbrood

European Foulbrood (EFB) is caused by the organism *Melissococcus pluton*. Few of the dead larvae survive long enough to have their cells capped; therefore, the "sunken-capping" characteristic does not occur as in AFB. Many diseased larvae are curled on the bottom of the cell and show the veins of the breathing systems as thin lines. The larvae remain curled at the bases or bottoms of the cells rather than lengthwise on the lower wall of the cells as in AFB. Dead larvae turn yellowish gray with brown, and a few larvae may be seen clinging to the sides of cells as well as on the bottoms. Dried scales of EFB can be removed easily from the cells by the bees. Instead of an offensive odor, EFB has a sour smell. Some of the dead larvae are rough and twisted in shape, especially when lengthwise in the cells.

An atypical form of European Foulbrood is caused by a secondary infection by *Paenibacilus alveii*. This form resembles American Foulbrood, smells like EFB, and the "rope" breaks at one-half inch or less. If unsure of your diagnosis, have the hive checked by a trained inspector or send a sample of comb to a bee laboratory.

Prevention and Treatment of European Foulbrood

Italian bees or bees which demonstrate hygienic behavior are considered resistant to European

Foulbrood and rarely allow this disease to proliferate. Hygienic strains of bees that properly clean comb are found to have fewer disease symptoms and fewer residues in their hives. Prevention consists in keeping all colonies strong and well fed. In some instances, slight cases of European Foulbrood disappear without treatment when a nectar flow begins, and bees begin to clean comb more vigorously. This is especially true of strong colonies of Italian bees. Infected colonies should be treated with Terramycin® in sugar syrup. Use the gorging method. Requeen to introduce a more vigorous line. A preventive treatment should be given all colonies in the apiary early the following spring.

Chalkbrood

Brood diseases caused by fungi have not been a major problem to beekeepers in Washington. But Chalkbrood, a fungal disease of honey bee larvae and pupae, has been known to occur for many years. This disease is caused by the fungus *Ascosphaera apis*, which was not known to occur in the US until 1967. Drone brood and recently sealed worker larvae are most susceptible to Chalkbrood. The infected brood dries down to a mummified condition and turns chalk white. After the larvae die, they may turn black. This coloration is caused by the fruiting stage of the fungus. Rarely is more than 5% to 10% of the brood affected. When greater amounts of brood are killed, it is often associated with low temperature and moisture stress conditions or when apiaries are placed where they are subject to high temperatures. House bees are able to remove the dead larvae from their cells.

There are no established chemical control agents for Chalkbrood. Symptoms usually disappear during the summer as worker bees remove the infected brood from the colony. The disease may be combated through these general practices: requeen with a young queen; replace heavily infected combs; get rid of larval mummies from the hive entrance which may be a source of fungus spore contamination; don't use commercial pollen which is contaminated with Chalk-brood mummies.

Sacbrood

Sacbrood is caused by a virus too small to be seen under a microscope. This disease is less destructive and much less contagious than foulbrood. It becomes most troublesome when the colony is short of young nurse bees or when the weather is damp and cold for a length of time. The diseased larvae turn gray then black, sometimes a grayish brown. The outer two or three segments of the dead larvae often rise a little and become dark gray while the parts deeper in the cell are a whiter gray. The skin of the larvae remains tough while the insides are watery and granular; from this characteristic originate the name Sacbrood. Dead larvae can be removed entirely from the cell with a toothpick. The disease may soon disappear by itself, or remain for a long time without any noticeable advance. It seldom becomes serious. Unless the disease persists, no control from the beekeeper is necessary. The bees normally clean out the diseased material as the nectar flow begins, and the disease disappears. Requeen the colony if the disease persists.

There are other forms of dead brood caused by chilling, normal mortality, or poisoning, but these are not caused by the presence of an organism. These may be conditions due to weather, faulty management, poor nutrition, or the presence of some adult bee disease that weakens the colony to the point that there are not enough nurse bees to properly care for the brood. The result may be confused with brood diseases, so it is important for beekeepers to be able to recognize disease.

Chilled Brood

This condition occurs when some of the brood around the edge of the brood rearing area or in

an isolated comb dies of neglect because there are not enough bees to feed and keep the brood warm. This generally occurs if the beekeeper moves brood combs so that it is isolated from the main brood rearing area and is not properly tended. Brood may become chilled when adult bees are dying in excessive numbers from disease or spray poison. Chilled brood turns gray or a grayish brown and looks somewhat like Sacbrood. Dead larvae or pupae are easily removed from the comb.

Chilled brood can be avoided during the cool build-up period in the spring by returning combs to the hive in the same order they were removed. It's also important that brood be returned to the hive as quickly as possible, especially when the weather is cold or when a cool wind is blowing. Opening or working the bees is not recommended if the outside temperature is below 50 degrees.

ADULT BEE DISEASES, CONDITIONS

Nosema

Nosema is a disease caused by fungi called *Nosema apis* and *Nosema ceranae*. It attacks the ventricular lining of the mid-gut of adult bees, and as a result reduces their vigor and shortens their life. It may cause a sizable loss of the potential honey crop if it becomes well established in an apiary.

There are no easily observed symptoms and, in most cases, the beekeeper may not suspect that the disease is present in his apiary. Nosema is most severe during March, April, and May, and disappears or nearly disappears during mid-summer, then gradually builds up again during the winter months. Heavily infected bees sometimes have slightly swollen abdomens and the colony seems to have a shortage of adult bees in comparison to the amount of brood. Also, Nosema causes dysentery and you may see a pronounced amount of fecal spotting on the front of the hive. However, these symptoms are not very definite nor reliable. A microscopic examination of the midgut by an experienced person is the only sure diagnosis for the disease.

The only treatment is to feed the infected colonies about 1 gallon of sugar syrup containing Fumidil-B. The syrup is made at the rate of one half gram of Fumidil-B to six gallons of syrup. The syrup is fed to the colony during March or April. This treatment helps to keep the disease under control and results in a populous colony that increases the size of the honey crop. A treatment is recommended as a fall feeding (especially in western Washington) to reduce the amount of Nosema in the wintering bees, and again in the spring. An increased queen acceptance in colonies has been documented in colonies fed Fumidi-B in the spring followed by feeding Fumidil-B in water to the queen and her attendants prior to introduction to a colony.

