RAISING HEALTHY HONEY BEES

Text by Randy C. Lynn, DVM
Illustrations by Todd Cooney, DVM

For

Christian Veterinary Mission

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Raising Healthy Animals Series

Every year, thousands of people around the world struggle to survive because they don't have the right knowledge, skills and resources to care for their animals. Christian Veterinary Mission (CVM) sends veterinary professionals to live and work alongside many of these people to encourage them and provide them with not only much needed veterinary expertise, but also the hope that is only found in Christ. CVM veterinarians build lasting relationships with individuals and communities, helping them be transformed through Christ's love.

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The series of books published by Christian Veterinary Mission includes the following in order of publication:

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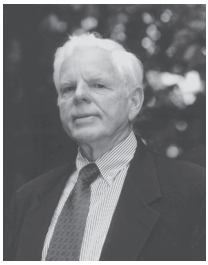
CVM fieldworkers have also developed specific training materials for the countries in which they work.

All of these books have been put together by Christian men and women; in a labor of love and service, for people in need throughout the world. It demonstrates dedication to their profession, service to humanity and a witness to their faith. We hope that they are a help to you in developing an appropriate livestock program to meet your needs. We pray God's blessing on their use.



Leroy Dorminy
CVM Founder

Disclaimer:

This booklet was prepared according to the current world literature on beekeeping. It is prepared as a service to people throughout the world that wish to better their lives by keeping honey bees. The editors, authors, co-authors and contributors to this volume, as well as Christian Veterinary Mission and World Concern assume no responsibility for and make no warranty with respect to the results that may be obtained from the uses, procedures and equipment listed. Furthermore, the editors, authors, co-authors, and contributors to this volume, as well as Christian Veterinary Mission, and World Concern shall not be liable to anyone whatsoever for any damage resulting from reliance on any information contained herein.

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Christian Veterinary Mission (Publisher of this book)

Our vision is to see

Christ's love expressed through veterinary medicine.

Our mission is to

challenge, empower and facilitate veterinarians to serve through their profession, living out their Christian faith.

CVM also provides education and encouragement for those who desire to minister through service, prayer, relationship building, and modeling Christ's love.

About CVM

Christian Veterinary Mission (CVM) is a registered non-profit Christian Service Organization 501(c)(3) based in Seattle, Washington, U.S.A.

CVM was founded in 1976 by Dr. Leroy Dorminy who came to realize the impact that veterinarians could have by integrating their faith with their practice, both locally and around the world. In 2008, CVM had nearly 30 veterinary professionals serving full-time internationally and over 200 veterinary professionals and student volunteers serve on short-term cross-cultural mission trips annually. CVM sponsors fellowship & prayer breakfasts at over 20 U.S. veterinary meetings each year and reaches out to veterinary students through Christian Veterinary Fellow-ship (CVF) groups in every veterinary school in the U.S. by encouraging them in spiritual growth and professional development.

There are over 3,500 veterinarians affiliated with CVM in the U.S. CVM also partners with organizations and networks in other countries that are focused on empowering Christian veterinarians. CVM has a volunteer advisory board of veterinarians who guide its vision, mission, and programming.

CVM books and the free International Animal Health Newsletter were written with small farmers, veterinarians, and agricultural development workers in mind. Our desire is that they would help individuals and groups develop an appropriate livestock program to meet community needs. CVM's Endowment Fund was started in the early years of the organization's life. The fund provides for meaningful programs that could not be funded by the regular budgeting process.

Section

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We thank our wives, Wendy Lynn and Lesa Cooney for giving us the time to complete this work. Finally, we thank Dr. Leroy Dorminy for encouraging us to use our knowledge and training to show God's love to our fellow man.

Introduction

Why do people keep honey bees? The simple answer is that honey bees produce honey and wax and improve the value of crops by pollinating flowers. The wax and honey may be consumed in the home or sold on the open market for cash. Keeping honey bees is the only type of farming that can be done profitably *without owning land.* Beekeeping can be done by anyone with fairly good health and strength.

Honey bees are very interesting animals. By opening a beehive you view an amazing insect world that is filled with order and purpose. It shows that God has a purpose and plan for the world and for our lives.

The fear of the Lord is pure, enduring forever. The ordinances of the Lord are sure and altogether righteous. They are more precious than gold, than much pure gold; they are sweeter than honey, than honey from the comb. By them is your servant warned; in keeping them there is great reward. Psalm 19:9-11

Section II

Honey Bee Biology

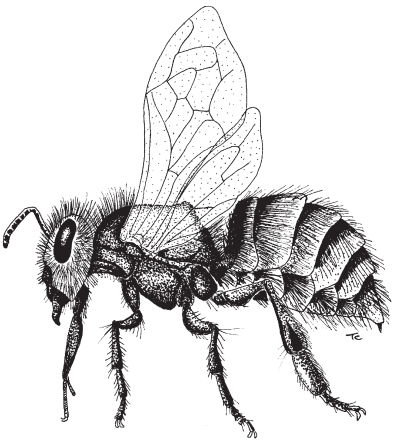


Figure 1. Adult Honey Bee

What is a Honey Bee?

A honey bee is an insect, which has six legs and two pairs of wings (Fig. 1). The honey bee usually lives in a large nest with many thousands of her sisters. They fly out of the nest during the day to visit flowers on plants, shrubs and trees. While visiting the flowers they gather pollen and sweet nectar. They feed the pollen to their young and turn the nectar into honey.

When the colony is threatened the bees fly out of the nest and attack the intruder, first by buzzing around the intruders head and then by stinging. The stinger is left in the flesh of the victim and the honey bee flies away to die.

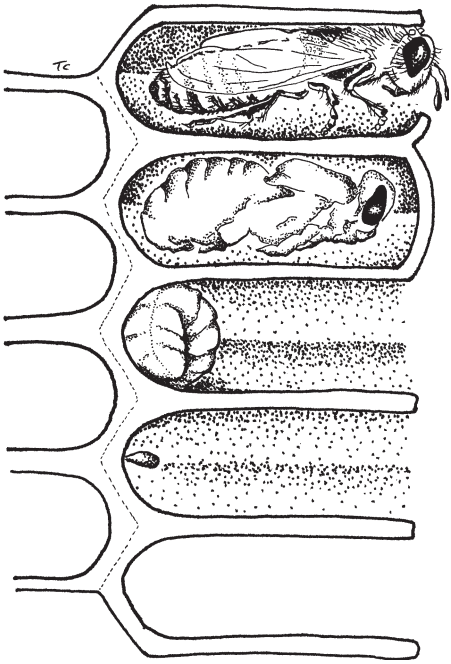
These three things typify the honey bee; large colonies, making and storing honey and stingers to protect the nest.

Lifecycle of the Honey Bee

Egg to Adult Bee

All honey bees start life as an egg, laid in a small chamber called a cell (Fig. 2). The cell is made of beeswax and is part of a larger structure called a comb. After three days the egg hatches and a larvae emerges. The larvae looks like a small maggot or grub. The larvae are fed a mixture of royal jelly and pollen. The royal jelly looks like a small drop of milk in the bottom of the cell. After five days, the larvae stops eating and begins to spin a cocoon. The cell is sealed with wax and left alone. Inside the sealed cell, the larvae is changing into the body of an adult honey bee. Thirteen days later, the young bee chews her way out of the cell and emerges as a full-sized, fully formed adult honey bee.

Figure 2. Lifecycle of the Honey Bee



Queen Bee

The queen bee is the mother of all the bees in the colony. She is larger than all the other bees (Fig.3). Her abdomen is especially long and slender, it contains the ovaries that allow her to lay over one thousand (1500–2000) eggs per day. A normal honey bee colony only has one queen. She lays eggs into empty cells in the honeycomb. She controls which eggs will develop into worker bees (female) and which will develop into drone bees (male). She has a stinger but she only uses it to kill rival queens, she will never sting a human.

The health of the queen will determine the health of the entire colony. If she is old and weak, then the colony will struggle and die. If she is young and fertile, then the colony will thrive and make the most of their surroundings. If she is gentle, then the colony will be gentle as well.

Drone Bee

The drone bee is the male bee. He is bigger and broader than his sisters (Fig. 3). He has very large wings and eyes. A normal colony may have several thousand drones. He does no work in the hive. His only job is to fly out of the hive and look for young virgin queens. When he finds them he must fly higher and faster than the other drones to catch the virgin

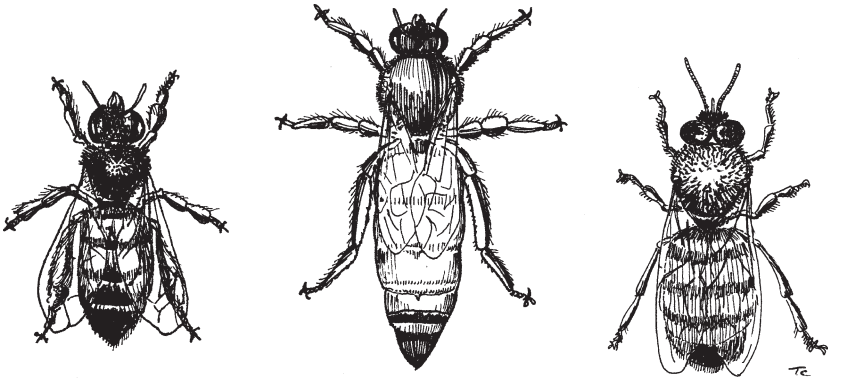


Figure 3. Queen, Drone and Worker

queen. When he catches her high in the air he mates with her. The mating process lasts just a few seconds and when complete then the drone falls away from the queen and drops to the earth dead as a stone. The queen will mate with more than a dozen drones in just a few days. She stores the seed (sperm) from the drones in her body and it will last her entire lifetime. Once she begins to lay eggs, she will never mate again.

When not chasing virgin queens, the drone does no work in the hive. He is fed honey and pollen by his sisters, the worker bees. They tolerate the drones as long as there is plenty of food. When the seasons change and food is in short supply, the drones are chased out of the hive to starve. Unlike workers and queens, the drone has no stinger.

Worker Bee

The worker bee is an infertile female bee (Fig. 3). She is the most numerous bee in the hive. A normal healthy colony may have 50,000 workers. These honey bees do all the work inside and outside the hive. The youngest bees start by cleaning the empty cells so that the queen can lay new eggs. After a few days she starts feeding the larvae and the queen with royal jelly from glands in her head. When the worker bee is about two weeks old, she begins to build comb using wax produced from her own body. She may also begin to process nectar into honey or pack pollen into empty cells. When she is about three weeks old, she will begin to guard the entrance of the colony and later she will start flying away from the hive to gather nectar, pollen and water. During periods of plenty the adult honey bee lives for about four weeks, before her wings and body wear out and she can no longer fly. When she is no longer useful for the hive she turns and walks away from the hive to die alone.

Lifecycle of the Colony

Basic rhythm of the colony

The honey bee colony responds to the environment that they live in. In most parts of the world there are two distinct seasons; one of plenty and one of dearth. In temperate regions these seasons correspond to summer and winter. In tropical regions these seasons are described by rainy and dry seasons. In seasons of plenty, the honey bee colony responds by dramatically increasing the population and the number of workers that can gather nectar and pollen. They store large amounts of honey so that they will have enough food to feed them through the period of dearth.

When the dearth comes, the queen decreases the number of eggs laid and the workers expel the drones. The colony population is diminished so that the precious food reserves will last. If the weather gets cold, then the bees gather together in a ball and vibrate their bodies to generate heat to keep the center of the nest a nice comfortable 35°C.

As the dearth period begins to ease, the queen increases her egg production so that there will be a sufficient number of bees available to gather the nectar when the time of plenty arrives. This cycle of plenty and dearth is the basic rhythm of the honey bee colony. It varies from region to region, but the people who live in the area know when these periods come and go.

Supersedure

A good, well mated queen may live for several years. Eventually however, even the best queen begins to suffer from advancing age or disease. When this occurs the colony must raise a new queen. This process is called supersedure.

