

before leaving the hive and traveling a mile or more for nectar or pollen collection. Nosema disease can greatly weaken them so that some bees will not make it home. Nosema infection in the queen is most serious, especially when she must digest enough food to produce 1000 or more eggs daily. When their queen is sick, the worker bees sense this in some way and initiate queen cells in the process of supersedure. (See **Supersedure**, p. 55.)

In early 2007, a new species of the nosema microbe was discovered in the U.S. This goes by its scientific name "*Nosema ceranae*". It appears to be much more virulent than the more common species, *Nosema apis*. It is also quite common. A recent sampling of Kentucky hives found the disease in 8 of 11 counties. Much more about this disease will be learned in the coming years.

Nosema disease cannot be identified without a microscope or sophisticated genetic analyses. Treatment for either type of nosema is with an antibiotic especially for this disease: fumagillin, sold as "Fumagilin B". It is fed to the bees mixed in sugar syrup. A good treatment time is during July or August. The bees are not making honey at this time, and can be helped by the sugar and water in the syrup as well as the fumagillin.

### Viruses

Several types of virus attack the adult bees or larvae. One is sacbrood which causes the larvae to become soft and watery like a sack filled with water. Other viruses cause the adult bees to tremble, become paralyzed or lose their hair. At least one virus is stimulated to kill bees when the colony is infested with varroa mites.

Virus infections are difficult to control for several reasons. The symptoms are not always clear cut and unambiguous. Viruses in bees can be detected only by sophisticated laboratory tests or very powerful microscopes.

Another problem is that there are no antibiotics which kill bee viruses. Control is primarily by keeping varroa mites at the lowest possible levels. Destroying comb with the disease (if it's sacbrood), and requeening the colony may be other courses of action, if the problem is bad or recurring. By requeening the colony, the genetic makeup of the hive will

of the wax in a frame in just a few days. Infested equipment will often have many white cocoons, each about 1/2" long, clustered together.

There is a common misconception that the moths will kill a hive. In fact, the moths move into a hive only after it is killed or badly weakened for some other reason. For example, mites, absconding, and starvation will leave the hive unprotected by the bees so that wax moths can enter and do their damage.

Some beekeepers will report that the moth killed their hive. In fact, the moths came in after the hive was weakened or killed by some other factor -- mites, starvation, etc. A strong bee hive will keep all moths away from the comb inside.

Wax moth damage can be prevented in several ways. A healthy hive of bees will keep the moths away with no difficulty. This is one reason to keep extra comb on the hives during warm weather. Cold weather (below 50°) works well also. Combs stored in unheated locations during winter will be moth-free (although they must be protected from mice in the winter). For comb that must be stored in a warm location, away from the bees, use paradichlorobenzene (PDB). This is sold by beekeeping supply companies as "Paramoth". It is an effective fumigant. Stack hive bodies on top of each other with the frames and a few ounces of PDB on the top of the stack, under the top cover. The PDB can be contained in a pan or cloth sack so that it does not fall to the bottom. The top and bottom of the stack should be sealed with covers and/or bottom boards. Holes should be sealed with duct tape so that the fumes reach a high concentration inside the stack. In warm locations the PDB will evaporate quickly and will then need to be replaced. Let the frames air out away from the PDB for at least a day before returning them to the hives. Do not use naphthalene or other chemicals sold for clothes moth control.

### **Small hive beetles**

In the late 1990's a beetle from southern Africa appeared in several states in the eastern U.S. This insect, the small hive beetle, can be very destructive of weak hives and stored comb. As a larva it is a worm-like creature which eats the comb including stored honey and

by, chicken wire rather than a shotgun. Hot pepper preparations sprinkled in front of the hive are supposed to irritate the feet of the animals, but will wash away with the first rain. A barrier that is not nailed or stapled in place is easily removed by the skunk.

### **Bears**

Bears have reappearing in eastern Kentucky after a long absence. They had been hunted out of existence in the state around 1900. In the 1980's bears moved into eastern Kentucky from West Virginia and Virginia, where they had been re-established. Attacks on hives have since been reported in the eastern part of the state. Bears have been sighted at several locations in central Kentucky. Clearly they are continuing to move west. We can expect more bear damage in the future.

A bear attack can be extremely destructive to hives. The animals can easily break open the wooden hive bodies. Stings are not much of a deterrent when they are hungry. Contrary to popular belief, they don't go after the honey. It's the brood they really like, a highly nutritious meal.

The best course in bear regions is prevention. Elevated stands can be effective, but are expensive to construct. Electric fences usually work well if erected and maintained correctly. If bear problems persist, relocation of the hives or the bears is the only recourse. You may wish to contact the nearest office of the Department of Fish and Wildlife regarding bear relocation.

### **Mice**

Mice will make nests inside hives with or without bees, especially in rural apiaries during winter. If the hive is not protected from mouse invasion, the beekeeper may find a nest during the first hive inspection of spring.

Usually the comb but not the wooden parts of the frame are destroyed. Mouse damage can be prevented by stapling 4-mesh screen across the hive entrance in October as part of the



### Swarming

Every strong, healthy hive will try to divide into two or more colonies in the spring. This is the natural way for bee colonies to reproduce. (See **The Life of a queen bee**, p. 4.) However, swarming is a problem for three reasons: many productive bees are lost; the original queen is replaced by her daughter; and the swarm can be a nuisance the neighbors. The daughter queen will have half of the genes of her mother. She may or may not be as good as the original mother queen. At best, the colony will suffer from a gap in brood rearing while the daughter queen matures and mates.