Paralysis

Paralysis is a virus disease that has not caused much loss in the North. It only attacks adult bees. Affected bees appear to be weak. They tremble after the disease has developed to some extent, and they appear to be partially paralyzed; they crawl slowly in front of the hive with jerky motions and may die in small clusters. If picked up by the wings and dropped, they fall to the ground instead of flying away. They look old and shiny or greasy. In advanced cases the hair on their bodies seems to be worn off. Quite often, normal bees try to drive infected bees from the hive giving the impression that the hive is being robbed and bees are fighting at the entrance.

Since this disease seems to be present in only inbred or nonresistant strains, the cure is to re-queen the colony.

Dysentery

Dysentery is a condition, not a disease. It is caused by poor quality of winter stores and prolonged confinement during winter due to cold weather. Honeydew, apple, or other fruit juices, and a few types of honey encourage the development of dysentery. Under normal conditions, bees must be confined for eight weeks or longer before dysentery develops. Evidence of this condition is the excessive spotting on the entrance of the hive or even the tops of combs and frames inside the hive. There is no known cure, but it may be prevented by providing the bees with good quality honey for winter. Dysentery is also caused by the Nosema parasite and treatment with Fumadil-B is necessary for a cure if this is the case. The condition is seldom present during a mild winter when bees can occasionally conduct cleansing flights.

Poisoning

Bees may be poisoned by the application of sprays to trees or other plants that are in bloom. Poison is often contacted by the bees on weeds or cover crops growing under trees or in fields. The poison may kill the bees as they contact sprays that hit them as they work the blossoms; it may act as a stomach poison in the nectar as it is gathered from the flowers; or, as a poison carried to the hive mixed with pollen. Affected bees may die before they return to the hive or during a period of several days after being hit by the spray. Poison in the pollen may kill the young bees. A few colonies may be affected or whole apiaries may be wiped out by spray poison. Poisoned adult bees often have enlarged abdomens and show signs of being partly paralyzed. There is little that can be done for a colony after it is hit by spray poison. A preventive measure is to move bees away from blooming plants that are about to be sprayed with material known to be poisonous to bees. It is illegal to spray fruit trees when the flowers are blooming. If you do have a poison kill, you might inform all your neighbors not to spray when fruit trees are blooming.

Poisoned larvae may have many characteristics. They may die and remain white in color but flattened; they may be yellowish gray; or some may be brown, similar to European Foulbrood.

PESTS OF HONEY BEES

Wax Moths

Wax moths are the most prominent enemies of bees, but they render a service when they destroy neglected combs on which bees have died of American Foulbrood.

There are two wax moths: the greater and the lesser moth. They lay eggs in combs that have been removed from the bees or in crevices about the hive. The larvae that hatch from these eggs feed on the combs, preferring those in which pollen has been stored or in which brood has been reared. In a live hive they tunnel beneath the surface of the comb, to keep out of the reach of the bees as much as possible. If bees are very busy during heavy nectar flows, they may overlook the wax worms for a short time, then remove them from the hive when the flow is over.

The larvae mature and spin cocoons from which they emerge as adult moths. Moths lay eggs and larvae feed on any neglected comb. Combs upon which they work are rapidly reduced to a mass of webs and cocoons and thus completely destroyed.

Moths do not kill bees but they do destroy combs not properly protected. The trouble in such cases is that the colonies become weak as a result of foulbrood, starvation, or queenlessness, and the moths occupy and destroy the combs the bees left unprotected. Strong colonies are a solution to this problem. The best way to protect combs is to give them back to the care of bees

by placing them over strong colonies.

If returning empty combs to colonies is not possible, they should be fumigated with Paradichlorobenzene (PDB). Stack the supers in an airtight pile, placing a tablespoon of PDB crystals on a piece of paper on top of the frames of each four supers. Cover the stack. PDB will kill the larvae and adults. It may be necessary to renew the PDB during warm weather. Be sure to follow label directions on the containers. Never apply PDB directly in contact with combs. Treated supers should be aired for 24 hours before placing them back on the bees. **NOTE: never fumigate with naptha based products, such as naphthalene crystals, since it leaves residues in the combs and will kill bees.**

Combs in an unheated building, where they are subjected to severe freezing from time to time during the winter, are safe from moths until warm weather comes, when treatment may then be necessary.

Small Hive Beetle

The Small Hive Beetle, *Aethina tumida*, was first found as an unidentified beetle in South Carolina in November 1996, and another in 1997. It was identified in Florida in May 1998 and in Georgia in June. It has since been found in South Carolina. The adult beetles have six legs and two pair of wings, are reddish brown to black in color, and are about 5-7 mm (about ¼ inch) long.

Small Hive Beetle eggs are pearly white and look much like honey bee eggs, but they are slightly smaller. Larvae are cream colored and when fully grown are about 11 mm (7/16 in.) long and slightly more than 1.6 mm (1/16 in.) in diameter. The larvae look much like young wax moth larvae. Small hive beetles and wax moths can infest the same bee colony. Females prefer to deposit irregular masses of eggs in crevices or cavities inside the hive, although eggs are often found in comb not defended by bees.

Beetle larvae mature from egg hatch to pupae in 10-16 days. Larvae require a diet of honey and pollen to develop fully. The mature larvae leave the hive and burrow into the soil beneath the hive to pupate. The length of the pupal stage varies, but most pupae emerge from the soil as adults in 3-4 weeks.

The adult beetles usually gather at the rear of the hive on the bottom board where they feed on pollen that falls from the brood area above. They are said to gather under a piece of cardboard laid on the bottom board. Adults live up to six months, therefore more than one generation may live in the same bee hive.

There is only one pesticide approved to control the small hive beetles in Washington State. Permithrin (liquid) under the name of Y-Tex Gardstar 40% EC Livestock and Premise Insecticide. This insecticide is not applied directly to honey bee colonies but only in front or before placement of hives in the apiary. However, most beekeepers do not have a need to use this unless infections are pronounced.

Yellow jackets, Ants, Earwigs

Strong colonies usually repel such insect invaders as yellow jackets, ants and earwigs. We recommend that you manage strong colonies rather than use an insecticide that may kill the bees. **NOTE**: Only use labeled insecticide. Read and follow all label directions. Never apply harmful insecticides directly in the hives to eradicate insect invaders; you will kill off your own bees. The following are good guides to read.