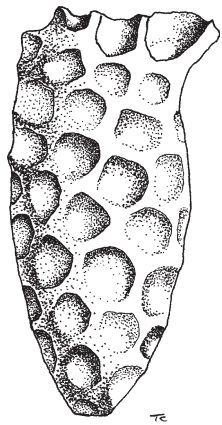


Figure 4. Queen Cell

If the queen is beginning to fail or if she has died, the workers take fertile eggs or worker larvae that are less than three days old and place them in a special cell called a "queen cell" (Fig. 4). These queen cells are shaped much like a peanut and they hang down from the surface of the brood comb like grapes. In supersedure, the queen cells are located in the middle of the brood comb (Fig. 5). The colony will usually raise 2–6 queen cells at one time when superseding an old queen. The larvae are fed large amounts of royal jelly and pollen, much more than they could

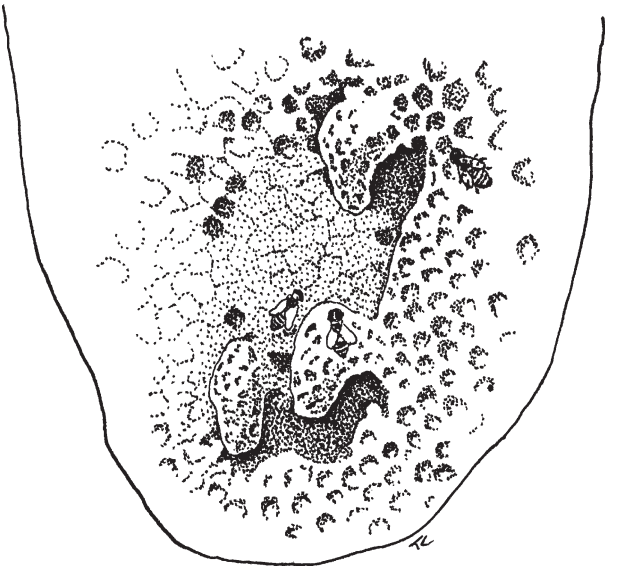


Figure 5. Queen Cells for Supersedure

possibly eat. The first virgin (unmated) queen will emerge from her cell in about 10 days. She will then search out the other queen cells that hold rival queens. When she finds them, she rips the cells open one by one and then uses her stinger to kill them all. This leaves her as the only virgin queen in the hive.

In a few days she is ready to fly out and mate. The queen will mate with up to 17 drones over several days. After she begins to lay eggs, the workers will not tolerate any other queen in the hive, and they recognize her by her scent, as their one and only queen. She has superseded her mother, who is usually removed by the workers.

Swarming

"Swarming" is when a strong healthy colony splits and sends out a daughter colony. A healthy colony normally has more than 50,000 honey bees living in one organized group. During a period of plenty and when the colony has so many honey bees that the hive is beginning to feel crowded, the colony begins preparation for swarming.

First, the honey bees fashion large numbers of queen cells along the bottom of the brood combs (Fig. 6). These "swarm cells" are different from supersedure cells in that they are found along the bottom of the combs and that they are found in very large numbers, typically 20–30. At

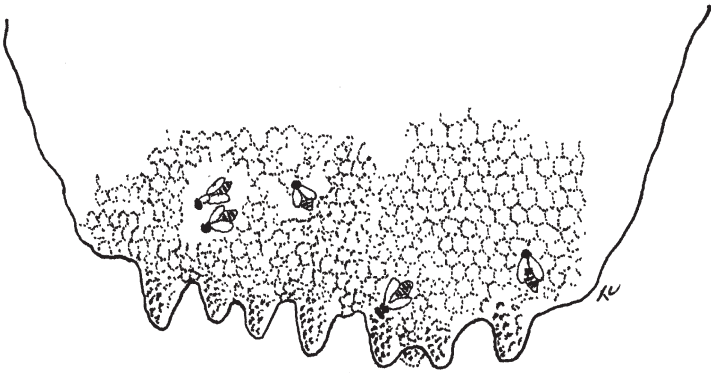


Figure 6. Queen Cells for Swarming

the same time the queen begins to decrease her egg-laying. This will allow her abdomen to begin to shrink, so that she can fly again. Finally, the workers begin to decrease foraging for nectar and pollen. This is obvious in a bee yard where all colonies are gathering except one or two, these colonies may be getting ready to swarm.

When the swarm cells are sealed at about eight days, the swarm is ready to leave the hive. If it is cold or rainy, they may wait a few days, but when the weather clears, they are ready to go. About 60% of the worker bees go to the nearest honey cell and fill themselves with honey. Then all the bees run throughout the hive in great excitement and shake the queen. The bees all rush out of the hive and fly around to create a great loud moaning sound. Soon the queen emerges from the hive and flies off with the swarm. The swarm looks like a big dark cloud of bees; it contains the original queen along with about 60% of the workers and a few hundred drones. The entire spectacle is very exciting and awe inspiring, but it only lasts a few seconds. The swarm often emerges in late morning or early afternoon.

The swarm flies a short distance away from the original colony and settles in a temporary resting place. A swarm will often gather on the branch of a tree, or a bush or fencepost. They all land on top of each other and form a great dark cluster of bees. They are all filled with honey and dedicated to find a new home. They have forgotten their old colony. Now they will live or die on their own, and will never return to the old colony. The bees are very gentle at this stage; they are full of honey and have no nest to protect.

Scout bees go out from the temporary resting place in search of a new nest site. The swarm will not move from the temporary site until a find a suitable new nest site is found. They usually stay a few hours and often

overnight, before they find the right nest site. Once the new nest site is found, they immediately fly to it. The new site may be close by or several kilometers away. The swarm moves in and begins to form a new colony. The workers fashion new comb from beeswax and the queen begins to lay eggs. The original colony has reproduced itself by sending out a swarm.

At the original colony, the remaining workers tend to the swarm cells. When the first virgin queen emerges, she may stay in the hive and take over the colony for her mother, or she may leave with a smaller group of bees in an "afterswarm". In many cases a strong hive may send out one "prime" swarm and many afterswarms. The prime swarms are very valuable to the beekeeper, and are the best way to start new colonies. The afterswarms are much less valuable and they often do not survive the dearth period, because they have too few bees and a virgin queen. The afterswarms weaken the parent colony to the point where it might not survive the dearth.

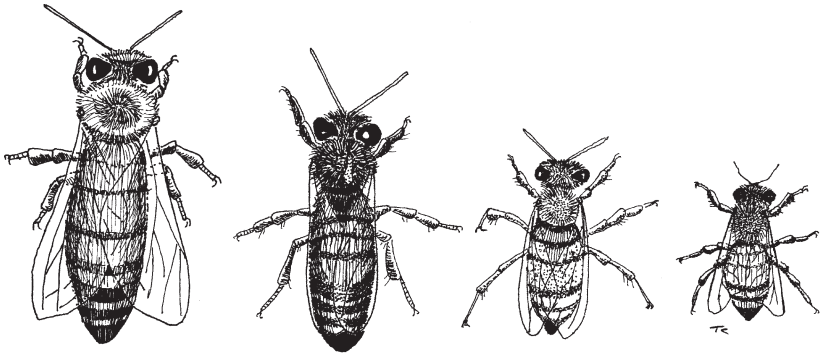
Eventually the "swarming fever" passes and the parent colony is left with a virgin queen and the remaining workers. The queen flies out, mates, and begins laying eggs to replace the lost workers. If they are lucky, they will gather enough strength and honey to survive the dearth. But they rarely gather as much honey as a strong colony that did not swarm.

Absconding

Sometimes a honey bee colony finds that it doesn't like the nest site or the area it is located in. When things are really bad the entire colony will leave the nest site and fly to a new nest site. This process is called absconding. Some types of bees are very prone to absconding and will do it often, other honey bees will almost never do it. The Asian honey bee is very prone but the European honey bee will rarely abscond. Absconding may be due to a disturbance of the colony, like a cow kicking over the hive, it may also be triggered when there is a shortage of food. In some areas of the world, Asian honey bee colonies migrate with the seasons, so that they always have access to a good food source.

Species of Honey Bee

There are about five species of honey bee in the world that produce a surplus of honey (Fig. 7). They all have important similarities and differences. Honey bees are present on every continent of the world except Antarctica. Most sizable islands also have honey bees. In the past, well meaning



Giant Honey Bee (*Apis dorsata*) | **Western Honey Bee (*Apis mellifera*)** | **Asian Honey Bee (*Apis cerana*)** | **Dwarf Honey Bee (*Apis florea*)**

Figure 7. Species of Honey Bee

people have brought honey bees to places where they were not naturally present, this practice sometimes created problems. Today most experts agree that the best course of action is to find the local honey bee species and use them in managed colonies. They are best suited to the local conditions and they usually cost nothing. The only cost is the time and trouble to find the natural nest or swarm and bring it home.

Are there beekeepers or natural honey bee nests in your area? If the answer is yes, then you are probably in an area where beekeeping may be worthwhile. What kinds of honey bees are there?

Western Honey Bees

There are two main types of Western Honey Bees, the European honey bee and the African Honey Bee (Fig. 7). They both produce large colonies that nest in hollow cavities with at least 10 parallel combs. In general, these two species of honey bee will not co-exist in the same area.

European Honey Bee

The European honey bee originates from the area of the central Mediterranean Sea and southern Europe. The most popular type or race of European honey bee is the Italian honey bee, *Apis mellifera ligustica*. There are many other races of European honey bee found throughout the world; these include the Carniolan, Carpathian, Caucasian, Syrian, Iberian, Cyprian, Sicilian, Punic and Saharan races. European honey bees are well adapted for temperate climates that have summer and

winter seasons. They raise large colonies, hoard large quantities of honey, are more gentle than other species and almost never abscond. The European honey bee colony is comprised of about 50,000 bees which cover about 10 combs that are parallel to each other. The nests are typically in a cavity, like a hollow tree. When ventilating the hive by fanning, the European honey bee stands facing the front of the hive. The drone cell caps of European honey bees have no holes. Unfortunately, they are often susceptible to diseases and predators. When European colonies are kept in the same area as African honey bees they are quickly taken over by African queens and converted to African colonies.

The European honey bee has been introduced by humans to almost everywhere on the planet. Today it is the resident honey bee in Northern Africa, the Middle East, all of Europe and Siberia, North America, Australia and New Zealand and most islands of the Atlantic and Pacific Oceans. The widespread influence of this honey bee was due to its introduction by European colonists who brought their own honey bees from home. Before European colonization, honey bees were not found in the Americas, Australia or tropical islands. American Indians called the honey bee, the "White Man's Fly."

African Honey Bee

The African honey bee is native to the African continent south of the Sahara Dessert. It is virtually identical in size and shape to the European Honey bee. The African Honey Bee is usually known by the scientific name of *Apis mellifera adansonii*. The key difference is that it is ***very aggressive*** and will defend the colony with ferocious stinging. It is more likely to abscond than the European honey bee, but it is well adapted to the harsh environment of Central and Southern Africa and is more resistant to disease. Because of it's aggressive nature, the site for these colonies must be chosen with care to prevent neighbors and bystanders from being severely stung. African honey bees raise large colonies, hoard large quantities of honey, but may abscond when conditions are unfavorable. The African honey bee colony is comprised of about 50,000 bees which cover about 10 combs that are parallel to each other, which are typically in a cavity. When ventilating the hive by fanning, the African honey bee also faces the hive entrance and the drone cell caps have no holes. They are less susceptible to diseases and predators than European colonies.

The African Honey bee is present throughout Central and Southern Africa and has been introduced into Brazil, where it has spread to all countries of South and Central America, throughout Mexico and into several areas of the United States.

Eastern Honey Bees

The Eastern part of the world is home to at least three different species of honey bee (Fig. 7). The Asian honey bee is similar to the Western honey bee as it lives on many parallel combs. The Giant honey bee and the Dwarf honey bee live on single combs out in the open. It is interesting to know that in some areas of the world all three species may co-exist in the same area.

Asian Honey Bee

The Asian Honey bee is slightly smaller that it's Western cousins. It is known by the scientific name *Apis cerana*. It is found throughout Japan, China, India and Iran and all areas south and east to the Philippines, Borneo, Indonesia and Papua New Guinea. The Asian honey bee is probably the first species to be kept in man made hives, in ancient China and Japan.

The Asian honey bee has colonies of 10–20,000 bees and is more gentle than the European honey bee. It lives on about 6–8 parallel combs which are typically in a cavity (hollow tree, rock cleft or walls). When ventilating the hive by fanning, the Asian honey bee stands facing away from the front of the hive. The drone cell caps of the Asian honey bee have a hole or "pore" in each one. It is superbly adapted to life in Asia and is much more resistant to parasites and diseases than the Western honey bees. It has a peculiar defense mechanism in addition to its stinging, when the colony is disturbed the bees join together to produce a loud hissing noise, much like a snake. It is particularly well adapted against attack by powerful enemies like the Japanese Giant Hornet *Vespa mandarinia*. The Asian honey bee mounts a group defense that allows them to overpower and kill the much larger enemy. Western honey bees can only defend the colony by individual action, and the hornets will often kill the entire colony.