Swarming is hard to prevent completely, but you can reduce swarming in several ways. The bees are stimulated to swarm when the hive is crowded and if the queen is older. Most of this activity occurs in swarm season -- May and June. During these months, reduce crowding in the hive by separating frames containing brood and inserting one or two empty frames. If the two lower hive bodies both have brood, reverse the positions of these bodies. Both of these techniques break the brood nest and give the bees the impression that they are not especially crowded. If possible, examine the brood nest every week or two during swarm season. Keep your eyes open for queen cells and destroy any that you find.

### Supersedure

Queen bees may fail because of diseases such as nosema, parasites, unsuccessful mating, or age. The worker bees are able to recognize that their queen is weak, and will gradually replace her with a new queen. (See **The life of a queen bee**, p. 4.)

Very often, supersedure occurs without the beekeeper's knowledge. Only by marking the queen or clipping a wing can the beekeeper know whether the original queen is still on duty. (See **Marking and clipping a queen**, p. 70.). As with swarming, the new queen is the daughter of the original queen, so she has some of the same genetic traits. She may be perfectly acceptable to the beekeeper.

### Starvation

### Queenlessness

If the queen disappears, a colony treats the problem as an emergency. The bees sense the loss of their queen within an hour or two, because the queen pheromone which is normally present in the hive disappears quickly. (See **The life of a queen bee**, p. 4.)

If the colony has young worker larvae, it has the ability to requeen itself. As soon as the queen pheromone diminishes, worker bees create *emergency queen cells* from cells with young worker larvae. These cells are typically among the worker brood cells, unlike swarm cells which are along the sides and bottom of the brood nest. Emergency queen cells are a reliable sign that a hive is queenless. The queen may be lost because of disease, because she did not return from a mating flight, or because the beekeeper accidentally killed her while examining the hive.

### Drone-laying queens and queens that produce bad brood patterns

Queens will occasionally have unsuccessful mating flights, or have some other problem that prevents them from laying fertilized eggs. An unfertilized egg becomes a drone larva, and eventually an adult drone. Drone-laying queens tend to lay eggs in worker cells. The drones that develop in the smaller worker cells become smaller adults. So colony that has had a drone-layer for over a month will have many small drones, each about the size of a worker bee. A hive with much drone brood, and little or no worker brood, either has a drone-laying queen or laying worker bees (below). A queen which generates a bad brood pattern should be replaced with a good queen as soon as possible. (See **Requeening a hive**, p. 67.)

### Laying worker bees

Worker bees are nearly always sterile females, but on occasion will be able to lay a few eggs. These *laying workers* develop if a colony has been queenless for several weeks. Their ovaries enlarge and they represent the colony's last-ditch attempt to rear brood. The colony will eventually die if it remains queenless.

go back in the hive through the top opening. But robber bees are not adept at learning how to get past this screen. Robber screens are easy to make from bits of wood and wire screen material. They are not usually sold through bee supply companies.

### **Abscending**

Bees are particular about where they live. If the hive is too small, too hot in summer, in a windy location, or frequently bothered by pests, the bees may take off for a better spot. In this case, all of the adult bees leave at once in a swarm. It looks like swarming, except that new queens are not reared and no bees are left behind. You may need to do a little detective work to decide whether the hive died or absconded. If it died, some evidence could be left there --signs of disease, mites or starvation. If your bees have absconded, determine what aspects of the hive conditions were undesirable, and fix them before re-establishing the hive.

### **Drifting**

Bees will occasionally enter the wrong hive when they return from foraging, if another hive is near their own. Often they will then join that colony, coming and going as if they had always lived there. This *drifting* behavior can be worst when hives are in a windy location. The returning bees will be inclined to join the down-wind hive, and soon that hive is full of bees while the others are depleted. It is also common when the hives are very close together.

An irregular arrangement of hives, rather than a straight row, reduces drift. Landmarks like bushes or fences, and hives painted different colors will also limit drift by helping the bees identify their hives when they return.

In practice, drift is usually accepted as a minor problem for hives with some protection from wind. However, it is responsible for the rapid spread of mites and disease within an apiary. This is why the beekeeper must treat for mite infestations or American foulbrood in all of the hives of one apiary at the same time. Drift is also a concern when establishing more than one new hive from packages, at the same apiary. For the first several days the bees do not have a strong affinity for the hive in which they are installed. The worker bees may



spring, according to temperature and rainfall at those times. Honey stores run low if foraging for the first nectar in the spring is delayed. Starvation, nosema disease and tracheal mites are often problems in long winters.

**A mild winter.** Warm winter weather may not seem to be a problem for bees, but it can be. If there are many days warm enough for the bees to fly, they will consume energy in the form of honey stores but without the opportunity to find nectar to replace it. Brood rearing will begin early in a mild winter, another factor causing the bees to consume stored honey more rapidly. If the bees continue to rear brood ahead of schedule into spring, several other concerns arise. First, swarming will be likely later on. Second, the colony's early brood rearing allows the varroa mites to begin reproducing early. A beekeeper who wants more colonies can turn the swarming impulse to an advantage by making divides following a mild winter.

Ideal winter temperatures are in the 30's and 40's. This keeps the bees clustered, and minimizes their honey consumption. An occasional warm day is beneficial also, allowing bees to fly and defecate on *cleansing flights*.