Protecting Honey Bees Against Yellow jackets FS017E (Available from WSU Extension web site)
How to Reduce Bee Poisoning from Pesticides PNW0591 (Available from WSU Extension web site)

Mice

Mice are very destructive to combs in winter and should be excluded from the hive. They like to nest in hives because of the protected environment. They enter the hive only during cold weather when the bees clustered. An entrance to the hive that is not over three-eighths of an inch in height will ordinarily keep mice out. If the entrance is larger, use a strip of wire netting of three-eighths inch mesh over the entrance. Bees object to occupying hives and supers that smell of mice and for this reason mice should be kept away from supers of combs during winter storage. Keep stacks of supers tightly closed to prevent entry by mice.

Skunks

These night travelers sometimes scratch on the entrance boards and eat the bees that come out to investigate the cause of the disturbance. Packed dirt at the hive entrance and a muddy bottom board is a good indication of skunk presence. Skunks may be trapped or a fence of poultry wire placed around the colonies.

Bears

Bears cause considerable damage to bees in the mountainous regions of Washington State, making beekeeping unprofitable in some areas. An electric fence with five strands of wire about ten inches apart may protect the hives, but once a bear feeds in an apiary, about the only control is to shoot the bear at night or have a game warden trap it and take it away.

Birds

The King bird or bee martin is often reported to destroy bees, but these reports of damage are probably greatly exaggerated, and, since this is a valuable insect eating bird, it should not be killed. In queen rearing apiaries where the birds might catch queens while they are out to mate, there may be some necessity for control. There are no other birds that have a reputation for destroying bees.

Lesson 9: HONEY BEE MITES

Until the mid-1980's, the internal hive problems of greatest concern to US beekeepers included bacterial and protozoan diseases. The availability of labeled antibiotic and anti-protozoan drugs made control of these diseases relatively simple and inexpensive. However, since that time, the arrival and establishment of two parasitic mites, the honey bee tracheal mite (*Acampis woodi*) and the Varroa mite (*Varroa destructor*) has greatly changed the situation. Within ten years, these two mites rose to the forefront as perhaps the major stumbling block to maintaining honey bee colonies. Estimates of the 1995 winter loss of colonies in the northeastern US, attributed to a great extent to mites, ranged from 50% to 80%. Such losses are, of course, unacceptable to beekeepers. For the foreseeable future, successful beekeepers must include integrated management techniques to control mites in their beekeeping operations.

Tracheal Mites

The Honey Bee Tracheal Mite was first described in Europe in 1921. There was considerable suspicion that a widespread loss of bees on the Isle of Wight (Isle of Wight Disease) was caused by tracheal mites. A survey undertaken in 1921 found no tracheal mites present in the

US and subsequently the Federal Honey Bee Act was passed, that restricted further importation of honey bees to the US. Unfortunately, tracheal mites were discovered in US honey bee populations in 1984, possibly gaining entry through illegal importation of queens. They rapidly spread throughout the country and are now credited as a major cause of so-called "winter" losses in honey bee colonies.

Honey Bee Tracheal Mites are so-named because they live and reproduce within the breathing tubes or "tracheae" of the honey bee. Diagnosis of tracheal mite infestation is made by dissection of adult honey bees and microscopic examination of the tracheae.

These microscopic mites can occur in such numbers that they may interfere with the respiration of individual honey bees. Colonies with high populations of mites sometimes exhibit "crawling behavior", in which large numbers of bees crawl around on the ground in front of the hive. This is presumably due to the inability of the bees to respire sufficiently for flight. Recognition of this behavior led to early descriptions of mite infested colonies as having "crawling disease".

One of the major problems associated with tracheal mites is that their presence is associated with reduced life spans for individual bees. It is this trait that is so devastating to honey bee colonies in the fall. Honey bees typically have a brief adult life span of 4 to 6 weeks during the warm months of the year. Thus, a moderate reduction in an individual's life span is probably made up for by the reproductive capacity of the colony during these times of overall colony growth. In contrast, individuals reared in the late fall (known as "winter bees") normally live through the winter months and are necessary to begin the brood rearing and foraging cycle of the colony in the spring. Even under "normal" circumstances, beekeepers may notice a lag period, when older bees die at a rate higher than the replacement rate (termed "spring dwindling"). Usually this phenomenon is temporary and after a few weeks at most, brood production exceeds the death rate, and the colony experiences an overall population increase associated with a spring nectar flow. When the life span of winter bees is reduced by a tracheal mite infestation, colonies often die in late winter, simply from a lack of bees to maintain the hive temperature. Beekeepers may find very weak (or dead) colonies in the early spring, even with a plentiful amount of honey.

Treatment

The only registered compounds at this time for the treatment of tracheal mites in the US are menthol and formic acid (Mite-Away II); however their effectiveness is dependent on temperature. Menthol acts as a fumigant to kill the mites within the tracheae of living honey bees. Typically, 50 grams of menthol crystals are placed in a porous bag and placed over the top bars near the back of the hive. The temperature range for the effective vaporization rate of the crystals is rather limited. Under ideal conditions and temperatures of 60-75 degrees F, the crystals should vaporize within a few weeks. Do not use menthol when honey supers are on the hive. Formic Acid under the brand name of Mite-Away II® comes in pre-measured pads which are placed on the top of colonies within a spacer under the top cover. Effective temperature ranges for formic acid is 50-79 degrees F. One pad is left on for 21 days before or after honey supers are present.

Recommended treatment periods in many parts of the US include the spring or fall, although spring treatments are generally considered less effective in western Washington. To maximize protection of the "winter bees", a late summer or early fall treatment, after the nectar flow, would be useful in areas where appropriate temperatures can be expected. It may be necessary to remove honey supers just prior to the end of the nectar flow to achieve treatment during appropriate temperatures. Treatments in colder weather will not be effective in lowering mite levels in bees.

A number of researchers recommend that grease patties made without Terramycin® are better suited for long term use in the hive to assist in mite control by possibly disrupting the transfer of tracheal mites as they move among individual bees. Various grease patty formulations have been reported, including some that use liquid vegetable oils and powdered sugar, so beekeepers may want to experiment to produce patties that better fit their operation. To better assess the impact of treatments, it is recommended that beekeepers sample their bees and have them tested in a diagnostic lab.