Giant Honey Bee

The giant honey bee is *Apis dorsata*. It is the largest honey bee in the world. The size of a hornet, it is described as the "most ferocious stinging insect on earth." The giant honey bee inhabits much the same area as the Asian honey bee but only extends westward to Pakistan and north to the Himalayas. It produces a single spectacular comb, which usually hangs in the open, affixed to trees or rock outcroppings. The single comb may be up to one meter square and may contain 10–25 kg of honey (Fig. 8). Some estimate that 70% of the honey harvested in India comes from this species of honey bee. Colonies of the Giant honey bee are generally collected from the wild rather than kept in man-made hives.

Figure 8. Nest of Giant Honey Bee (*Apis dorsata*) (after Beekeeping and Development No. 52, September 1999)

The colony depends on the large body size and strength of numbers for defense. Surely, any predator must gather their courage before attempting to attack the colony.

Dwarf Honey Bee

The dwarf honey bee *Apis florea* is the smallest of the honey bees. They live in the same general area as the other Eastern honey bees, but they may be found farther west into Iraq and Abu Dhabi and extend east to Indonesia. They are found primarily in tropical regions in areas with dense bushes and small trees. Their colonies consist of a single small comb that is attached to a branch, combs typically measure 130–270 cm across (Fig. 9). The colonies may sometimes be found in small caves. A colony is usually comprised of about 7000 bees. They often abscond if conditions are unfavorable.

Figure 9. Nest of Dwarf Honey Bee (*Apis florea*) (after Ruttner)

Section III

Beehive Designs

Before we begin a discussion of the beehives, we need to define a few technical terms. For the purposes of this book, “hive” will be used to describe the physical home of the honey bee colony. The term “colony” will be used to describe the population of the honey bees including the queen, workers, drones, eggs, larvae and pupae. The term “brood” refers to the eggs, larvae and pupae. “Brood comb” refers to the wax combs that hold eggs, larvae and pupae. The brood comb is generally dark brown to black, depending on how many generations of bees have been raised in them. “Honey comb” holds honey, only honey and absolutely no brood, it is usually a bright white to golden yellow color, this is the comb that is highly prized for human food. Honey comb can be sold as it comes from the hive. No buyer can argue that comb honey is not the real thing; real honey right from the bees. Alternatively, honey comb can be processed further into liquid honey and put into bottles and jars for use in the home or for sale.

Wild Hives

The best way to see how bees live in a man-made hive is to first see how they live in a natural wild hive. Assume that a swarm has found a nice tight hollow tree to set up the colony in. How will they furnish the cavity? Honey bees follow a very precise arrangement in the hive. They rarely deviate from this pattern. There is a place for everything and everything will be in it’s proper place.

First, they will make 10–12 wax combs that are parallel to each other. The combs are attached at the top of the cavity and built down toward the bottom of the cavity, they are usually not attached at the bottom. The brood combs will be along the bottom of the center combs. The brood will extend to other combs to form a ball shaped brood nest. Pollen is packed into a thin band of cells just outside the ball of brood cells. Then outside the ball of brood and pollen, the bees will store the honey. In a healthy hive, the rest of the space will be packed full of honey, all the way to the sides and the top of the hollow cavity.

An important thing to note in the wild hive is that there is a space between each comb for the bees to pass through. This space is always the same size; it is called the "bee space." The bees respect the bee space. Any space in the hive larger than the bee space will be filled with comb. Any space smaller than the bee space will be glued shut to keep out weather and enemies. For European honeybees the bee space is 8 mm, for African and Asian honeybees the space is somewhat smaller. The other critical measurement in the wild hive is the distance between the centers of each comb. For European honeybees the comb space is 35 mm, for African honeybees the comb space is 32 mm and for Asian honeybees the comb spacie is 30 mm.

Species of Honey Bee	***Size of Comb Space***
European Honeybee	35 mm
African Honeybee	32 mm
Asian Honeybee	30 mm

Since the beginning of time human beings have hunted wild honey bee nests. Even today, honey hunters search out wild honeybee nests and then chop open the nest and take everything; bees, brood and honey. There are several problems with this approach. The colony is usually killed in the process. That is like killing a goat to get the milk. Also, hollows are usually found in old trees, therefore with increasing deforestation there are fewer old trees that provide nesting sites for honeybee colonies. To help solve the shortage of suitable nesting sites, humans started to make houses or "hives" for the bees to live in.

Fixed Comb Hives

The simplest man-made hive is a fixed comb hive (Fig. 10). It is simply a hollow log, box, basket, gourd or other container that is provided for the bees to live in. These have been found in all areas of the world where human beings have kept honey bees. The bees move into the hive and set up the colony as if it were in a natural cavity. The bee keeper often places the hives together in a "beeyard" where they can be watched and cared for. When the beekeeper wants honey, the oldest heaviest colony is killed and harvested much like a wild hive. Sometimes the beekeeper can take out the honey and leave the brood so the colony can survive, but more often than not the colony is seriously disrupted and killed in the process. African and Asian honeybees may abscond as a result of the insult.

The beekeeper catches swarms as they issue from the fixed comb hive and uses these swarms to replace the colonies he has killed or lost.

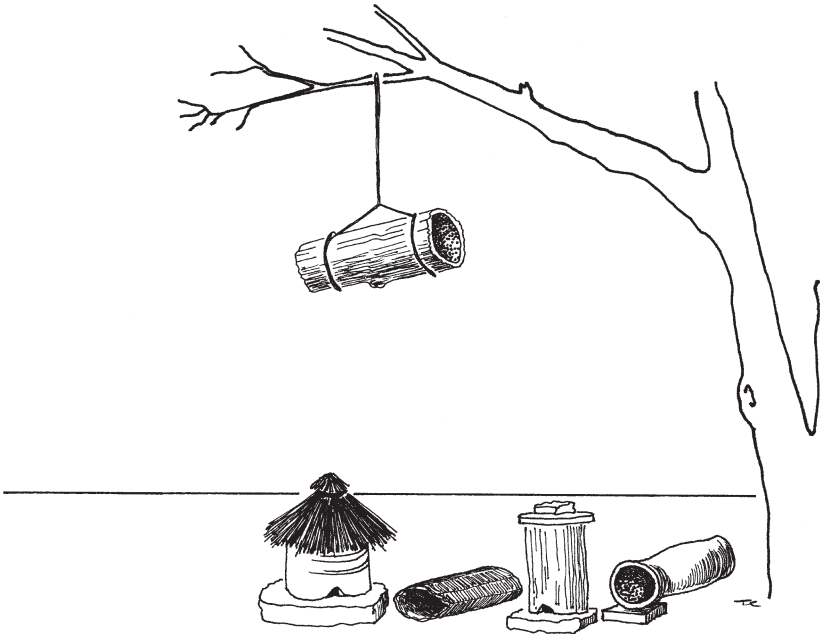


Figure 10. Traditional Fixed Comb Beehives

When beekeeping in this fashion, the beekeeper wants the bees to swarm often, so that the number of beehives can be increased.

The advantage of this type of beekeeping, is that it costs very little to start. The only cost is the cost of building or finding suitable containers. The disadvantage is that the harvest often results in the death of the colony; like killing a goat to get the milk. Another problem with this type of beekeeping is that the beekeeper cannot look into the hive to check for disease or problems with the colony.

Moveable Comb Hives

A major advancement in beekeeping was the development of the moveable comb hive. This hive is a container that has no fixed top (Fig. 11). The top of the hive is comprised of wooden or bamboo sticks called "top bars." The top bars are fitted tightly against each other to form the "top" of the hive. The bees naturally attach the wax combs to the top bars. The beekeeper can then pull out a single top bar and the comb that is attached to it. This means that the comb is moveable.

This inexpensive hive is easy to make and allows the beekeeper to have complete control over the colony. The beekeeper can open the hive at any time to inspect the colony for strength or disease or to harvest

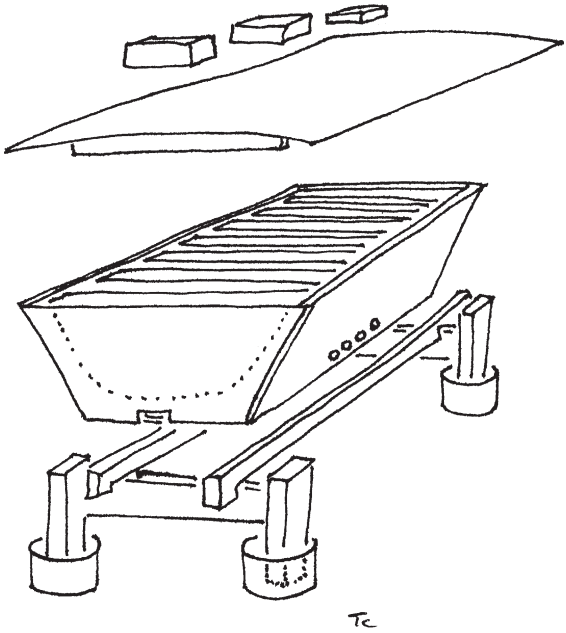


Figure 11. Moveable Comb Beehive

honey. The colony is not disrupted because the brood nest is totally undisturbed, that is like milking the goat without killing it.

The more advanced beekeeper can split the colony and start another hive from the first or unite two weak hives into a single strong and healthy hive. An undesirable queen can be removed and replaced with a young vigorous queen. A single strong hive can be used to raise a whole crop of young queen cells that can be used to re-queen the entire beeyard.

There are two popular designs for moveable comb hives, the "Kenya top bar hive" and the "Tanzania top bar hive." The main difference is the angle of the sides.

Kenya Top Bar Hive

The Kenya Top Bar Hive is made up of a long shallow box. See Section X. The two long parallel sides are sloped so that the box is wider at the top and narrow at the bottom. The originators of the Kenya hive believed that the sloping sides would prevent the honey bees from attaching the combs to the sides. The dimensions of the *box* are approximate and not critical to the function of the hive. The dimensions of *top bars* are critical,

if they are the wrong width, the bees will glue them together. If the top bar has no centering device, they will build their combs at right angles to the top bars and you have an old fashioned fixed comb hive.

Tanzania Top Bar Hive

The Tanzania Top Bar Hive is made up of a long shallow box. See Section X. The two long parallel sides are straight up and down so that the box has the same width at the top and at the bottom. Recent research has shown that the bees rarely attach the combs to the walls and when they do it is only a small attachment that is easy to cut through. The advantage of the Tanzania hive is that the square sides are easier to build and take less lumber. In addition, the wider base is less likely to tip over.

As with the Kenya hive, the dimensions of the *box* are approximate and not critical to the function of the hive. The dimensions of *top bars* are critical; if they are the wrong width, the bees will glue them together. If the top bar has no centering device, then they will build their combs at right angles to the top bars and then you have an old fashioned fixed comb hive.

Top Bars

The top bars must be thick enough to hold the weight of a comb full of honey. Some people use solid wood, bamboo or straight branches that are the right size. The width of the top bar must be equal to the size of the comb space (European bee = 35 mm, African bee = 32 mm, Asian bee = 30 mm (Fig 12). Finally, the top bar must have a "centering device." The centering device gives the honey bee a starting place for the comb. In natural hives the combs are curved for maximum strength. To make the combs moveable, they must be straight. The centering device is affixed to the bottom of the top bar along the centerline. The device may be a thick ridge of beeswax, a thin sheet of beeswax "foundation" that is stuck to the top bar with beeswax; or it may be triangular piece of wood. When the bees are first placed into the hive, they will start at the centering device and build their combs downward from there. When the combs reach the bottom or sides of the hive they will stop to leave a bee space between the comb and the walls of the hive. The end result is a straight comb firmly attached to

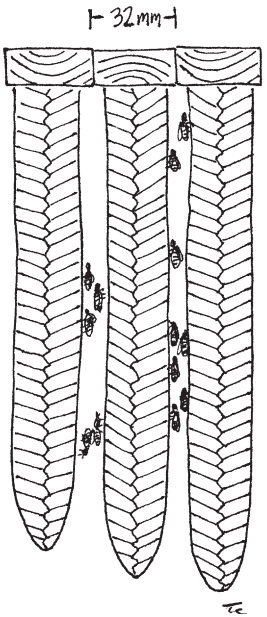


Figure 12. Normal Arrangement of Top Bars and Combs (after Fichtl)

the top bar, yet unattached to the sides and bottom of the hive and unattached to the other combs. The beekeeper can then move or remove the comb at any time, without disturbing the rest of the hive.