**High winds.** Strong winds are difficult for any creature that flies. Forager bees that have to fly upwind on their trip home may have trouble. We can readily understand this when we examine worker bees under the microscope. Older bees with a lot of flight experience have tattered wings that must be less efficient than the wings of young bees. A bee with tracheal mite damage (see **Tracheal mites**, p. 47) is unable to get air to its flight muscles efficiently.

In a windswept apiary with more than one hive, bees will often drift to the hive that is farthest downwind (see **Drifting**, p. 59). Some returning foragers will enter the first hive they reach, and join that colony, rather than struggle all the way home. This is a problem for the beekeepers, they will then have hives of unequal strength and productivity.

High winds will also topple hives. If your apiary is windy, be sure to check it very soon after a windstorm. If the hive has fallen over, it must be put back together as soon as possible. Under warm, dry conditions the hive will not suffer much if it is put back together

of the large pool with insect repellent. Any repellent which includes DEET will work. The bees will adjust their water foraging to this new source, and avoid the insect repellent. For the first few days, apply more insect repellent to the inner perimeter of the pool each morning. Eventually this will no longer be necessary. You can move the wading pool to a slightly different location by pulling it a few feet each day.

The same strategy is used to lure bees away from livestock feeding troughs and bird feeders: provide an additional feed source, treat the perimeter of the original source with insect repellent, and transfer bees from the original to the new source of feed. Ideally, the new feed source is moved to a location not accessible to the animals.

Hummingbird feeders are also attractive to bees. The best feeders are designed to exclude bees but allow the hummingbirds to feed with their long tongues. Occasionally these feeders will leak, and bees will collect at the leak to feed. This is solved with a little glue or tape over the leak.

## IMPORTANT ACTIVITIES

### Interpreting the brood pattern

When the bee colony is rearing brood, there is much to learn from an examination of the brood nest. The amount of comb containing eggs, larvae and capped brood tells the beekeeper about the recent history of the hive, its present condition, and what can be expected in the near future. The location of the brood in the hive also tells us much. The amount and distribution of brood in the hive is the *brood pattern*.

The development times for worker brood (**Table 1**, p. 3) provide the basic information. Note that the development time for larvae (6 days) is twice as long as for eggs (3 days). The capped worker brood development time (12 days) is twice as long as for larvae. This indicates that the larvae in the brood nest will cover twice as much comb as the eggs, if the queen is laying the eggs at a steady rate and if no stressful factors interrupt brood rearing. Likewise, the capped brood will cover twice as much comb as the larvae, if egg laying and



Some pesticides affect the bee colony's brood more than the adult bees. A light dose of pesticide can cause a temporary gap in brood rearing without killing many adult bees.

### Finding the queen

It can be difficult to find the most important member of the hive. She is living with tens of thousands of workers, and looks only slightly different. Also, the queen tends to avoid light. If you hold a frame of bees horizontally, she may walk quickly to the darker underside before you notice her. Even the most experienced beekeepers have trouble finding the queen at times.

Here are a few tricks to finding your queen:

1. Open the hive with a minimum of smoke and disturbance. If the colony is badly disrupted, the queen may run to a corner and hide under a layer of workers.
2. Look first on the brood nest frames. She will almost always be there, looking for an empty cell to lay her next egg. Very rarely will she be on a honey frame or empty frame outside of the brood nest.
3. Hold the frame in direct sunlight. It's amazing how much harder it is to find the queen on a cloudy day.
4. Form a "search image" in your head. While you are looking, think about just how she looks --a longer abdomen, often a slightly different color than the workers, walking slowly, and surrounded by a circle of attending workers.
5. Some beekeepers will mark their queens with a bit of paint. (See **Marking and clipping a queen**, p. 70) A white spot on her back makes her much easier to find. Some queen producers will mark your queen for you if you specify this in your order.
6. Set an empty hive body near the hive, on a stand or another hive body. After examining each frame place it (including the bees on it) in this hive body. This keeps the queen from moving over to a frame you have just examined. Eventually you will narrow the search down to the last few frames in the hive.

schedule through the spring. They may not be able to get your queens mailed when you want them, especially if a late spring hurts their queen-producing hives. If you need to buy queens in fall, only some queen producers in the south may have them for sale. One good source for fall queens is Hawaii. Check beekeeping magazines for advertisements.

Queen bees experience some stress in the mail. If possible, collect your queens directly from your post office. Contact the queen producer by phone or e-mail for the anticipated shipment date. Then inform your post office that you will pick them up the day they arrive. This will save the queens from the stress of being in a hot or cold mailbox.

When you get your queens, try to install them in the hives as soon as possible. However, bad weather can force you to wait. In the meantime, find a safe place for her. A dark spot not too warm or cold is ideal, for example a cabinet or drawer. Place a tiny drop of water on the screen of the cage, every day. She should go into the hive within two or three days if at all possible. She may die if she's in the cage too long.

Each queen cage will include about five worker bees, the attendants, which feed the queen. Occasionally a few of the attendant bees will die in the cage. This is not a serious problem if a few remain alive to care for the queen.

### **Requeening a hive**

When a queen is old, failing, or of an undesirable genetic stock the hive should be requeened. The first step is to find the old queen and remove her. This step is usually the most difficult one, but important because the two queens cannot live together in the same hive. (See **Finding the queen**, p. 65) Let the hive remain queenless for several hours to two days. In this time the queen pheromone will diminish and the workers will become eager to accept a new queen.