Commonly used "grease extender patties" may help in mite control. Mix sucrose (Table sugar) - 6 cups, with hydrogenated vegetable shortening (e.g. Crisco) - 3 cups, then divide into ten portions. Each portion treats one hive.

NOTE: For the latest information about approved miticides, contact your local beekeeper association or the Washington State Department of Agriculture.

Varroa mites

The Varroa mite (*Varroa destructor*) represents an interesting biological example of a parasitic species that has "host-shifted". The original host of the Varroa mite is *Apis cerana*, the eastern hive bee of Asia. *A. cerana* has a number of adaptations and defenses against the mite and the two co-exist in a typical balanced host-parasite relationship. However, within historical time, humans moved our western honey bee (*Apis mellifera*) into areas in the geographic range of *Apis cerana* and a population of mites transferred to and became established on the new bee host. Unfortunately, the western honey bee had few adaptations to control Varroa rnites. As a result, Varroa mites were devastating to European honey bees and, without beekeeper intervention, colonies usually died within a couple of years. In the late 1980's Varroa mites were discovered in the US (again - the probable cause appears to be the illegal importation of honey bees) and immediately became a serious problem. Preliminary reports suggest that Varroa mites have eliminated much of the previously large population of feral honey bees in the US. Beekeepers who are not aware of Varroa mites and their management will not have bees for long.

The oval reddish-brown mite is an external parasite on both adult honey bees and brood, although reproduction takes place exclusively in sealed brood cells. These mites are clearly visible to the unaided eye. Diagnosis can be made either by opening sealed brood, especially drone brood, and looking for the mites or by several techniques that get the mites off the adult bees. The ether roll technique is quite easy and involves placing a sample of several hundred workers in ajar, spraying engine starting fluid into the jar and rolling the jar around. Mites will become dislodged from the bees and stick to the wall of the jar. There is also a similar technique using powdered sugar. Again with several hundred workers in a jar, add enough powdered sugar to thoroughly coat the bees. Shake and roll the jar to dislodge the mites. Replace the solid lid with a piece of 1/8” hardware cloth and shake the mites out of the jar onto a surface where they can be counted. Alternatively, colonies may be treated with Apistan® strips (see below) an approved Varroa miticide and the mite fall detected by inserting a piece of heavy paper or cardboard coated with a sticky substance (Crisco, Pam®, or Tangletrap®) placed on the hive bottom board. Be sure to cover the sticky detector with a screen of eighth-inch mesh hardware cloth to prevent bees from becoming stuck.

Treatment

The following are compounds presently registered for the treatment of Varroa mites in the US; Fluvalinate® (trade name: Apistan®), Formic Acid pads (Mite-Away II®), Sucrose octanoate esters liquid (Sucrocide®), Thymol gel (Apiguard®), and Thymol + eucalyptus oil + menthol tablet (Api Life Var®). For the most part beekeepers no longer use Apistan® due to the fact that

the mites have developed resistance to it. The other products have varied amounts of effectiveness. Make sure you follow all labeled instructions closely before applying these to your colonies. In Washington a late summer application after honey supers are removed is recommended to prevent Varroa buildup.

NOTE: As with all pesticides — read and follow label directions to be assured of correct dosage. Treat colonies only during non-nectar flow periods and for the period of time indicated for each. Never leave treatments on colonies over the winter. Do not leave Apistan® strips, or other chemicals, in the hive through the winter because if used improperly mites will develop a tolerance to the chemical.

Improper use has already led to resistance of the mites to Fluvalinate and Coumaphos in honey bee colonies in many European countries. This resistance appeared first in areas where it was a widespread practice to leave Apistan® inside colonies "year round" or to mix homemade formulations of Fluvalinate for application.

In 1998, Varroa mites resistant to Apistan® were confirmed in some Florida apiaries. These resistant mites have now been found in other states throughout the U.S. Current efforts are underway to register additional compounds for the treatment of Varroa in the US. At the time of printing of this text, the compounds listed above are registered for use.

Hard chemical treatments are widely used among commercial beekeepers. Due to Varroa's ability to adapt the list of useful miticides changes frequently. Also, hard chemical miticides have been found to contaminate comb and honey within the colony. As the list of registered products changes rapidly it is recommended that the beekeeper contact a local beekeeping association, equipment supplier or WSDA for available products.

There are numerous resources available to beekeepers for treating Varroa mites.

Soft chemicals are another line of defense. Compounds such as Formic acid and Thymol have pre-packed treatments available to the beekeeper. Sucrose octanoate, another soft chemical, can be easily mixed from concentrate and sprayed on the bees, using a common garden sprayer, to control Varroa mite. Some of these compounds also work on tracheal mites which mean a tracheal mite infestation is treated at the same time as Varroa mites with no additional effort on the beekeepers part. Soft chemicals are desirable from the standpoint that they generally leave little or no residue in beeswax or honey, particularly when used according the labeled instructions.

Hard chemicals and many soft chemicals have, or may have, an effect on queen pheromones within the colony and also on the development and maturation of brood and adult bees. This may result in shortened life span of queens, drones and workers, and also may affect the ability of both queens and drones to properly mate.

IPM, or Integrated Pest Management, is also useful for managing mite populations. IPM is more a strategy rather than a specific treatment. IPM techniques for managing Varroa populations may include any or all of the following methods:

- Freezing drone comb---full frame drone comb method.
- Cutting/removing drone comb---short frame method.
- Screened bottom boards.
- Make a split (create a broodless situation).
- Use small cell foundation.
- Use selected stock such as SMR, or Suppression of Mite Reproduction stock.

NOTE: For the latest information about approved miticides, beekeepers can contact their local association, Washington State Beekeepers Association at www.wasba.org, or the Washington State Dept. of Agriculture at www.agr.wa.gov for the current status of approved treatments.

Other reading:
Beekeeping in Northern Climates. 2000. Furgala, B., M. Spivak and G. S. Reuter. Univ. Minn. Ext. Service, 68 pp.
Honey Bee Diseases, Pests and Predators. 1997. Edited by R. A. Morse and K. Flottum. A. I. Root, Medina OH 718 pp.
Diagnosis of honey bee diseases. 1991. Shimanuki, H. and D. A. Knox. US Department of Agriculture Handbook No. AH-690, 53 pp.