The key advantages of the top bar hive is the low cost of construction, and the simple design. A disadvantage is *new combs* are very fragile. The new combs must be handled with great care or they will break off of the top bar, and the beekeeper will find the beautiful comb smashed to the ground. This makes moving the top bar hive a rather delicate maneuver. Old brood combs get much stronger with age. In the end, the low cost and flexibility of the design still make the top bar hive one of the best hives for developing nations.

Moveable Frame Hives

The moveable frame beehive, was invented over one hundred years ago (Fig. 13). Today they are known by the names of the various inventors, like Langstroth, Dadant or Newton. These hives are based on a complex system where each comb is surrounded by a wooden or plastic frame. These frames hang in wooden boxes that have no top or bottom. The boxes stack on top of each other to provide more space as the colony requires it. These hives are the backbone of intensive commercial beekeeping in industrialized nations. It allows the colonies to be handled by power equipment and large trucks. The hives are often hauled for hundreds or even thousands of kilometers to find the best bee pastures. The

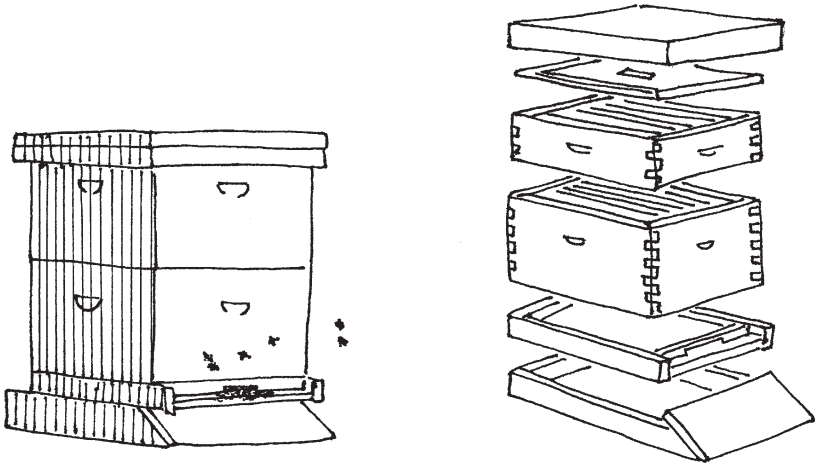


Figure 13. Moveable Frame Beehive

full combs are cleaned of their honey by large electric centrifuges and then placed back on the colonies to be refilled again. It is a beautiful system to watch, but expensive to acquire and maintain. A typical hive requires over 150 pieces of wood that are machined to precise tolerances. A new moveable frame beehive costs more than $100.00 in the United States. This price range is beyond the grasp of many potential beekeepers in developing nations. Plus the moveable frame hive has no real advantages over a well-made top bar hive, except that it will produce more honey.

A full description of this type of hive is outside the scope of this book. There are many books available that describe the dimensions, construction, and maintenance of these hives (Kelly, Root, Dadant & English).

Best Sites for Honey Bee Colonies

Choosing the best site to keep honey bee colonies is often a matter of much debate. The place that honey bees are kept is often called a "bee yard" or an "apiary." Put most simply it is a place where the honey bees are most likely to get the food and water they need. It should also be a place that is convenient for the beekeeper to get to and where the hives are not likely to be stolen, or damaged by vandals or livestock. It should also be a place where the bees will not sting or be a nuisance to other people.

Honey bees, need a good source of plants that produce nectar. It is nice to have these plants nearby, but honey bees will fly up to 5 kilometers in search of nectar and pollen. The more plants and the closer they are, the better the location for the beehive.

Honey bees also need access to water, especially in hot climates. The bees gather water from the edges of lakes, streams and even mud puddles, and bring it back to the hive. They evaporate the water inside the hive and cool the hive by fanning a constant stream of fresh air through the entrance. Without this cooling effect, the wax combs will melt. Honey bees cannot swim, so they generally land at the edges of the water.

Sunlight and shade are also important factors. The best locations provide sunlight in the early morning, so the bees begin to fly early in the day. Good locations also provide shade in the heat of the day, to help keep the hives cool. Locations where the hives are out in full sun all day long are not usually good, because the bees must work extra hard just to keep the hive from overheating. In general, placing the hives under tall trees, and facing them toward the south and east is a good place for them. If trees are not available, placing a thatched shade over the hives is a good substitute. Some people like to actually hang the hives from the branches of tall trees. This helps keep livestock and thieves from bothering them. Traditional log hive and top bar hives are often kept in this way.

Hives should be hung from trees or placed on stands. It is not good for hives to be placed directly on the ground because the wood rots quickly, and ants can gain ready access to the hive. Stands should place the hive at a height that makes it easy for the beekeeper to work the hive. Too high and the beekeeper must stand on a ladder to reach it; too low and he is crawling on the ground. Hive stands can be made of just about anything; scrap wood, pipe, metal or plastic. Some people put their beehives on a wall or roof.

If you are using African honey bees it is important not to have more than 12 beehives in one location, because when one hive gets angry, they all join in. With other types of honey bees you can put several dozen together in one place without any problem.

Section IV

Beekeepers Equipment

Smokers

A smoker is a device used by beekeepers to blow smoke into the beehive (Fig. 14). Smoke calms the bees and makes them much less likely to sting. Scientists know that honey bees communicate with one another using chemical smells called “pheromones.” When one bee becomes alarmed it releases a chemical called “alarm pheromone.” It smells like peanut butter. This smell tells the other bees to get upset and makes them want to sting. When the honey bee smells smoke first, it cannot smell the alarm pheromone, so it remains calmer. It may also think that the hive is on fire, so it runs to a honey cell and fills up with honey, which also makes the honey bee less likely to sting.

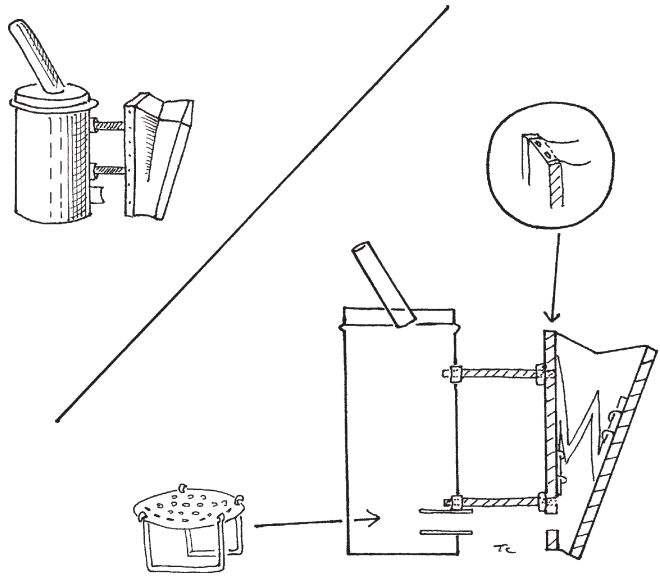


Figure 14. Beehive Smoker (after Gentry)

Ancient or traditional bee hunters used torches made of burning rags or grass to calm honey bees. These are sometimes dangerous because they often cause brush fires.

Modern smokers consist of a small metal can where a small fire is started; it is attached to a small bellows that blows air through the can. The whole device is small enough to pick up in one hand. It allows the beekeeper to control the amount of smoke and exactly where to blow it. It also helps prevent fires because the fire is safely contained inside the metal can.

Modern smokers can be purchased from local suppliers or made from local materials.

Hive Tool

The hive tool is a metal tool that is designed to manipulate the beehive. Soon after moving in, the honey bees begin to gather a sticky substance called "propolis." This is gathered from trees and plants and used to varnish the inside of the hive. They use it to stick all the parts of the hive together. The hive tool is designed to gently move the hive parts without upsetting the bees. They hate to be jarred or shaken. The hive tool also is designed to scrape propolis and cut through beeswax. It is often the only tool that the beekeeper needs to attend the bees. There are various designs used throughout the world. A few of the most popular designs are shown in Figure 15.

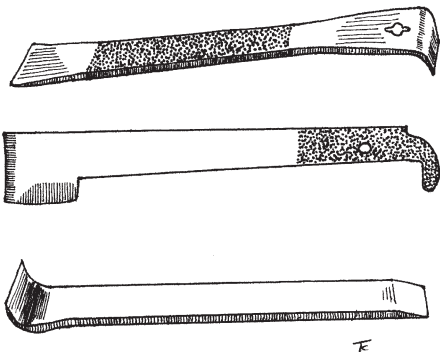


Figure 15. Hive Tools

Protective Clothing

Protective clothing is not a must, but it is an important factor in beekeeping. It is possible to tend bees even though they are stinging you all over, but it is a much more pleasant job if you have something to protect you from the stings. The most important protective garment is the veil. It is a head covering fitted with screen wire, so that the beekeeper can see, but the bees cannot sting the face. Honey bees naturally try to sting the face and eyes, so it is important to wear a veil to protect this vital area. Some beekeepers wear a "beesuit" which covers the whole body, except the hands and feet. This can provide even more protection against stings. Finally, some beekeepers wear gloves to protect the hands. Many expe-

rienced people prefer not to wear gloves because they make the hand movements clumsy and retain alarm pheromones for many hours, which can make the bees angry.

These items are not stingproof, but they greatly decrease the number of stings. They should be made of light colored material, never anything dark. Honey bees love to sting anything dark. They should be cotton or nylon to allow some degree of ventilation to the beekeeper. These items can be purchased from local suppliers, or see Section X for patterns to make them yourself.

Swarm Catchers

Swarm catchers are devices used to capture honey bee swarms. Since swarms are the best way to stock a new hive of honey bees, every beekeeper should be ready to capture them when they occur. It is a good idea to let everyone in the area know that you are looking for swarms of honey bees and then have your swarm catching equipment ready to go at a moment's notice. Most non-beekeepers are very happy for you to take them away, and you often get a nice colony out of a few minutes work.

The simplest swarm catcher is simply a burlap or cloth bag. If a swarm is clustered on the branch of a tree, simply pull the bag up under the swarm and around the branch. Tie the bag around the branch with the cluster of bees inside. Then cut the branch off and carry your bees home.

A better swarm catcher is a large plastic bucket on a pole. If the swarm is high up in a tree, then the bucket is placed up under the swarm and jammed against the branch, which jars the bees loose and they fall into the bucket. Then it is lowered to the ground and a screened lid is put in place to keep the bees inside. Make sure they have plenty of ventilation or they will suffocate.

An even better way to capture swarms in a bucket is to take a comb of young open brood (the ones that look like maggots) from an existing hive and place it in the bucket and prop it up near the swarm. This works especially well when the swarm is on something you cannot jar loose, like a wall or a building. The honey bees in the swarm will smell the pheromones coming from the young bee larvae and will immediately cover the brood and move into the bucket.

Once captured the swarms are easily settled into the beehive of your choosing.

Section V

Managing Honey Bee Colonies

Starting Colonies

There are several different ways to actually get started with honey bees. The easiest is to find a local beekeeper and obtain a colony by trading or buying one. Beekeepers are often ready and willing to help other people get started; you might be surprised by their generosity. If you start in this way, the beekeeper is often willing to help you move the colony to your beeyard and give you advice on when the major periods of surplus and dearth occur. Try not to buy a colony before or during a period of dearth because that is when colonies often die. Try to get one at the beginning of the surplus period. It is also a good idea to have the beekeeper open the hive and show you the strength of the colony, the amount of brood present and the presence of a live queen. It is like checking the teeth and legs of a horse before buying it. Try to observe the skills and equipment the beekeeper uses. It will help you learn how to work bees yourself.

In some countries you can also buy bees without buying a hive. You can buy a "nucleus" hive, sometimes called a "nuc." The nuc can be just a few combs of brood and bees and a laying queen. When placed into a hive and given food, it will develop into a full sized colony. The nuc can be sold in a temporary container for you to take home, or you can take your hive to the beekeeper and he will take the nucleus out of his hive and put it into yours. The nuc is usually less expensive than a full size colony, but in a few weeks it will grow into a full sized colony.

In some countries it is possible to buy a "package" of bees. The package usually contains three pounds (1.3 kg) of bees and a queen. The package is shipped by mail to the beekeeper in a cage made of screen-wire. It also has a can of sugar syrup that keeps the bees well fed on the journey. The beekeeper opens the cage and dumps the bees into the hive and then finds another tiny cage inside that holds the queen bee and several worker bees that "attend" the queen. The beekeeper puts the queen cage inside the hive and the workers will start setting up housekeeping. The queen cage has a special plug of candy that the

workers remove which releases the queen in a day or two, long after they have adopted the new hive as their home.