When you are ready to introduce the queen, bring the queen cage to the hive and open the hive. Next, note that the cage includes some white sugar paste, or "candy" at one end of the cage. A small cork plugs a hole at the end of the queen cage with the candy. Remove this cork with a pocket knife or hive tool.

When making a new hive by dividing an existing hive, a new queen will be needed for the divide which does not have the original queen (See **Dividing hives**, p. 71.). Follow the introduction procedure given above under **Requeening a hive** (p. 67).

A hive that has lost a queen through disease or some other factor is more difficult to requeen if it has been queenless for more than several days. Over a long period of queenlessness, some workers become aggressive toward a new queen and may kill her. Consequently the beekeeper should take extra care in the procedure. Follow the procedure above for queen introduction, and if possible add a frame with young brood from another hive. This young brood emits a pheromone that encourages the workers to accept the queen.

**Why not let a colony requeen itself?** Beekeepers may be tempted to let a colony rear its own queen. This is certainly easier on the beekeeper, as no queen must be purchased and no hive manipulations are required. However, there are important disadvantages to this short cut.

First, the hive may be unsuccessful in the process of rearing a new queen. Also, the queen may be unsuccessful in mating with sufficient drones, especially if the weather is bad when it's time for her to take a mating flight. Second, the time for the hive to rear a queen and for her to mate is around two or three weeks. This will be a long gap in egg laying, and eventually a big drop in the worker bee population. Third, the new queen may mate with drones of an undesirable stock. However, beekeepers often see success with this method. It's often called a "walk-away split" because the beekeeper simply splits the hive and walks away.

### **Marking and clipping the queen**

I like to have marked queens in my hives, but this is not essential to good beekeeping. The advantages are that a marked queen is much easier to find, and that I can tell whether she has been superseded. Some commercial queen producers will mark your queens before sending them to you for a small additional charge.

To mark a queen, a paint pen sold by beekeeping supply stores for this purpose is best. Other paints have been used -- the small bottles sold in hobby stores or typewriter correction



To divide a strong hive into two smaller hives you will need another queen and an extra set of hive parts including a bottom board, inner and outer covers, and a hive body. When you have the new queen and hive parts ready, set up the empty hive and transfer frames so that about half of the brood, honey and pollen are in the new hive. Do not shake the bees off as you transfer the frames --they will be a part of the divide too. During this process, look for the queen. She can remain in the original hive or be moved to the new one. Just remember where she is, and introduce the new queen to the queenless bees. (See **Introducing a queen to a newly divided or queenless hive**, p. 69.)

**Establishing the divide at the same apiary as the original hive.** If your new hive is in the original apiary, many of the older bees in it will fly back to their original hive. These are the field bees that have learned where the hive is in relation to landmarks nearby. (See **The life of a worker bee**, p. 8) The younger bees have had no experience outside of the hive, and will orient to the new hive when they are older and begin to fly. To compensate for this, shake about 2/3 of the adult bees into the new hive when making your divide. After many of the older bees return to the original hive, you will have roughly similar populations in each one.

**Establishing the divide at a new apiary.** If the new hive is to be established more than a mile away, few or no bees will recognize their new surroundings and find their way back to the original site. In this case, you should make the divide by transferring about half of the adult bees. Divides are relatively easy to move because they are small. (See **Moving Hives** p.73.)

### Uniting hives

There will be times when two colonies must be united into one stronger colony. This may be when some are not strong enough for winter, or when one colony has been queenless so long that it can no longer be requeened. (See **Laying worker bees**, p. 58.) The potential difficulties are that any two hives have different odors which are easily sensed by the bees, and that two brood nests must be arranged into one.

A staple gun is ideal for securing the mesh across the entrance. Tie the hive together very tightly, from outer cover to bottom board with rope or straps.

The big move should be done soon after closing the hive --when it is still dark or early in the morning, if possible. The bees will suffer if they are confined for a long daytime period. Lifting the hive into the truck or trailer is generally a two-beekeeper operation. One person on each side of the hive lifts while holding the bottom board, and the hive is then fastened securely on the truck or trailer.

Consider your route before traveling. Try to avoid very steep and rough roads. Bring all of your beekeeping equipment along, in case a problem develops. If the hive tips or opens on the trip, the bees will be irritated and you will be very glad to have your bee suit, veil, gloves, hive tool and smoker handy.

When you get to your chosen site, place your hive on a steady and level hive stand. Then untie the hive and remove the screen from the entrance. The bees will begin to fly around and will realize they that are in a new location. They will circle the area for the first day or two, memorizing landmarks: trees, houses, and other conspicuous objects. By the third day (or later if bad weather prevents flight) they will be coming and going as if they had always lived there. For the first week or so they will still be irritable from the disruption, so it's best to avoid opening the hive in that time. If the weather is good and forage abundant, the bees will usually be very gentle one week following the move.

### **Culling old frames**

Wax comb darkens as the bees use it, especially when the comb is used for rearing brood. Maturing larvae and pupae leave behind very thin skins (called *exuvia*) as they molt, and also tiny fecal pellets. In this way brood rearing thickens and darkens the comb. Pigments from pollen also add to the comb color as they leach into the wax. Most important, spores from nosema, foulbrood and chalkbrood diseases persist indefinitely in and on the

However, the bees often need assistance by the beekeeper to make overwintering success routine. Preparations for winter begin in August and September. Here is a five-point check list:

1. Are there enough bees in the hive?
2. Is there sufficient honey in the hive?
3. Are mites and diseases under control?
4. Is an entrance reducer installed and the hive reduced to one or two hive bodies? (page 76 indicates that it is necessary to have 10-12 deep frames of honey for overwintering and below it indicates that you should have 8-10 deep frames covered with bees. There isn't enough room in one deep super to overwinter and still have some brood...)
5. Has the queen excluder been removed?