Status of approved Washington State mite control products:
http://agr.wa.gov/PestFert/Pesticides/docs/StatusMiteControlProds.pdf

LESSON 10: POLLINATION, QUEEN REARING, MARKETING

This chapter covers three topics more appropriate for experienced, commercial, or specialist beekeepers. It is intended to introduce the new beekeeper to these topics and provide enough information to cover the few situations when a beginner might delve into these areas. Anyone planning to enter one of these fields in a serious way should research the topic in more depth.

Pollination

Pollination is the transfer of pollen from anthers (male parts) to stigmas (female parts), either on the same flower, different flowers of the same plant, or flowers on different plants. Self-fertile plants can be pollinated from the same variety of plant, but many fruits require cross-pollination, where the pollen of one variety must be carried to the stigma of another variety. Sometimes, as in holly and willow trees, the male flowers are on one plant and the females are on another plant.

Many farm crops are either dependent on insects for pollination, yield more abundantly, or improve in quality when insects are plentiful. These crops include most fruits and berries, some of the nuts, many legumes (clover, alfalfa, vetch, and trefoil), melons, cucumbers, and many, other vegetables. Populations of wild pollinators, including feral honey bees, are dropping due to changes in the nature of farming and elimination of nesting places for these insects. Farms are getting larger, especially those specializing in fruits, vegetables, and seed production. The importance of honey bees as pollinators is increasing because colonies can be moved (in large numbers) in and out of a crop as needed. It is estimated that honey bees do 80 % or more of the pollination of fruit and seed crops in the United States.

Wild native bees, such as the leaf-cutter, mason, carpenter, and bumble bees, are helpful as pollinators, but are not as reliable as the honey bee, which visits only one kind of plant each trip. Solitary bees gather both nectar and pollen in a single trip, while honey bees usually concentrate on one or the other. Pollen gatherers are probably the best pollinators. Raising or encouraging native bee populations may provide sufficient pollination for small or backyard orchards and berry patches.

Renting out hives for pollination is a specialized facet of beekeeping and another way to generate income. The same colonies may be rented for several crops during the year. Caution: persons moving bees between crops need to be aware of any problems pertaining to pollination. Care needs to be taken to prevent cross pollination in hybrid varieties. And, hives need to be moved at least 3 to 5 miles when changing sites.

Most beekeepers are not aware of the costs involved in moving bees. In addition to the labor and the cost of operating a truck, there is a loss of honey (as much as one shallow super per colony). Also, there are hazards, which include loss of queens (about 5%), an occasional colony lost to suffocation in transit, possible exposure to pesticides and vandalism, and the dangers of increased incidences of disease, robbing, and drifting. Other risks are flooding and liability suits for bee stings.

A common mistake that newcomers make when entering the pollination business is to set their prices too low. It is okay to put a hive in a friend's backyard to pollinate their apple tree, or to keep a few hives in an apiary on a farm in a mutual benefit arrangement. But to supply hives for pollination of a commercial crop at a low price is unfair to those beekeepers trying to make a living at pollination. It is also uneconomical when the aforementioned costs and hazards are taken into account. There is probably room for both commercial and non-commercial beekeepers in pollination. Most commercial beekeepers have their hives on pallets and use large trucks. They usually don't want to bother with the small jobs requiring only a few hives. Non-commercial beekeepers could take these jobs, after checking to find out a fair price to charge.

Strong colonies (8-12 frames of bees) are best for good fruit tree pollination. Two five-frame colonies, with the same total strength of a ten-frame one, will not pollinate as effectively as the stronger one. A ten-frame colony has a larger field force, flies at lower temperatures, better deals with minor diseases, and resists attempts at being robbed. It is good beekeeping to equalize the strength of the colonies before the bloom and to concentrate on making them uniformly strong, which is especially important for pollination. The number of colonies required for pollination varies with the crop. Beekeepers in the pollination business should be familiar with minimum colony strength recommendations for the various tree fruit crops needing pollination in the state.

Pollination may be the key to the future of beekeepers in the United States. Since so many growers depend on honey bees for a good crop, they may be willing to help fund the research programs that are trying to find ways to increase the effectiveness of honey bees as pollinators and ways to protect honey bees from pesticides, diseases and parasites. With strong colonies and the proper equipment, it should be possible to operate more hives, pollinate more crops, produce less honey, yet have a larger net income than with honey production alone.

Queen Rearing

Queen rearing requires special techniques, patience, attention to detail, and a desire to raise better queens. The queen is the most important single member in the colony. Within limits, she determines the temper, strength, productivity, swarming tendency, longevity, and resistance to disease, etc., of the colony. By merely replacing the queen in a colony, many of these characteristics can be changed within a few weeks. There are probably a limited number of qualified people who can make a successful business of queen rearing, but anyone with at least one strong colony can rear queens without materially affecting the honey crop.

Beekeepers who are not commercial queen breeders can raise queens using simple methods. One way is to take a frame of eggs and young larvae selected from a colony with good traits. This frame is placed between frames of pollen and honey above a double screen on top of the parent colony, with an entrance in the rear. Extra nurse bees are shaken in from the parent colony, taking care not to get the queen. When the bees above the screen find themselves queenless, they start queen cells and rear a new queen, which will mate and start to lay eggs.

Another method was mentioned in the chapter on swarming and involves moving frames with

swarm cells to nucleus colonies (nucs) or to queenless colonies, leaving the old queen in her own brood nest. Or, if the old queen is missing and the colony has started several emergency queen cells, some of these could be moved. In either case, if the cells are not capped, there should be lots of nurse bees in the colony receiving the cells.

If more than one new queen is desired, the capped queen cells from any of the above methods must be moved to separate hives before the new queens start to emerge. Large, well-formed queen cells are selected and carefully cut from the comb with a sharp knife, taking extra wax around the base (top) of the cell. One or two are fastened into the brood nest of queenless colonies or in nucs. A toothpick is inserted through the extra wax at the base of the cell to fasten it toward the top of a comb in the brood nest. This must be done within six days after the first queen cell is capped, otherwise the first queen to emerge will kill the rest of the queens while they are still in their cells.