Catching a Swarm

Another great way to get started is to catch a swarm. Start by getting all your equipment ready *before* swarming season starts. Then tell all your neighbors that you are looking for swarms. In many countries the police and fire departments keep a list of beekeepers who want swarms.

The section on swarm catchers gives some information about the equipment and procedure for catching a swarm. Once you get the swarm home, it is a simple matter to place it into the hive. The most impressive way to hive a swarm is to lay a bedsheet or similar cloth on the ground and place the hive in the middle of it. Then just before dark take some of the top bars or frames out of the hive and dump some of the swarm into the hive, then pour the rest of the swarm onto the bedsheet. The sheet will keep the bees from getting lost in the grass. Gently replace the top bars or frames. The bees will start to investigate the hive, and as soon as they accept it, then the fun begins! Bees will line up near the entrance and stick their rear ends in the air and start to fan. They are releasing a chemical signal that tells all the other bees to go into the hive. The rest of the bees will all line up like little soldiers and march right into the hive! It is an impressive sight to see. After sunset, the hive can be removed from the bedsheet and placed on the permanent hive stand. But don't move it more than a few feet from where you first placed the hive.

Baiting a Swarm

Another way to get a colony is to bait the hive and hope that a swarm will move into it. It is a little like fishing, some years you catch a swarm and some years you don't. To bait a hive, you need to put some kind of smell into the hive to induce the bees to move in. There are several ways to get the smell you need. Melt some beeswax and paint it over the inside of the hive. Some people pour small amounts of dry granulated sugar or dry cassava powder into the hive. Other people use leaves of the lavender plant, or the "nunum" plant or lemon grass leaves and rub them on the inside of the hive. If none of these materials are available, some beekeepers rub small amounts or fresh cow dung on the inside of the hive. Once baited, the hive should placed on the permanent hive stand and left alone. It is very important that the hive be placed in the shade. If the heat of the sun touches the hive, the bees will reject it.

The hive should be checked periodically to see if the honey bees have found it. It is also important to check and see if any other guests have

moved in, like wasps, hornets or birds. These uninvited guests must be thrown out or bees will never move in.

Most new beekeepers are too impatient to simply wait for the bees to show up and prefer to actively go and find them. But experienced beekeepers will often place baited hives in the beeyard. This serves two purposes; first it allows them to use empty hives they would have to store elsewhere, and second, it gives them the chance to catch swarms from their own bees that might otherwise fly away for someone else to catch.

Transferring Colonies From a Wild Hive

Another good source of honey bees is to transfer them from a wild hive or from a fixed comb, traditional hive. Begin by bringing your hive as close as possible to the wild hive. Start your smoker and get dressed. Have two containers, one for honey combs that will be harvested, and one for brood combs that will be melted down for beeswax. Get a large feather or bee brush and a quantity of string.

Begin by puffing smoke into the wild hive. Be sure to smoke every entrance. Now cut into the wild colony with whatever tool is necessary. If in a tree, use axes and saws to open it up. Once the colony is exposed, begin pulling the combs out one by one. Be sure to look carefully for the queen. Put the combs that are filled with honey into the proper container and keep it covered. Brush the bees off the combs and into the new hive. When you find the brood combs, take 4–5 of the best ones and tie them with string to the top bars of the new hive. Also tie up two or three of the honey combs to the top bars as well. Brush or shake all the bees into the new hive. If you find the queen, try to brush her into the new hive. She will probably hide among the brood combs in the new hive. Remove all the combs and bees from the old hive. After putting the best combs in the new hive, put the rest in the containers destined for harvesting of honey or beeswax.

Close up the new beehive and place it as close to the wild hive site as possible. Leave it there for a few days. If you have removed all the old combs the bees will move into the new hive and make it their own. After a few days you can move the new hive to the permanent beeyard. Be careful when moving the new hive because the combs are only held onto the top bars by string. After seven days open the hive to make certain that the combs have been attached to the top bars by the bees. If so, you can remove the string. Also check to make sure that you still have a laying queen in the new hive.

It is a good idea to try to repair the damage done to the wild hive site. Close up the opening and leave the hollow space. That way another wild swarm may want to move in and you will have a chance to get another colony from the same site.

Inspecting Colonies

Once you have a colony established, it is time to start inspecting it. If you buy a new goat or horse, you will check on it occasionally to make sure it is healthy. It is no different with honey bees. Inspecting the colony will also tell you when it is time to split it into two colonies or when to harvest honey.

Inspecting colonies can only really be done with moveable comb or moveable frame hives. A fixed comb hive, in a calabash, log or box hive does not allow the beekeeper to inspect the colony. That is why moveable comb or moveable frame hives are better. This description will be directed to inspecting a top bar hive with moveable combs. The inspection of a moveable frame hive is very similar and is covered in detail in many other beekeeping books. These books can be obtained from the companies that supply moveable frame hives.

It is important to gather all your equipment together before opening the first hive. Next put on the veil and other protective clothing. The last step before opening the hive is to light your smoker. Make certain that you have a nice little fire going that will produce enough smoke. The last thing you want is the smoker to go out just when you need it most.

Before you even touch the hive, puff a little smoke into the entrance of the hive and into any other hives that are nearby. The colony will make a small buzzing sound as they begin to smell the smoke. Remember, the smoke is blocking the bees ability to recognize alarm signals from other bees. Therefore, the smoke must be applied BEFORE the bees get alarmed.

STOP! Take a deep breath and relax. Remember, what bees dislike most of all is vibration and being smashed. Take your time, be very deliberate and gentle and enjoy the experience. You are about to view a world that very few human beings ever take the time to see and enjoy.

Gently remove the cover from the top of the hive. Try to avoid vibration. Look to see if there are any holes in the top of the hive that the bees might be using as another entrance. If you see a hole, puff some smoke into it and wait a minute.

Lightly tap the top bars to find which ones have combs attached. In a newly established colony, the nest will usually be at one end of the hive. Start at the opposite end of the hive and gently remove one top bar (Fig. 16). The top bar may be glued down with propolis. The hive tool should be used to gently pry up the top bar. Set the top bar aside. If it has comb attached, be careful to set it where the comb will not be damaged. Gently blow a small amount of smoke into the gap left by the missing top bar.

Gently remove the next top bar and place it in the gap left by the first one. Then repeat this step, moving down the length of the hive until you

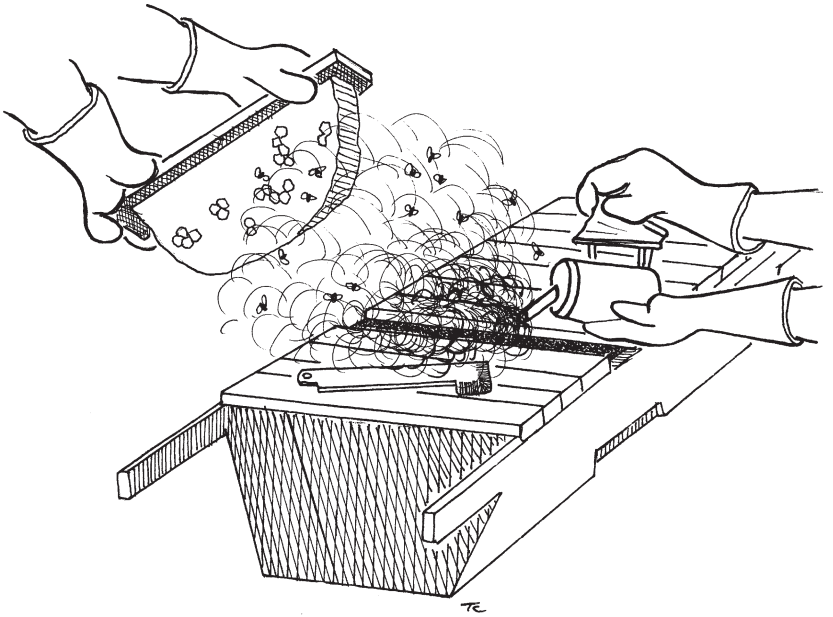


Figure 16. Opening a Moveable Comb Beehive

get to the first top bar that has comb attached to it. Blow small amounts of smoke into the gap from time to time, to keep the bees calm. Before you move the first comb, look to see if it is attached to the sides or bottom of the hive. The first comb is usually smaller than the others and usually contains honey or nectar. If the comb is attached to the sides or bottom of the hive, take your hive tool and gently cut the attachments. Be certain that you do not disturb the attachments to the top bar. After cutting the attachments, remove the top bar and comb and move it over against the top bars that you have already moved. Keep moving through the combs, carefully looking for attachments and cutting them. Be careful not to twist the top bar, or the comb WILL BREAK OFF! This is a discouraging feeling to see a beautiful newly drawn comb, break off and fall to the ground at your feet. If this happens, brush off the bees and place the comb into a container for harvesting. If it breaks off in the hive, then you must pull the comb and all the pieces out of the hive. Otherwise the bees will wax everything together and you will have a fixed comb hive.

As you move through the nest, you will first find combs filled with honey and nectar. Then the combs will begin to contain a small amount of "brood" in the center of the comb. Brood is made up of the young bees; eggs, larvae and capped pupae. When you get to the brood combs, take a close look. The brood cells should be grouped together on the comb (Fig. 17). They should be uniform in distribution, with brood of the same age grouped to-

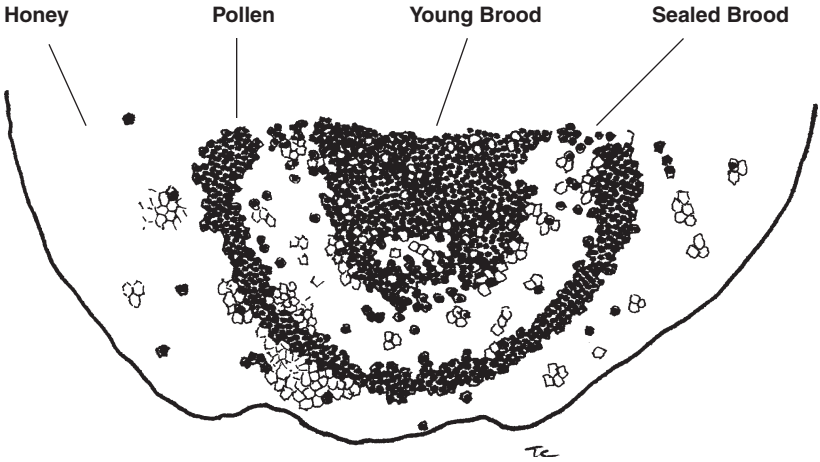


Figure 17. Normal Brood Pattern

gether. There should be cells with eggs of the same age, and larvae of the same age, and capped pupae all together. This indicates that a good fertile queen is present. She is laying all the eggs that the colony needs and is careful to lay them close together. If the brood pattern is spotty or haphazard, then something is wrong. Diseases and problems are discussed elsewhere in this book.

Look for queen cells. If the queen cells are in the center of the hive, they are getting ready to supersede the current queen. If they are very numerous and along the bottom of the combs, they are getting ready to swarm. You should take steps to prevent swarming or divide the hive.

Assuming that you have a good brood pattern, look for some other things in the hive. Look for pollen. Pollen is stored in cells very close to the brood, and it is seen as brightly colored cells. The pollen can by yellow, or gray or green. This serves as food for the young larvae. Look for drone cells, these have caps that look like little bullets. They stick up above the surface of the comb. The caps of worker cells are flat. If all the cells are capped with drone cells, then the queen is not fertile and must be replaced. Look at the worker bees, they should literally cover the combs. Look for drones, a good healthy hive should have plenty of drones during the periods of surplus. During a dearth period, they should be absent.

Look for the queen. She is often timid and hard to find. If you see a good brood pattern, don't worry about finding her; you know that she is there. Try to look for the queen whenever you inspect a hive. With practice it is easy to find her. Some beekeepers mark the queens with little dabs of paint. That way they know how old she is because they use a different color for each year.

Keep moving through the hive until you get to the other side of the nest. Take the first top bar that you removed and set aside, and place it in the gap left by the last top bar. Quietly and gently, replace the cover.

It may seem like there is a lot to look for, but with practice you can work through the entire hive and check all these things in just a minute or two. If everything is fine, move onto the next hive. If something is wrong, take a minute or two to fix the problem while it is still minor.

Try to inspect you hives frequently when you first start with beekeeping. With practice, the beekeeper will become confident and efficient around the hives. Each time a hive is opened, you will see more and know more about the bees. Take the time to watch the entrance for a few minutes and you will be amazed at God's creation.