The remedies for the corresponding problems follow:

### **Increasing the number of bees by uniting weak colonies**

By August or September the bees will be rearing less brood than earlier in the year, so little growth can be expected before winter. At this time, weak colonies should be united with each other or with stronger colonies. (See **Uniting hives**, p. 72.) The goal is to have a hive with at least eight to ten deep frames (most of one deep hive body or the equivalent) covered with bees.

When estimating the population of bees in a hive, consider that the weather and time of day make a difference in the number of frames they cover. During cool weather the bees will cluster. The middle of a warm day, many field bees will be away from the hive. Either of these conditions can lead the beekeeper to underestimate the number of bees in a hive.

### **Evaluating the hive for honey stores**

Your bees will have no opportunity to collect nectar for about five months in late fall and winter. During most of that time the weather will be too cold for them to accept sugar



excluder, and the queen below it, the workers will have to choose between the honey and their queen. They will choose the honey, the queen will be left alone to die, and without the queen the rest of colony will die quickly. Remember that in winter the colony has no brood, no drones and hence no chance to make a new, fertile queen.

## **PART 5: BENEFITS FROM HEALTHY HIVES**

### **PRODUCTS OF THE HIVE**

#### **Honey**

Honey is a concentrated solution of sugars and other floral substances prepared by bees from nectar. To be ready for harvest, honey should contain 18% water or less. The remainder is mostly two sugars --glucose and fructose. Small amounts of other sugars, enzymes, vitamins and minerals are present, plus the floral components that give it a distinctive color and flavor.

Nectar is a watery, sweet liquid produced by the flowers of many types of plants. By offering this reward, certain plants attract bees and are cross-pollinated when the bees carry pollen from one plant to another. On returning to the hive, a bee places the nectar in a honey comb cell. Other bees then process the nectar by adding enzymes and fanning air across the nectar. Much of the water evaporates, and enzymes remove some of the water. Other enzymes produce natural antibiotics, make the honey slightly acidic, and convert sucrose sugar to glucose and fructose sugars. When the enzyme activity and the evaporation of water reduces the water content sufficiently, the honey is *ripe*. Each cell full of ripe honey is then covered with wax.

**Crystallized honey.** Honey has such a high concentration of certain types of sugar that it will tend to form sugar crystals. Crystallized honey, also called granulated honey, is perfectly safe to eat. It has the same flavor as liquid honey, but a different texture. Some

Pollen grains are the male germ cells of a plant. Some plants need bees or other flower visitors to move their pollen from flower to flower. Most other flowers rely on wind to spread their pollen. This process of pollination initiates fertilization and then the creation of seeds. Kentucky apples, peaches, berries, cherries, cucumbers, squash, pumpkins, melons, sunflowers, and many other crops begin with pollination by bees.

Plants usually produce much more pollen than they actually need for the cross pollination of a few of the plants in the area. The surplus serves as a rich food for the pollinators: protein, vitamins, minerals and other nutrients. When bees bring it back to the hive, they will store it in the comb. Some workers may eat the pollen right away, particularly the nurse bees which have active glands for feeding larvae and the queen. In a hive that is desperate for pollen, nurse bees may snatch the pollen loads off of returning foragers just as they enter the hive. Pollen is needed especially in springtime, when thousands of hungry larvae are growing in each hive and the queen is laying 1000 or more eggs daily.

On a nice spring day, bees with pollen packed onto their hind legs are rushing back to the hive in great numbers. During this pollen flow you can watch the entrance of your hive to see many different colors of pollen. This will give you an idea of how many types of flowers are visited by your bees. But any one pollen forager generally carries only one type of pollen. By specializing only on one plant species at a time, the bee is a more efficient pollen collector and also better at pollinating that particular type of flower.

### **Beeswax**

Beeswax is produced by a set of eight wax glands on the underside of the worker bee. A bee secreting wax will pull a tiny scale of wax from her gland, and add it to the wax comb. Using her mouth and antennae, she then shapes the wax scales into the hexagon pattern of the comb. This comb pattern is truly remarkable: it is the most efficient use of space and the strongest structure for the amount of wax used.

Bees produce wax most readily when they are foraging heavily on honey plants, or right after they are installed in a hive from a package or as a recently captured swarm. This is

Bees make propolis from plant resins. The resin is carried to the hive on the bees' legs, like pollen, and it then may be mixed with beeswax. A lot of propolizing is done in the fall when the bees are sealing up the hive in preparation for winter. Some strains of bees are heavy propolizers and will even cover part of the entrance of the hive with this sticky substance. This habit gives propolis its name, "before the city" in Greek.

### **HEALTH AND NUTRITIONAL BENEFITS OF BEE PRODUCTS**

Many claims are made about therapeutic effects of products from the bee hive. Some are true, some exaggerated and some are false. Many claims cannot be evaluated because the necessary research has not been done. Furthermore, most of what research has been done on the therapeutic effects of hive products is from other countries. For whatever reason, the results of that research have not been embraced by American doctors and medical researchers. The use of bee products for human nourishment, to cure illness or to heal injuries is called *apitherapy*.