It is important to have an adequate number of mature drones available for mating queens. Twenty drones, two-weeks old, should be available for each queen that will be mating. Weather during mating flights should be clear and above 65 degrees Fahrenheit. Twenty five hives or more of genetically different stock are needed from which to raise queens to prevent inbreeding. When raising queens, important factors to remember are good genes, plenty of pollen (or pollen supplement) and honey (or sugar syrup), and lots of young, nurse bees. With proper selection of cells from colonies that have desirable characteristics, and replacing poor queens, it will not take long to improve the quality of a beekeeper's stock.

Marketing

Most new beekeepers do not worry about marketing their honey; they feel lucky if their colonies actually make enough surplus for their own use. They usually have only one or two hives, which, in an average year, yield an amount sufficient for their own use or to give for presents. As they learn the basics of managing bees they often make mistakes which reduce or eliminate the honey crop.

However, there comes a year when there is honey beyond the needs of the immediate family and circle of friends. This may be a result of better management, having more hives making a little honey each, or one of those occasional years when the bees make honey even when they are poorly managed. At this time, beekeepers often start thinking about making some money by selling the excess honey. Then they need to become concerned with the quality of the honey, the packaging, and where and how to sell the honey. See Washington State requirements in Chapter 69.28 RCW – Honey.

Honey Quality

Whether a commercial beekeeper selling barrels of honey to a packer, or a hobbyist selling a few jars to their colleagues at work, the honey producer needs to be concerned with the quality of the honey. Some kinds of honey and honeydew have strong flavors and should not be sold to the unsuspecting customer. While most consumers prefer milder flavors, there are some that want a more pronounced taste. Whether mild or strong in flavor, the quality is still important.

Most honey produced by honey bees is of fine quality if it is left with the bees until sealed, since bees seal only ripe honey. Thin or unripe honey contains over 18.5% water. The beekeeper should not damage the honey through the excessive use of smoke or chemicals used in taking off honey. By using a bee escape or a bee blower, honey may be taken from the bees with little danger of altering its flavor. It is important that the honey is not left above an escape for more than two or three days, as it will absorb some moisture. It is never safe to store honey in supers in a damp room (where moisture is in excess of 65% relative humidity) because it will absorb

moisture, deteriorate in flavor, and then ferment. It should be extracted soon after the supers are removed from the hive to prevent absorption.

Honey contains acids that dissolve metal from galvanized, iron, or aluminum tanks, extractors, or other equipment. For this reason, it is best to extract and store honey only in food approved stainless steel, plastic, or galvanized containers having a food approved coating. Rusty or corroded metal imparts a bitter and unpleasant flavor to honey.

All extracted honey is strained before bottling and it is possible to do it well without a lot of expensive equipment, even in a small operation. The initial straining can be done right at the extractor with a large sieve over the collecting container to catch the big chunks of wax and bee parts. Finer straining is done through cloth. Unheated honey can be gravity strained through 80 mesh or finer material. For faster or finer straining, the honey may be heated to 120 F. After straining, the honey is left to stand for several hours to let the foam rise to the top for skimming off before the honey is bottled.

Some customers think crystallized honey is spoiled, since naturally formed crystals may be coarse, gritty, and give the honey an undesirable appearance. To re-liquefy crystallized honey the honey is heated to not more than 140°F, until all crystals are dissolved, then cooled as quickly as possible. Overheated honey turns dark and tastes burnt. Heated honey will stay liquid for a considerable time. Storing liquid honey in the freezer retards granulation; it just needs to be brought to room temperature before use. Caution is needed when using glass to avoid placing a hot jar in a draft or on a cold surface, or cold jars near heat.

Containers and Labels

Most honey sold in the United States is liquid, in glass jars. Squeeze bottles or bears are popular for the table and can usually be refilled. Honey is also sold in 1, 2, 4, or 5 gallon plastic pails for the customer wanting a larger amount. Creamed honey is usually sold in small, plastic tubs, and there are several clear plastic containers available for cut-comb honey. Wood sections or plastic rounds of comb honey are packaged in cellophane or plastic wrap.
Honey given or sold to friends and neighbors may be packed in recycled jars, but since honey has a reputation for purity, cleanliness is of the utmost importance. Soaking in hot water will remove most old labels; and stubborn adhesives will yield to wiping with warm mineral or salad oil. Lids may be reused, but lids of jars from products like pickles need to be replaced. Lids printed with unwanted writing can be replaced, or covered with a cut out circle of contact paper with a nice design. Many jars will accept canning lids, which are easily found in most supermarkets. Bottling companies sell new lids, but usually prefer case orders.
Honey sold to the general public should be packaged in new containers. New canning or jelly jars work well, or a source for other styles and sizes may be located in the yellow pages. Many bee supply companies offer sizes and styles especially suited for honey.

Labels may be hand-lettered, designed on a computer, or bought preprinted from a bee supply company. They may be very informal for friends, but for general sales must include certain information required by law: net weight of honey in pounds and ounces; floral source; country of origin; and the name, address, and zip code of the packer or producer.

Promotion and Sales

Talks at service clubs, schools, grange meetings, and other gatherings help sell honey. These talks are especially effective if an exhibit of honey or other visual aids are used. There are a number of videos, available through local associations, which would enhance a lecture. The National Honey Board (see Reference list) also provides many fine promotional materials.
Honey makes a nice gratuity or present. Gifts of honey for use at banquets, church or grange

suppers, and other gatherings help promote honey, as do donations for raffles, gift baskets, auctions and other fund-raisers. Displays at fairs, at farm product shows, and in stores or chamber of commerce windows help, too - any way to bring the product to the public's attention.

If zoning and local sign regulations allow it, an easy way to sell honey is from the home or at a roadside stand. A large HONEY FOR SALE sign is placed in the front yard and smaller ones down the road in either direction to let motorists have time to make up their minds to pull in to buy. An outside stand should be roofed to protect the product from the elements and may be wired with a buzzer that sounds in the house. A self-service stand may not be practical or safe in all communities, but are convenient and effective when feasible. Payment is made in a sturdy locked box with a small slot in the lid for money. Customers needing change can ring a bell or buzzer for help; or, customers can make their own change from an open box with a small amount of money.