Make a note of the date, the number of combs, the quality of the brood pattern and amount of honey. These notes can help you learn about how the colonies build up in your area of the world. Keep notes on the amount of sunshine and rainfall, and what flowers are blooming and when they start and when they stop.

Brood Inspection Checklist

Eggs and brood are present and look healthy
- The queen is present and laying, all is well with the colony

No eggs, no brood present
- Not brood rearing season,
- No queen,
- New queen not yet laying, or
- Extended shortage of pollen

No eggs, but brood present
- Brood-rearing ceased, end of the season,
- Queen has died,
- Colony is preparing to swarm, or
- Lack of pollen curtailed brood rearing.

Too many eggs per cell
- Young inexperienced queen, she will soon start laying normally, or there is a laying worker present.

If there are no eggs and the queen cannot be found, test for the presence of the queen. Place a brood comb with eggs or very young larvae from another colony into the middle of the brood nest and check back in three days. If the colony has started queen cells, then it had no queen.

Dividing Colonies

During periods of surplus and plenty, the colonies will greatly increase in population. This allows the colony to gather more honey for the dearth periods. The larger population also prepares the colony for swarming. Many experts believe that as the population in the hive gets more crowded, the bees will prepare to swarm. When they swarm, the most important part of the hive is lost, and the amount of honey they can gather is greatly decreased. You can avoid this problem by splitting the colony before they swarm. Splitting a large colony can also be used simply to increase the number of colonies.

To split a colony, prepare another hive of the same size and design. Take the new hive and place it next to the hive that you wish to split; the "parent" hive. Place some screen wire over the entrance holes of the new "daughter" hive. Now open the hive the way that you would for a normal inspection. The parent should have at least 10 full combs of honey and brood. As you move through the combs, take every other comb and place it along with the bees into the new hive. Make certain that you have young larvae or eggs in both the parent and the daughter hive. This will allow both hives to rear a new queen if they need to. Some books insist that you must find the queen. This is a waste of time if both hives have young brood. If queen cells are present in the hive, then make sure that some of the queen cells end up in both hives.

Take several combs from the parent hive and shake the bees into the daughter hive. This will even out the populations so that you have about the same number of bees in both hives. Now push all the combs together and use the top bars from the daughter colony to fill the gap at the end of the parent colony. (Please note: the combs left in each hive must be placed next to each other, so that there are no gaps in the brood nest), put all the empty top bars together at the ends of the hives). Close up both hives. Move the parent colony to a new location at least 3 km away, and place the daughter where the parent stood.

If you cannot move the parent 3 km away, then leave many more bees in the parent colony and move it to another part of the bee yard. As the bees leave the parent hive to forage for nectar and pollen, they will return to the daughter colony where they lived before the split. This will leave the parent with a much smaller number of bees. When you move the bees 3 km away, they will recognize that they live in a new location and return to the correct hive.

Leave both colonies alone for at least 14 days, this gives the colonies time to raise a new queen. After that time you should see eggs. If no eggs are present, close the hive and check again in another 7 days. If no eggs are present, the colony may be queenless. If this happens, give the

colony another queen, queen cell, or young eggs and larvae so they can raise another queen.

After three weeks you can move the colony back into the original bee yard.

Reversing Colonies

You can take advantage of the bees homing characteristics to help shift bees from one colony to another. Bees always return to the place where they used to live, unless you move them at least 3 km away. If you have a strong colony and a weak colony that needs help, simply swap their locations. The bees from the strong colony will go back to the weak colony and help them out and the bees from the weak colony will return to the strong colony. The net effect is the strong colony loses bees to help the weak colony.

Even though the returning bees have a different smell, they are readily accepted because they are bringing food.

Uniting Colonies

If you have two or more weak colonies, then it is better to unite them into one strong colony. This is especially important as the colonies enter the period of dearth. Small weak colonies are much less likely to survive. It is usually better to have one colony that can survive than two or three that will certainly perish.

In general, honey bee colonies are hostile to one another. They will readily kill each other and take the honey if they can. They distinguish each other based upon smell. The bees and the queen of each hive have a different smell that the bees can readily determine. There are two ways to unite a colony. The first and best way to unite two hives is to make a square box the same width as the top of the top bar hive. The box should have no top or bottom. Remove the combs from one of the weak hives and place them in the box. Now remove *one* of the top bars from the other hive that we wish to unite. Be careful to maintain proper spacing of the top bars, so that another top bar will fit in the open space. Place a sheet of newspaper over the space left by the missing top bar. Now place the special uniting box with the combs of the other hive over the newspaper. Now cover the united hive and leave it for at least 4 days.

The bees will slowly chew away at the newspaper. As they do so, the smells of the two hives are intermingled. By the time the paper is gone, the bees all smell alike and there is no fighting. After four days, the combs can be combined into a main hive and the uniting box removed.

It is a good idea to kill one of the queens before uniting the colonies, otherwise the queens will fight until one is killed. Most beekeepers prefer to kill the queen in the weaker hive.

Another way to unite two weak colonies is to simply confuse both hives and hope that they are intermingled before they can figure the whole thing out. To use this method, figure which hive is the weakest and open it. Puff a large amount of smoke into it. Now open the stronger of the weak hives and smoke it thoroughly. Now take each comb from this hive and shake the bees into the first hive. Smoke thoroughly before and after each comb is shaken. Now put all the combs into the one hive and close it up. Remove the other hive from the beeyard, because the bees will want to go home again. Note: this method can really make the bees mad. Be prepared for some stings.

Transferring Queen Cells

The beekeeper will often find queen cells in colonies that are swarming or superceding. These queen cells are a valuable commodity. Using queen cells, the beekeeper can requeen an entire colony to replace an old or failing queen, replace a queen that heads an aggressive colony, or to start a nucleus hive or a new colony split from another hive.

When given a choice, swarm cells produce better queens than supersedure cells. Select the largest most mature queen cell available, and carefully cut the cell from the comb (Fig. 18). If there are plenty of cells, you may want to move 2–3 cells to help your chances of getting a good queen. Don't take queen cells until the bottom end is completely capped over. Be careful not to cut into the queen cell itself. It is easiest to cut a wide margin of "comb base" around the queen cell. Place the queen cell into a small container with some padding in the bottom. Keep the cell upright, in the same way that it was hanging on the comb. If you allow the cell to fall over or if you handle it roughly, the queen inside can be crippled.

Take the queen cell to the hive that needs a new queen and open the hive. Find a good brood comb, and cut a hole in the middle of the brood comb that is twice as big as the queen cell. Now knead the "comb base" of the queen cell into the comb of the circular hole. The net effect is the queen cell should be left hanging in the middle of the circle. It is very important that the bottom of the cell is not touching anything. This is the space where the queen will emerge.

If a laying queen is in the hive, she must be killed, or she will rip open the queen cell and kill the young queen. Now put the comb back in the normal position and close up the hive. In 7–14 days the new queen will emerge, mate and start to lay eggs.

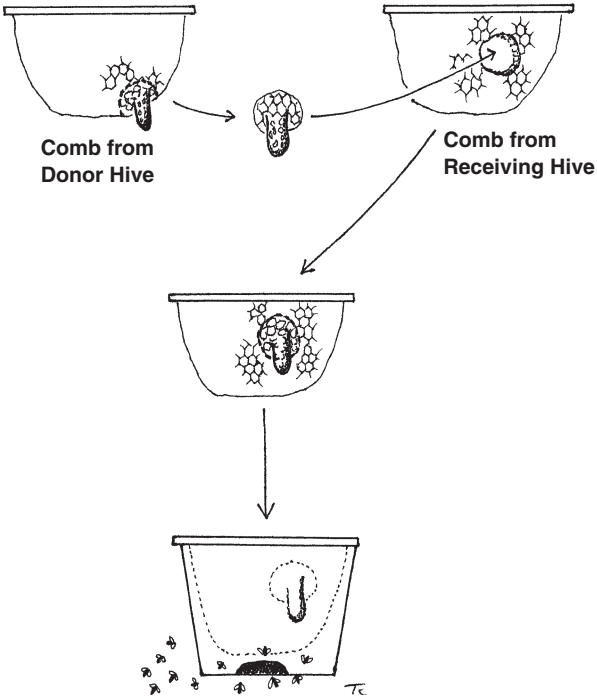


Figure 18. Transferring Queen Cells (after Gentry)

Raising Queens

Beekeepers can manipulate honey bee colonies to produce new queens whenever they want. This is much better and more profitable than waiting to find them. Once the beekeeper learns how to raise queens, there is almost no limit to the number of new colonies they can produce. They can also sell quality queens and colonies to other beekeepers in the area.

The key to producing queens is to review the steps that honey bees normally use to produce new queens and adapt them to your own purposes. The bees make new queens to replace a lost one, supercede an old one, or in preparation for swarming. They take larvae that are less than three days old and move them into a special queen cell. The queen cell looks a little like a grape or a peanut and it hangs vertically with the open end hanging down. The young "nurse bees" feed massive amounts of "royal jelly" to the young queen larvae. Glands in the head of young nurse bees produce the royal jelly. Royal jelly looks like milk and contains all of the special ingredients that will allow the young larvae to develop

into a queen. The queen larvae is sealed into the cell when it is 8 days old. It takes 16 days for the queen larvae to change into an adult queen bee.

When the young queen emerges from her, cell she searches the entire colony for any other queen cells. When she finds one, she rips the cell open and stings the developing queen to death. If two young queens emerge at the same time, they fight until one is stung to death. Queen honey bees have a smooth stinger which allows them to sting and remove it from the victim. Queen honey bees almost never sting people, even if they are handled with bare hands.

There are many ways to produce queens in vast numbers. Here is a simple method that will produce several dozen queens at a time. First, select a good strong colony with the characteristics you like. That queen will be the mother of the queens you will produce, this will be the "mother colony." Select another strong hive you want to requeen. This will be the "cell building" colony.

Take a frame of young brood from the "mother colony" and close up the empty space by re-arranging the combs or put another empty top bar in its place. Brush all the bees off the comb. Take the comb and find the area of the comb with eggs and young larvae. Cut the comb in half at that point, so the young larvae are along the newly cut edge of the comb. Wrap the comb in a damp cloth or towel to keep the larvae from drying out.

Open the cell building colony and find the queen. If she is undesirable, then kill her. If she is good queen, you can move her to a weak colony that needs a good queen. Next, open up the brood nest and make a space between two combs with lots of brood and pollen. Place the cut comb from the mother colony into this space. Be sure to mark it so that you can find it later.

The bees in the cell building colony will soon discover that they have no queen. The bees will begin to build queen cells along the cut edge of the comb. Open the hive after a few days and examine the cut comb. You should see many queen cells along the edge of the comb. Close up the hive again and let the bees finish the queen cells.

Ten (10) days after the cut comb was put into the hive it is time to remove the queen cells. Take the comb out of the cell building hive and gently remove all the honey bees that cling to it. DO NOT SHAKE the comb, it will cripple the young queens. A feather or bee brush is probably the best way to remove the bees from the comb.

Next cut the queen cells from the comb. In some cases the queen cells are packed into a tight row, so that you must cut through some of the queen cells to get the others apart. If this is necessary, then try to cut through the smallest queen cells because they will produce queens of lesser quality anyway. Try to leave a piece of the original comb attached

to the queen cell. This will serve as a handle so the queen cell can be handled without damaging it.

Use the queen cells as described elsewhere in the book. Put one or two queen cells back into the cell builder colony so they can have a new queen. You can take your strong colonies and split them and put a queen cell or two into each split, so they will have a ready made queen to give them a good start. Or you can go into all the colonies you wish to requeen and kill the old queens and put a new queen cell in. Then the queen that you selected and raised will take her place. Another use for queen cells is to make up small mating nucleus colonies. Take a few frames from a strong colony, be sure to leave the good queen in the strong colony, and place them in a small hive box. Place a queen cell in each mating nucleus. This is probably the best way if you want to sell queens.

Wherever you put the queen cells, the young "virgin queen" will emerge from her cell in a few days. The bees will feed her and care for her for a few days, and then she will fly from the hive and mate with several drones. After a few more days she will begin to lay eggs and the colony will be back to normal.

After two weeks check all the hives, which were given queen cells, to make sure the queens are laying eggs. If you find new queen cells and no eggs then the queen you raised is probably lost. Make other arrangements to make sure the colony will be queenright. Give them another queen, queen cell, some young brood, or unite them with another queenright colony. All queen cells do not take, so don't be disappointed if a few are lost.