#### **Honey**

Honey is predominantly water and several types of sugar. (See **Honey** p. 77.) Small amounts of enzymes from the bees and floral components give honey its distinctive flavor, color and aroma. It contains only tiny amounts of protein, vitamins and minerals. Some minerals, such as fluoride and boron, may be present at levels high enough to be significant for human health. The minerals in honey originate from the soil in which nearby flowering plants grow. Consequently, the mineral content of honey will depend on the soil within foraging range of the hives.

A recent study showed that dark honey is higher in anti-oxidants than light honey. Foods with antioxidants reduce the risk of cancer. This is good news for beekeepers who produce mainly dark honey.

Many people feel that honey consumption reduces their pollen allergies. One hypothesis is that consumption of the small amounts of pollen that accumulate in honey cause relief of the allergies. If this happens to be true, the honey would be beneficial only if it had not been



to have a bad reaction to one type and not other types of pollen. Those who want to eat pollen should start with very small amounts.

A second issue is whether pollen has any special nutritional value when compared to other foods. All of the nutrients known to be in pollen are found in a conventional diet which is less expensive. Also, the human digestive system is not well adapted for pollen. The pollen grains often do not rupture in our stomachs or intestines as they do in the digestive system of a bee. If the pollen grains remain intact they do not release many of their nutrients.

Finally, many vitamins in pollen degrade if the pollen is not frozen. All of the pollen I've seen in stores is kept at room temperature. Who knows how long it has been since the bees collected it?

Pollen is fed to domestic animals too. Many of the horse farms around Lexington add pollen to the feed of their horses.

### **Propolis**

Bees gather plant resins and mix it with beeswax, especially in fall, in the process of propolizing their hives. This material has antibiotic properties which probably help the bees fight their diseases. Extracts of propolis in alcohol have been used by people to fight infections. Like other bee products, propolis has received little careful study in the U.S. However, a new type of antibiotic would seem to be valuable if it were effective and had no serious side effects. Human health is seriously threatened by bacteria and other microbes which are now resistant to many of our standard antibiotics.

### **Royal jelly**

The nutrient-rich food fed by bees to the larvae which are developing into queen bees can be collected by beekeepers. (See **The life of a queen bee**, p. 4.) This is more popular for human consumption in Latin America than in the U.S.

Royal jelly does have many of the nutrients needed by humans. But many of the concerns about pollen apply to royal jelly also. People have been known to suffer allergic

**Uncapping knife.** The wax cappings on honey frames must be removed before the honey can be extracted. This is done with an electric uncapping knife. The knife contains a heating element that gets it hot enough to melt wax. The beekeeper slices the cappings off of the honey frame just before putting them in the extractor. If you have only a few frames to uncap you can get by with a capping scratcher (below) or any stout knife.

**Extractor.** A honey extractor is a large centrifuge that spins the frames so that the honey is thrown out of them. The honey collects at the bottom where a gate can be opened. Alternatives to an extractor are described below.

**Filters.** As the honey comes out of the extractor, it is then filtered to remove bits of wax and other foreign material. A good system is a pair of stainless steel filters which nest together and rest on a plastic bucket. The honey then goes through a final filter of 80-mesh cloth.

The following tools are not absolutely necessary, but can be useful:

**Bee escape.** This is essentially a one-way door for bees. When placed in the hive it causes the bees to move away from the honey super. (See the description below.)

**Cappings scratcher.** This looks like a fork with many tines. It's inexpensive and handy for opening the capped cells you can't reach with the knife.

**A large basin.** This is to catch the honey cappings. You can purchase a stainless steel basin, or just use a large pan.

**Refractometer (re-fract-AH-meter).** This is a device that measures the amount of water in honey. It's a help when rainy conditions interfere with the ripening of honey. It costs several hundred dollars and is usually not purchased by the beginner.

### **Extracting and bottling the honey**

Before starting, be sure you have enough containers. One shallow super will hold up to 25 pounds of honey. That's about eight quarts.

**Removing the honey frames from the hive.** There are several methods for removing the bees from the honey frames. If only a few frames are to be harvested, it's easiest to

This will get most of the honey out of the frames, although they will still have a little. Return these "wet" frames to the bee hives. In a few hours the bees will clean up these frames. If you're curious, take a look at these frames in the hive the following day to see how quickly the bees clean and repair the honey cells.

**Filtering and bottling.** Arrange the filter under the outlet of the extractor and get the bottles ready. Open the outlet and filter directly into the jars. (Tom, I don't agree with this. If you have any quantity of honey it is better to strain it into a settling tank or 5 gallon bucket and bottle from this. Skimming each individual bottle takes a lot of time.)

Let the bottles stand one or two days. A little fine debris and bubbles will come to the surface. This is easily skimmed off with a spoon. You now have your first honey harvest.

The honey extractor costs at least \$200 new. Is it really necessary to buy an extractor? Since it is used only once a year it can be shared. Some local beekeeping associations have extractors available to members. Inexpensive "honey squeezers" and "honey presses" that squeeze the honey out of the comb can be an alternative to an extractor. These devices have two disadvantages. Squeezing the honey from comb is much slower than removing it with an extractor. Also the comb is destroyed in the process, so the bees will need to build new comb to replace it in the hive. The bees require more time and food, and produce less honey if they need to build new comb for the next honey harvest.