Local produce stands and farmers markets are great outlets for honey. How appropriate for honey to be sold with the other fruits (and vegetables) of the bees' labor! Local grocery stores are often very willing to stock local honey if it is well packaged and labeled appropriately.

Beekeepers selling honey should be well informed regarding the composition, properties, and uses of honey in order to be able to discuss their product fluently with any customer. **NOTE: bee products should not be advertised, recommended, or promoted as having health benefits!** Without a license to prescribe medicines, making health claims is illegal, raises issues of liability, and may be subject to litigation for fraud. Information about honey is available from state land grant universities, county extension offices, and the National Honey Board.

GLOSSARY

Absconding Swarm: Bees that leave their hive because of disease, lack of food, or other unfavorable conditions.

After-swarms: Swarms that leave a colony with a virgin queen after a swarm of the same season has already left with the old queen.

American Foulbrood: Serious disease of brood, caused by *Paenibacillus larvae larvae*.

Aphid: A plant louse that secretes a sweet liquid, termed honeydew, which the bees store.

Apiarist: A beekeeper

Apiary: The site where hives of bees are kept; bee yard.

Apiculture: The science and art of raising honey bees for man's economic benefit.

Apis mellifera: Scientific name of one race of honey bees.

Artificial Insemination: The impregnation (mating) of virgin queens in confinement by the use of instruments.

Artificial Swarm: A swarm made by dividing a colony of bees by shaking some bees into a new hive with a queen or queen cell, to reduce crowding and swarming in a hive.

Bee Blower: An engine with blower attached to create a wind of high velocity and volume to dislodge bees from combs in a super, to remove honey.

Bee Escape: A device to remove bees from honey supers or buildings, constructed to allow bees to pass through in one direction, but prevent their return.

Bee Gum: A colloquial term for "a beehive", usually a hollow log hive.

Beehive: The man made box(s) and frames provided as a domicile for a colony of bees.

Bee Line: The shortest distance between two points, as the bee flies.

Bee Space: An open space in which bees build no comb or deposit a minimum of propolis. It is a passage between combs or parts of a hive measuring from 1/4 to 3/8 inch. Five sixteenths is usually taken as average.

Beeswax: The wax secreted by honey bees from eight glands between the ventral abdominal segments and used in building their combs. It is composed of variable quantities of cerotic acid and palmitic acid. Bees may consume from 7 to 10 pounds of honey to secrete one pound of beeswax.

Bee Venom: Poison secreted by glands attached to the sting of the bee.

Box Hive: A plain box used for housing a colony of bees. It is illegal in many states, because it does not contain movable frames and combs.

Brace, bridge Comb: The terms "brace, bridge and burr comb" are often used interchangeably. More exactly, a brace or bridge comb is comb built between the face of adjacent combs to fasten them together, or between a comb and adjacent wood, or between two wooden parts, as between two top bars or top and bottom bars. Burr comb is wax built upon a comb or wooden part in a hive, but not connected to any other part.

Brood: Immature bees (eggs, larvae, and pupae) in the comb.

Brood Nest: The area of a hive containing brood.

Brood Super: The hive body(s), or super(s), in which brood is raised.

Burr Comb: See Brace Comb

Cell Cup: A queen cell when it is only about as deep as it is wide. Artificial cell cups can be bought or made.

Chunk Honey: Honey cut from frames and placed in jars and surrounded with liquid honey.

Cluster: The hanging together of a large group of bees one upon another; e.g., a cluster of swarming bees. See Winter Cluster.

Colony: A community of bees having a queen, some thousands of workers, and during part of the year a number of drones; the bees that live together as one family in a hive.

Comb: A wax construction of six-sided cells made by honey bees in which they rear their young and store their food.

Comb Honey: Honey produced in small boxes or plastic rounds containing comb, and also consumed in this fashion; often called section honey.

Creamed Honey: See Finely Crystallized Honey.

Cross Pollination: The transfer of pollen from the anther of one plant to the stigma of a different plant of the same species.

Cut-Comb Honey: Comb honey cut into various sizes, the edges drained, and the pieces wrapped or packed individually.

Dearth: A time when no nectar is available to foraging bees.

Decoy Hive: A hive placed with the object of attracting passing swarms. Usually the hive contains comb that was previously occupied by bees.

Demaree: The Beekeeper who devised a method of swarm control that became quite popular; also used as a verb "to demaree." It consists of separating the queen from most of the brood.

Dextrose: One of the two principal sugars found in honey; known also as grape sugar. In granulated honey, it forms most of the solids.

Dividing: Separating a colony in a manner to produce two or more colonies. See Artificial Swarm.

Division Board: Any device designed to divide two parts of a hive to make two separate units.

Division Board Feeder: A wooden or plastic container that is hung in a hive in place of a frame and used to feed bees. Frame feeder.

Double Screen: Two screens separated by a space, usually about 1/2 inch, to separate bees and vertical portions of a hive.

Drawn Combs: Completed brood or honey comb. Compare with Foundation.

Drifting: When bees do not return to their own hive in an apiary. Young bees tend to drift more than older bees, and bees from small colonies tend to drift into larger colonies.

Drone: The male bee.

Drone Comb: Comb having cells measuring about four to the inch. Drones are reared in drone comb; also honey is stored in it, but not often pollen. Drone comb has about 181/2 cells to the square inch.

Drone Layer: A queen that lays only infertile eggs that develop into drones.

Dummy frame: A thin board of the same size as a frame, or a little smaller, having a top bar nailed on top.

Dwindling: The rapid dying off of old bees in the spring. Sometimes called "spring dwindling".

Dysentery: The discharge of fecal matter by the bees within the hive. Many factors may contribute to this condition: starvation, low quality food, moist surroundings or Nosema infection.

Extracted Honey: Honey removed from the comb by centrifugal force.

Fermentation: Chemical breakdown of honey caused by sugar tolerant yeasts. Associated with honey having high moisture content (above 18.6% water.)

Fertile Queen: One that has mated with several drones and has a supply of spermatozoa in her spermatheca.

Finely Crystallized Honey: Honey that has been allowed to crystallize usually under controlled condition, to produce a fine, soft crystal.

Flash Heater: A device for heating honey very rapidly to prevent it from being damaged by sustained periods of high temperature.