Using this simple procedure, any beekeeper can raise good quality queens to improve the number and quality of their own colonies and to raise queens and colonies for sale. The best quality queens are produced by strong colonies during periods of surplus. Queen cells can be raised almost anytime, but the virgin queens need drones to fertilize them, and all the drones are usually killed during periods of dearth.

Avoiding Stings

Although honey bees are fascinating to beekeepers, most people think about just one thing. Honey bees sting! It is unfortunate that many people cannot get past that simple fact. Some people liken it to life or marriage; you can't take the honey without getting a little pain.

A beekeeper that is afraid of stings is like a herdsman who is afraid of his cattle. The herdsman knows how to work with his cattle so that his risk of injury is very low. It is much the same for beekeepers, they learn how to work with their bees so that they have a low risk of being stung, and they know what to do if they are stung.

The prepared beekeeper should wear a veil and light colored clothing because bees prefer to sting dark objects. They also sting if they get tangled in long hair; so long hair should be tied up kept and inside clothing or the veil. Some beekeepers wear a white one-piece coverall with ties around the ankles and wrists. This keeps the bees from getting inside the clothing.

Keep clean; don't go near the bees when your breath or your body is smelly. Avoid perfumes or eating garlic before working with the bees.

The most important attribute to avoiding stings is to always remain calm. Avoid any sudden movements; move slowly deliberately around the bees. Never swat or flap at a bee, it only draws the attention of many other bees. Even if you are stung, remain calm and you will decrease your chance of another sting. Never stand in front of the hive for more than a moment. The bees are flying in and out of the hive and it disturbs them if the flight path is blocked.

African honey bees are disturbed by loud noises. Keep your voice low and avoid any sudden loud noises. European honey bees are usually unaffected by loud noises. All species seem to be disturbed by gasoline engines when running nearby.

Use smoke to help calm the bees and choose the right time to open the hive. Bees are always grumpy when the hive is queenless or during a period of dearth. They are usually in a foul mood when the weather is turning bad, especially when a lightning storm is brewing nearby. Obviously it is best to work the bees when the colony is queenright and the weather is stable and there is plenty of nectar coming in.

The time of day has a big impact on the risk of stings. African honey bees are most docile before 9 in the morning and after 5:30 in the evening. They are most aggressive during the heat of the day. European honey bees have the opposite demeanor, they are most docile during the heat of the day and most aggressive early or late in the day.

Before opening the hive, apply plenty of smoke to diminish the effects of alarm pheromone. Make every effort to minimize jarring or vibrating the hive. Avoid dropping or jarring the combs, but most importantly avoid smashing bees. When bees are smashed, they release large amounts of alarm pheromone, which instantly makes the nearby honey bees angry. If you do smash a bee, thoroughly smoke the area to try and mask the alarm pheromone.

What To Do if Stung

If you are stung, you must immediately remove the stinger! The best way to do that is to SCRAPE IT OUT using a fingernail, hive tool or pocket knife. NEVER try to pull it out.

The reason to scrape the stinger out is that when the honey bee stings, she drives the stinger into the skin, then she pulls away, leaving the barbed stinger and the poison sac in place. When left alone the stinger continues to work its way deeper and deeper into the skin and the poison sac pumps more venom into the wound. If you pull the stinger out, then you squeeze even more venom into the wound. If you quickly SCRAPE the stinger out, then you remove the entire apparatus before it can pump much venom into the body. It is more important to do it quickly rather than to search and find the perfect tool. Most experienced beekeepers use whatever tool they have in their hand at the moment, and if they have no tool, then they simply use a fingernail.

After removing the stinger, immediately apply smoke to the area, because alarm pheromone will be present at the site. This is a chemical signpost to all the other bees to sting again in the same place. The smoke will cover up that chemical signal.

There are many home remedies for bee sting; saliva, tobacco juice, mud, etc. The simple truth is that once the venom is injected into the body, there is not much you can do by application of remedies to the skin. The most important thing to do is to remove the stinger as rapidly as possible.

Different people have different reactions to bee stings. Everyone experiences pain from a bee sting, even experienced beekeepers still get that sensation. After the initial pain reaction, then tenderness and swelling will appear. This is a normal local reaction. Application of ice will decrease the swelling somewhat. Eventually, the reaction will subside. The body of many beekeepers will adjust to the bee venom, so that they have very little reaction to the venom.

In severe cases, a person may have difficulty breathing after being stung. They may have swollen lips, tongue or eyelids even though they were stung in a different part of the body. They may also develop nausea or vomiting. These are all indicators of a systemic or anaphylactic reaction to the bee venom. This is a medical emergency. The person should be given an injection of epinephrine, or seek immediate medical help. Without immediate treatment, the person may die! Many beekeepers carry epinephrine in the toolbox, just in case.

What To Do if Attacked

Sometimes, even a beekeeper is attacked by honey bees, maybe the weather turned bad, or the colony is queenless, or they are just in a bad mood. If a hive turns mean, then calmly close up the hive and blow as much smoke around you as possible. Then calmly put your head down and move away from the hive as quickly as possible. Blow as much

smoke as possible, even if you are being stung. Try to move through bushes or brush to confuse the bees. They can't easily see through the brush to find you. Keep moving as fast and as far as possible, until they stop following. Most European bees will stop chasing after about 50 meters. African honey bees will chase people and animals up to 300 meters away from the hive.

If you are in open country and are attacked by honey bees, run as far and as fast as you can, until they stop chasing you. Alternatively, you can go into a building and close the windows and doors; a dark building is even better, because bees don't like to fly into dark places. A third alternative is to get into a vehicle and roll up the windows. Smash the few bees that get inside with you and wait for the attack to subside.

Keeping Safe

Remember that honey bees can provide a fascinating and profitable source of income. They can be handled safely without undue risk to the beekeeper or the neighbors, if you keep in mind the proper way to work and act around your bees.

Section VI

Harvesting Honey and Wax

What is Honey?

Honey is nature's most perfect food. The Bible refers to the "land flowing with milk and honey" [Exodus 3:8] as the place where God provides his chosen people with a land flowing with goodness and plenty.

Honey is a very concentrated solution of simple sugars. It is so concentrated that the weight of the sugar makes honey heavier than water. Honey weighs 1.44 kilograms per liter [12 pounds per US gallon] while water only weighs 1.0 kilograms per liter [8 pounds per US gallon].

Honey has some special properties. It is very sweet, which makes it an ideal and delicious food for people. It is also used in remedies such as treating open wounds. The sticky liquid protects the open wound, and it also has special enzymes that inhibit and even kill bacteria. Honey is known to keep for a very long time. It has been found in the tombs of ancient people and is still liquid and sweet.

The honey bees make and store honey during periods of plenty and then use the stored honey as food during times of dearth.

How Honey is Made

The honey bees make honey from the nectar that they collect from flowering plants, shrubs and trees in the area. Each honey bee will fly up to 4 kilometers [2.5 miles] on each trip to gather nectar. Plant nectar contains a small amount of complex sugar. The honey bee sucks up the nectar into the honey stomach and flies back to the hive. While in flight the honey bee mixes the nectar with special enzymes and proteins that begin changing the nectar into honey. When she returns to the hive she gives the nectar to another honey bee and returns to the field for more nectar. The house bee adds more enzymes and begins the long process of evaporating the excess water out of the nectar. During this evaporation process the enzymes convert the complex sugars to simple sugars like glucose and fructose. Simple sugars are very easy to digest.

Finished honey is stored in empty cells within the honeycomb. When the cell is sealed it is covered with a capping of snow-white beeswax. Over time the color of the capping will darken as the honey bees walk over it. The beekeeper can easily tell what honey is freshest by the color of the capping.

Harvesting Honey

Three things are critical in harvesting honey; 1) don't take it all, 2) keep it clean, 3) don't cheat the customer.

Don't take it all. The honey bee colony has worked long and hard to gather and store the honey. Without any honey the colony will die. If the beekeeper takes all the honey, the colony will die. [Like the herdsman who kills a goat in order to get the milk.] Figure out how much honey the colony needs to survive in your area, and leave that much with the bees. The beekeeper can take the rest.

Keep it clean. Honey in the honeycomb is clean and pure, without blemish. Make every effort to keep that honey clean and pure. Wash your hands before handling honey and honeycomb. Use only clean tools, utensils and containers for harvesting honey and honeycomb. Store honey in a clean place. Your family and your customers will enjoy a clean wholesome product and come back for more.

Don't cheat. Some selfish and untrustworthy people take beautiful pure honey and add sugar water or corn syrup and sell it as pure honey. *Honey is not sugar water!* Honey that has been doctored in this way doesn't keep like real honey, and it does not taste like real honey either. Cheating the customer is not consistent with Christian business principles.

Fixed Comb Hive Harvesting

In a fixed comb hive (like a box, log, basket or wall hive) the hive entrance is smoked, the hive is opened and the honeycomb removed (Fig. 19). Try to remove the honeycomb only. Don't remove the brood comb which has the baby bees in it. Try to leave enough honey for the colony to survive. Sometimes it is difficult to know how much to leave in a fixed comb colony, especially if has a narrow entrance and you have to reach way back in, like with a log hive.

Use only enough smoke to keep the bees under control, otherwise the honey may smell and taste of smoke. Bring at least two clean containers with covers. Use one for the clean white honeycombs. Use the other for brood combs, old honey combs and odds and ends of empty combs.

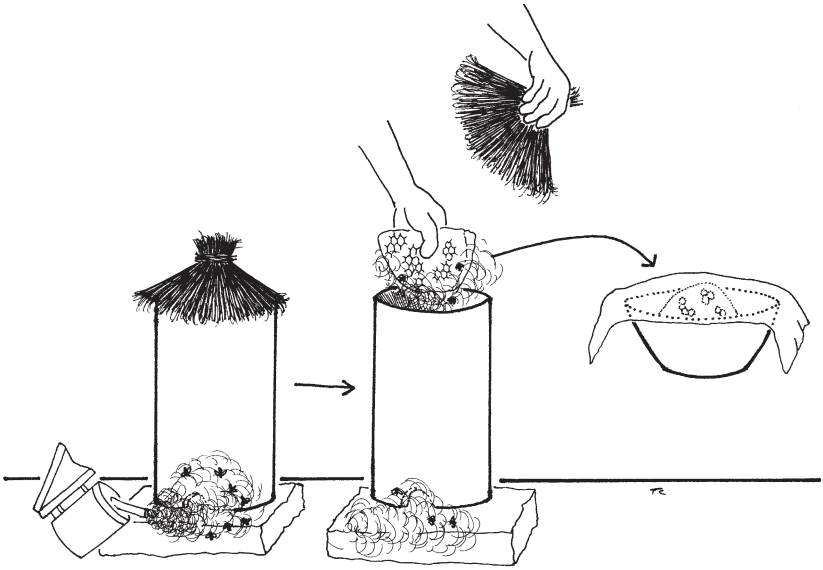


Figure 19. Harvesting Honey from Fixed Comb Beehives

When pulling the combs out of the hive, quickly brush the bees off them with a clean feather, a bunch of clean leaves or a bee brush. Then quickly put them into the covered container; otherwise every bee in the neighborhood will be on it trying to get honey.

When you finish harvesting, close up the hive and take the containers home for processing. Don't leave any honey or honeycomb lying around the hives, it leads to robbing by ants, bees and other troublesome creatures.

Moveable Comb Harvesting

Harvesting of honey from a moveable frame (top bar) hive is a real joy. This is where all the trouble and expense of making the top bar hive pays off. The entrance is smoked, the hive is opened and examined bar by bar to see how much honey and brood are present. The beekeeper can quickly determine which honey combs are freshest and which can be removed without hurting the colony. In general, the beekeeper should leave at least 8 combs of brood and honey. The rest can be harvested.

Harvest only combs that have at least half of the cells covered by wax cappings. Honey in cells that are not capped is not yet finished by the honey bees, and contains more water than the honey in cells which are capped. This is not a problem as long as more than half the cells are capped.