## **HONEY PLANTS IN KENTUCKY**

**What makes a good honey year?** Certain years have just the right weather pattern. This occurs when honey plants, especially trees, bloom profusely and there is little rain during bloom. The year 1993 was an example. For about two weeks, black locust trees were covered with white blossoms all across the state, and many beekeepers made an excellent crop. Black locust floral initiation takes place the previous season and is a function of the previous year's crop, the weather during floral initiation and if a killing frost occurs during the current season.



removed promptly when 90% of the petals have fallen to allow the grower to apply insecticides to protect his crop.

**Placement of hives.** If more than ten acres are to be pollinated, it's best to distribute the hives within the field or orchard. When foraging over a large acreage, the bees will concentrate on the bloom closest to them. In a field or orchard of less than ten acres, the hives may be placed either within or adjacent to the crop.

**Number of hives.** Most crops require around one hive per acre, although two or even three hives per acre are recommended for some crops. For guidelines on specific crops, consult your extension apiculture specialist.

**Hive strength.** The bees that are the best pollinators are those that are gathering pollen from the flowers. Nectar foragers will pollinate also, but less effectively. Consequently, the best pollinating hive is one with many pollen foragers. A hive full of bees and brood is ideal. The bees need the pollen for its protein and vitamins, to keep rearing all of that brood.

**Pesticide use.** If you do not own the crop to be pollinated, discuss the issue of pesticide use with the farmer before agreeing to the pollination job. If at all possible, insecticides should not be applied while the crop is in bloom and the bees are nearby. Insecticides are much more hazardous to bees than herbicides and fungicides. (See **Pesticide poisoning**, p. 56.)

**Competing bloom.** The bees will look for whatever is in bloom near the crop. If attractive honey and pollen plants are abundant, fewer bees will visit the crop to be pollinated.

**Pollination fee.** Beekeepers receive a fee per hive for pollination services. The fee will be relatively low if the beekeeper is not sacrificing a honey crop in the process, no pesticide damage is allowed, and the hives are not moved a great distance.

Some crops, such as cucumbers, bloom over a long period of time or there may be multiple plantings. Hives which provide this pollination over an extended bloom period have higher rental fee, perhaps over \$100 per hive. Hives that are moved suffer a little as the forager bees must learn their new location and the bloom that is available. If the location

Honey bees don't do this while other bee species like bumble bees are very good "buzz pollinators". The alfalfa blossom is also a problem for honey bees, but for a different reason. It has a trip mechanism that hits the bee on the head to deposit pollen on her. Soon the foraging bee learns to avoid tripping the flower by sneaking nectar from the side of the flower. But the honey bee then becomes a poor pollinator because she doesn't pick up any pollen. Bumblebees, leaf cutter bees and orchard bees have become popular for the pollination of certain crops.

## **PART 6: LEARNING MORE**

### **BEEKEEPING ASSOCIATIONS AND FIELD DAYS**

The Kentucky State Beekeeping Association (KSBA) welcomes new members. Members receive the Bee Line, a newsletter that comes out both on paper and electronically, to inform members of beekeeping news, advice and comment. The KSBA meets on a Saturday every spring, summer and fall.

Approximately 27 local beekeeping associations also exist in Kentucky. Regular meetings provide excellent opportunities for beginners to meet experienced beekeepers. Some associations hold field days. These are social occasions when hives are opened and beekeeping techniques are demonstrated. Contact your apiculture extension specialist or the KSBA president for more information on the KSBA and local associations near you.

The Heartland Apicultural Society (HAS) conducts a three day conference in the Midwest or south, usually in July. About 50 topics are presented for beginners and experienced beekeepers. Practical beekeeping skills and opportunities are emphasized. See [www.heartlandbees.com](http://www.heartlandbees.com).

The Eastern Apicultural Society (EAS) holds meetings every August, at a location in the eastern United States or Canada. They are usually five days long: a 2 1/2 day "short course" on beekeeping topics followed by the 2 1/2 day conference on all aspects of beekeeping and

**Bee Culture** (A. I. Root Co., 623 W. Liberty St., Medina OH 44256 or [www.BeeCulture.com](http://www.BeeCulture.com)). Recent articles: I "Bees in the city", "Observation hives", "Propolis", "Making honey beer", "Antique gardens", "Questions and answers".

### **Books**

**The Beekeeper's Handbook**, by Diana Sammataro and Alphonse Available, 3rd edition, published by Cornell University Press, Ithaca NY. (If you can buy only one book on beekeeping, this is one of the best. It is thorough and well written.)

**Beekeeping: a Practical Guide**, by R. Bonney, published by Storey communications, Pownal, VT (very good, practical)

**A Year in the Beeyard**, by R. A. Morse; published by Scribner and Sons, New York. (very good, practical)

**The Hive and the Honey Bee**, J. M. Graham and Dadant & Sons, eds., 1992, Hamilton, IL (essentially an encyclopedias for reference on nearly all beekeeping topics; with 27 chapters and over 1300 pages, it's a good investment for the serious beekeeper)

**The ABC and XYZ of Bee Culture**, by R. Morse & K. Flottum; published by A. I. Root Co., Medina, OH (a handy, alphabetical listing of many beekeeping subjects; much like an encyclopedia but shorter and more limited than The Hive and the Honey Bee)

**How to Keep Bees and Sell Honey**, by Walter T. Kelley; published by Walter T. Kelley Co., Clarkson, KY (inexpensive and helpful but very limited in scope)

**First Lessons in Beekeeping**, by C.P. Dadant; published by Dadant & Sons, ed., Hamilton, IL (inexpensive and helpful but very limited in scope)

**The New Starting Right with Bees**, revised edition by K. Flottum, D. Sammataro and C. Stephens; published by A. I. Root Co., Medina, OH (inexpensive and helpful but very limited in scope)

**American Honey Plants** by F. C. Pellett; published by Dadant & Sons, Harnlilton, IL - (the most extensive book on bee forage, written many years ago but as good as ever; now out of print)



there, in addition to many other informative displays pertaining to Kentucky wildlife. The Game Farm may be reached at (502) 564-4406.