Foundation: Thin sheets of beeswax embossed with the shape of cells to start a comb. Compare to Drawn Combs.

Food Chamber: A hive body filled with honey for winter stores. Frame: A rectangular device for holding honeycomb.

Fructose: See Levulose.

Fume Board: A device for removing bees from full honey supers by the use of fumes from a liquid repellent applied to the board.

Fumigate: To expose beekeeping equipment to the fumes of a toxic chemical for the purpose of destroying developing wax moths, other pests or diseases. Bees are sometimes killed by fumigation.

Grafting: To transfer newly hatched worker larvae from a brood comb into special queen cell cups used for queen rearing.

Grafting Tool: A needle or probe used to transfer the larva in grafting.

Hive Body: A deep Langstroth wooden box that holds frames and combs.

Honey: A sweet, viscous material produced by bees out of the nectar of flowers, composed largely of a mixture of the two sugars, dextrose and levulose, dissolved in about 17% water. It also contains small amounts of sucrose, minerals, vitamins, proteins, enzymes, etc.

Honey Bee: A social, honey producing bee of the class Insecta, order Hymenoptera, super family Apoidea, and family Apidae. In 1758 Linnaeus named the honey bee *Apis mellifera* (honey-maker), which the American Entomological Society uses as the correct scientific name for the honey bee. Races or varieties of the domestic bee are also distinguished by the names of the geographical localities in which they occur and from which they have been exported, as Italian, Carniolan, Syrian, Cyprian, Banat, Caucasian, and Tunisian.

Honeydew: A sweet liquid excreted by plant lice and scale insects.

Honey Gate: A valve used to control the flow of honey from drums, cans or extractors.

Honey House: A building used for extracting honey and storing equipment.

Honey Sump: A tank with two baffles into which honey from the extractor, uncapping knife, and uncapped combs runs by gravity. The baffles remove pieces of comb and particles of wax from the honey. It is attached to a pump used to move the honey to a settling tank.

Invertase: An enzyme that speeds the inversion of sucrose to dextrose and levulose.

Invert Sugar: A mixture of equal parts of dextrose and levulose, with or without water. Invert sugar is made from sucrose (cane or beet sugar) by heating with a trace of acid. It superficially resembles honey.

Larva (Larvae - plural): A developing bee in the worm stage; second stage of bee metamorphosis.

Laying Worker: A worker which lays eggs, such eggs producing only drones, found in colonies that are queenless.

Levulose: One of the five important sugars, it occurs in all fruits except the grape and is the predominant carbohydrate in honey. It is also known as fruit sugar or fructose.

Life Cycle:

STAGES	QUEEN (days)	WORKER (days)	DRONE (days)
Egg	3	3	3
Larva	5 ½	6	6 ½
Pupa	7 ½	12	14 ½
Adult Emerges on	16th day	21st day	24th day

Nectar: A sweet liquid secreted by nectaries located chiefly in flowers, and on leaves of some plants.

Nectar Flow: A time when nectar is plentiful and bees produce and store surplus honey.

Nucleus (Nuclei - plural; also called a Nuc) : A small hive of bees covering two to five frames of comb: used primarily for rearing or storing queens.

Observation Hive: A hive largely of glass or clear plastic to permit observing bees.

Orientation Flights: Short flights taken by young bees in front of the hive to acquaint them with their hive location. Sometimes mistaken for robbing or preparation for swarming.

Package Bees: Adult bees with or without a queen contained in a wood and wire screened shipping cage.

Parthenogenesis: Production of a new individual from a virgin female without intervention of a male; reproduction by means of unfertilized eggs. It sometimes occurs in bees, though usually unfertilized eggs produce only males. An infertile queen, and sometimes a worker, lay eggs that will produce only drones.

Piping: A series of sounds made by a queen, consisting of a loud, shrill tone, succeeded by several others, each sound shorter than the one that precedes it. A laying queen seldom pipes. A virgin pipes at intervals after emerging from her cell. In response to her piping may be heard the "quark" of one or several virgins in their cells, it being uttered in a lower key and in a more hurried manner than the piping.

Pollen Basket: A flattened depression surrounded by curved spines or hairs located on the outer surface of the bee's hind legs adapted for carrying pollen from flowers to the hive.

Prime Swarm: The first swarm; the swarm with the old queen.

Proboscis: The tongue or combined maxillae and labium of the bee.
Propolis: A kind of glue or resin of plants collected by the bees and chiefly used to close up cracks and anchor hive parts.

Pupa (Pupae - plural) : Third stage of bee metamorphosis, during which the larva changes to an adult; also known as capped brood.

Queen Cell: A cell in which a queen is reared. It has an inside diameter of about 1/2 inch and hangs down from the comb face or edge an inch or more.

Queen Excluder: Metal or plastic device used to confine the queen to one area of the hive. The spaces are such that a worker can pass through the device but not a queen (or drone.)

Queenright: The condition of a colony having a laying queen.

Royal Jelly: A milky white jelly secreted from the hypopharyngeal glands of worker bees.

Skep: A beehive, made of straw, without movable frames or combs.

Slumgum: The refuse left after old combs have been rendered. Mostly brood cocoons, pollen, etc.

Super: A box of frames and comb in which bees raise brood or store surplus honey.

Supersedure: The natural replacement of an older queen by a daughter queen.

Swarm: The group of worker bees, queen, and drones that leave the parent colony to establish a new colony; the natural method of propagation of the honey bee colony.

Tested Queen: A queen whose progeny show she has mated with drones of her own race (or strain) and has other qualities which would make her a good colony mother.

Thin Super Foundation: Foundation used in comb honey production.

Thixotropic: A peculiarity of heather and some other honeys. The honey jells in the comb but when agitated it becomes fluid.

Transferring: The process of changing bees and comb from feral or box hives to movable frame hives.

Travel Stain: A darkened appearance of the cappings of comb honey left on the hive for some time, caused by bees tracking propolis over the surface.

Uniting: Combining two or more colonies to form a larger colony.

Virgin Queen: An unmated queen.

Winter Cluster: The tight cluster that bees assume during the cold winter months.

Worker Bee: A female bee whose reproductive organs are underdeveloped. They do all the work in the colony except lay fertile eggs.

Worker Comb: Comb having cells which measure about five to the inch in which workers are reared and honey and pollen stored.