### WHAT'S NEXT?

Give yourself about two years to become familiar with the basics of beekeeping. When you are confident with your understanding of the seasonal cycle and the most common activities and problems, you might be ready to take another step.

**More hives:** You will soon have a feeling for how much time and resources are needed for a few hives. More hives may seem like a natural progression. If you are efficient and the hives are all in one apiary, the additional time and equipment for 10 or 20 hives will not be very intimidating.

The largest investment for those harvesting more honey will be in extracting equipment. See beekeeping supply catalogs or web pages for specifics. With this expense in mind, a grant awarded to Kentucky State University has allowed the purchase and placement of large honey extraction units at various locations around the state. These are available to Kentuckians who have at least several hundred pounds to extract. Transportation of hive bodies, supers and other heavy equipment will require a truck or van.

Generally one apiary will support 10 to 20 hives. If the beekeeper places more hives at that site the bees will compete with each other for flora and suffer reduced yields.

**Alternative products:** The market for clean, carefully prepared pollen and beeswax is very strong. Start out on a small scale to how much time and effort is required.

**Queen rearing:** The procedure for rearing queen honey bees is fascinating and enjoyable. You can rear stock from your best bee stock, or from that of another beekeeper. The equipment needed is inexpensive and readily available. Workshops in Kentucky and books are devoted to this skill.

**Nucs:** New and established beekeepers are frequently looking to purchase additional hives. The option of buying nucs from another beekeeper nearby is attractive. (See Buying a nuc.) Once you are comfortable in managing your hives, you can see that it will be a simple

**bee space** -- a distance of 3/8 inch which the bees naturally maintain between adjacent combs

**bottom bar** -- the bottom piece of a frame, usually wooden

**bottom board** -- the bottom part of a hive, which supports the rest of the hive

**burr comb** -- comb built not in the frames but between frames or between frames and the inner wall of a hive body, usually because the frames are too far apart

**chalkbrood disease** -- a very common fungal disease of bee brood, which turns the brood to a chalk- like white or gray

**colony** -- the bees which live together in a cohesive society, including adult bees and brood but not necessarily including the hive they inhabit

**Colony Collapse Disorder (CCD)** -- a condition in which many adult bees suddenly disappear from the hive, for no obvious reason, but now apparently caused by a combination of mites and other factors

**comb** -- the wax structure made of many hexagonal cells in a hive, which the bees use for storing honey and pollen, and for rearing brood

**drawing out comb** -- the process by which bees construct their comb by adding wax and forming hexagonal cells on the foundation

**drifting** -- the movement of bees from their own hive to another hive nearby, usually because they aren't orienting to their own hive very well

**extract** -- to spin honey frames rapidly so that the honey is thrown out of them, prior to the filtering and bottling of the honey

**extractor** -- a large cylindrical device used to extract honey from frames by spinning them rapidly, working much like a centrifuge

**European foulbrood (EFB)** -- a disease of bee brood caused by bacteria

**feral bees** -- bees not kept by a beekeeper but living without management, for example in a hollow tree

**foundation** -- thin sheets of beeswax embossed with a hexagon pattern, used for guiding the bees' construction of wax comb in a frame

**observation hive** -- a small hive with transparent sides, usually kept indoors for close viewing of bee activities

**outer cover** -- the cover to a hive that fits over the inner cover and the rest of the hive; the type which overlaps the hive body below it is called a telescoping cover

**package bees** -- a colony of bees including the queen, in a screened box purchased from a commercial producer

**pheromone** (pronounced "FER-o-mone") -- a chemical used by an animal to communicate with one of its own kind; very important to honey bees and other social insects

**pollen bound** -- a hive condition in which so much pollen has been stored in the brood nest by the bees, they do not have room for rearing brood

**propolis** (pronounced "PRO-po-lis") -- a sticky substance made by bees to fill in cracks and openings in their hive, and as an antibiotic to protect the bees from diseases

**pupa** (pronounced PYU-pah) (**pupae, plural**, pronounced Pyu-pee) -- the immature form of a bee as it transforms from a larva to an adult --a local term for frame

**robber bees** -- bees that are stealing honey from another hive robbing the bees --removing honey from a hive for harvest

**royal jelly** -- a nutritious food that worker bees secrete and place in queen cells to feed larvae which will become queens

**rustic hives** -- hives kept by beekeepers in hollow logs or other non-standard equipment; also called "gum hives" or "bee gums"

**sacbrood disease** -- a disease of bee larvae that causes the larva to die and then resemble a sack of liquid; uncommon in Kentucky

**scattered brood** -- an irregular brood pattern (see "shot brood")

**shot brood** -- an irregular pattern of brood on a comb that shows many empty cells, like the pattern made by a shotgun on a target; caused by a queen with fertility problems or by laying workers stand -a local term for hive

**super** -- one of the upper hive bodies, which contains the honey frames