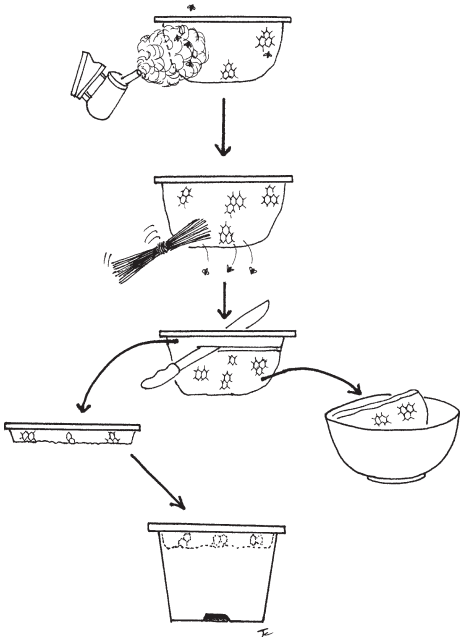


Figure 20. Harvesting Honey from Moveable Comb Beehives

To harvest a top bar comb, simply remove the top bar, brush off the bees with a clean feather, clean leaves or a bee brush (Fig. 20). Take a sharp knife and cut the comb from the top bar. Be sure to leave 3 cm of comb attached to the top bar. Simply put the top bar back into the hive and the bees will build new honeycomb.

Another way to harvest the combs is to take the entire honey comb and top bar and replace it with a new top bar. This way the entire comb can be sold. No customer can doubt that the honey is pure and clean, when they buy it in the honeycomb!

Be sure and bring at least two clean covered containers, one for the clean white pure honeycomb and another for the odds and ends of old dark comb and brood comb. When finished close up the hive and bring the covered containers home for processing. Remember not to leave any honey or honeycomb lying around the hives, it leads to robbing by ants, bees and other troublesome creatures.

Moveable Frame Harvesting

Harvest time is when the moveable frame hive is at its best. In fact the moveable frame hive was actually designed to make the harvest as efficient as possible. The general idea is that frames containing honeycomb are removed from the hive, the wax cappings are removed with a hot knife and placed into a centrifuge called an “extractor” (Fig. 21). The honey is thrown out of the cells with centrifugal force and then the empty combs are returned to the honey bees. The bees refill the honeycomb without having to make new comb. The moveable frame becomes a recycled container. Some people estimate that the honey bees must consume 6 kilograms of honey to make one pound of wax! By not requiring new wax for each crop to honey, the bees can make even more honey.

Unfortunately, the drawback of the moveable frame hive system, is that it requires hundreds of precision made wooden parts to work properly.

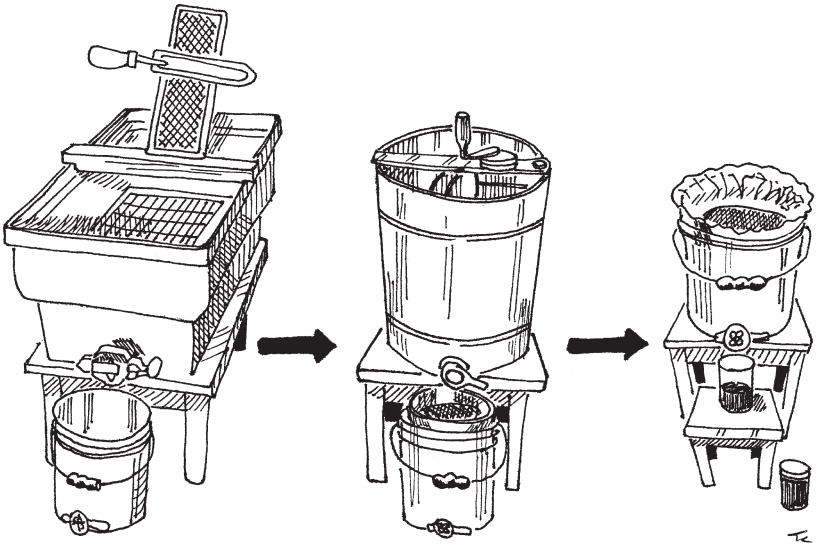


Figure 21. Harvesting Honey Using a Honey Extractor

It also requires the use of an extractor which is expensive to buy or difficult to make. In some settings, a group of beekeepers can pool their resources in order to acquire an extractor and share it for the harvest.

When harvesting a moveable frame hive, the beekeeper most often removes an entire "super," which is a box of frames that sits on the top of the hive. The super typically contains nine or ten frames of honey comb. Each hive may have three to six supers filled with honey at harvest time. The beekeeper traps the bees out of the super with a "bee escape" or drives the bees out of the supers with a foul smelling chemical or blows them out with a blast of air from a "bee blower." The full supers are hauled back to the honey house and the wax cappings are removed with a hot knife and placed in the extractor. The frames are spun around and around in the extractor and the honey is thrown out of the frame and it lands against the sides of the extractor. The honey runs out of the extractor through a hole in the bottom. The empty combs can be returned to the hives or they can be stored for the bees to use next year.

It is important to note here that the extractor is very hard on honeycomb. Moveable frames have special reinforcing wires to stiffen the combs or they will break in the extractor. Combs from top bar hives would be torn apart in an extractor.

If the beekeeper has moveable frame hives but no extractor, the frames should be handled as if they were from a top bar hive. Either sell the entire frame to a customer, or cut the honeycomb from the frame and process it like other honeycomb.

In summary, moveable frame beekeeping is designed for large intensive beekeeping operations and is outside the scope of this book. There are many other books that describe the construction, and maintenance of moveable frame equipment (Kelly, Root, Dadant and English).

Processing Honey for Market

The critical parts of processing honey for market are cleanliness and honesty. Honey in the honeycomb is a pure, wholesome food. The only way to protect that purity is to practice strict cleanliness when handling honey. Wash your hands before handling honey and only use clean and wholesome containers and utensils for processing honey.

Be sure to only use containers made of stainless steel, plastic or earthenware. Never store honey in iron, galvanized, copper or aluminum containers. Honey is a very acid food and will corrode these metals. Iron is particularly known for this and will soon turn the honey to a dark black color.

Honesty is required when processing honey. Your customer is expecting to purchase pure honey as it was made by the bees. Some selfish and untrustworthy people add water, sugar water or sugar syrup to the honey. Honey that has been adulterated in this way will soon spoil, and the customer will realize that he has been cheated. He may never buy your honey or any other honey ever again. Adulteration of honey is not in keeping with Christian business practices. Furthermore, in many nations, there are strict laws against the adulteration of honey.

Proper processing of honey begins in the field, when the honeycomb is harvested. It should be examined closely to make certain that at least half of the honeycomb is capped, the bees removed by brushing and placed into a clean covered container. Combs with “unripe” honey (less than half the cells are capped), combs with brood present or old dark combs should be placed into a separate clean covered container for processing separately from the main honey crop.

All processing should be conducted in a place where bees cannot enter; ideally a warm room with screens on the windows and doors. If that is not available, process the combs at night when the bees are not flying. The smell of fresh honey will attract every honey bee in the region. They will come and try to reclaim their honey!

Decide early on if you will sell honey in the comb or liquid honey.

Comb Honey. If you are selling honey in the comb, the customer has no worries that your product is the real thing, just like the bees made it. Many buyers will pay a premium for honey in the comb. If the entire comb is capped and free of brood, then sell the entire comb, top bar and all. If the comb has some blemishes then cut it into sections that can be

wrapped in plastic boxes or placed into plastic bags for sale. Alternatively, these pieces of comb can be slid into a widemouth jar and then filled to the top with liquid honey. This is a beautiful package that is called "chunk honey pack."

Liquid honey. For liquid honey, simply crush the honeycomb in a clean container and separate the honey from the wax. The simplest way to do this is to smash the honeycomb right in the original container that brought it from the hive. Smash it with a clean spoon or stick until you have thick "soup" of honey and wax. Pour the soup into a common kitchen strainer and place it over a clean container. The clean wax will run out of the strainer and into the container. The honey will run very fast at first and then slow down. It may take several days for all the honey to run out of the wax. Let the honey stand for seven days before bottling it. This will allow all the little air bubbles and tiny bits of wax to rise to the top forming a thin white layer on the top of the honey. Either skim this off and place it in another container, or use a container with a valve or gate on the bottom and draw the clear honey into jars, leaving the white layer on top.

If a kitchen strainer is not available, or there is too much honeycomb to fit (which always makes the beekeeper smile!), then improvise a strainer by punching small holes in a calabash, pail or other container. Another alternative is to take a large piece of clean loosely woven cloth and pour the wax honey mixture into it and tie the free ends together and let that serve as the strainer (Fig. 22).

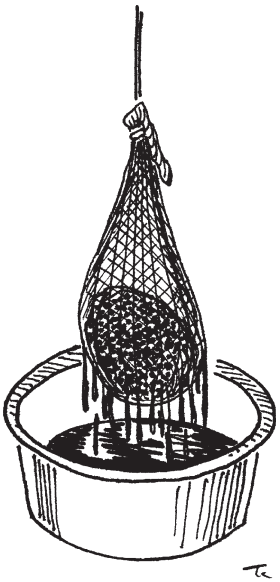


Figure 22. Straining Liquid Honey (after Kigatiira)

The temperature of the honey determines how fast this process proceeds. Warm honey is more fluid than cold honey, therefore a warm room makes it all happen faster.

The straining should be conducted in a cleanly manner. The white film of air bubbles and wax should be removed and the resulting clear honey should be allowed to settle for at least seven days. Then the honey may be bottled and sold.

Crystallized Honey. All pure honey will eventually crystallize within a few weeks or months unless it is processed further. Remember honey is a very concentrated solution of sugars and sooner or later the sugars will crystallize out. In some parts of the world (like Western Europe) crystallized honey is a mark of pure and unadulterated honey. Bee-

keepers in these areas simply strain and bottle the honey. In other parts of the world (like the United States) customers think that crystallized honey has "spoiled" and must be thrown away. In these areas, beekeepers have found that if they heat the honey to 60° C (140° F) for 30 minutes the honey will stay liquid for a much longer period before it crystallizes. On the other hand some customers complain that heating honey destroys some of its nutritional properties even though scientists have not been able to confirm that.

Every beekeeper must know what the consumers in their area want and provide the product that will bring the most money for their efforts.

Bottling Honey. Once the honey has been strained and allowed to settle for at least seven days, it can be poured into the final container for sale (Fig. 23). Choose a container that will enhance the beauty of your product. In developed nations bee supply companies manufacture special containers for honey. In developing nations honey is often packed in recycled containers. Used glass jars and bottles are often easy to find and easy to clean. Glass is particularly good because it will not harbor any flavors from the previous contents that might taint the flavor of your honey. Some plastic containers can also be recycled but be sure and give them a good sniff to make certain that no odor from the previous product remain. And finally, make sure that the cap is also clean.

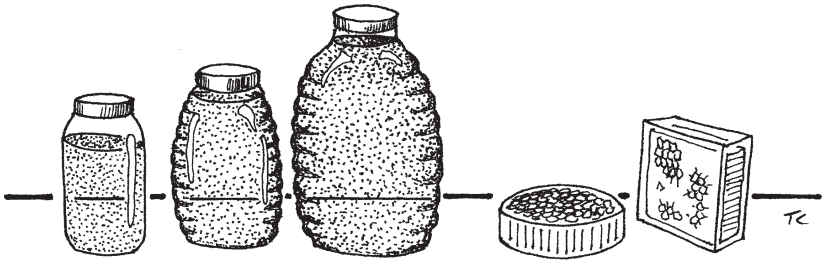


Figure 23. Selling Honey in Jars and Combs

Once the honey is bottled label it proudly. Be sure and mark it as "Pure Honey" with the amount of honey in the container in kilograms or pounds and the name and address of the producer. When a customer finishes the last of that delicious wholesome honey, they will read the label and remember where to go and buy some more!

Other Honey. Remember the unripe honey and dark combs that were separated from the pure white honeycomb? These combs can be processed in a manner similar to the other combs, but this honey will have a much darker color and stronger taste than your "number one" honey. If

it contains much unripe honey, then it may spoil within a few weeks of harvest. This honey can be consumed quickly in the home before it spoils or can be used in cooking and baking in place of table sugar. Another option is feeding it back to the bees. Give it to weak colonies that need a little help to get through the dearth period. This second grade honey should not be sold unless the customer knows exactly what they are buying, how it will taste and how long it will last.

Rendering Beeswax

What is beeswax? The body of the worker bee produces beeswax. There are small glands on the underside of the abdomen that secrete thin plates of beeswax. When first secreted, the wax is white as milk. The bee takes the wax scale and chews it up to soften it and adds it to the honeycomb. New honeycomb is very white to a light yellow color. Over time the comb becomes darker and darker as the bees mix propolis into the wax and as they walk over it they leave tiny dark footprints called "travel stain." The wax eventually turns a dark brown. Wax rendered from new honeycomb is usually a light yellow color. Light colored wax is more valuable than dark wax.

Rendering Beeswax. After all the honey has dripped out of the wax it can be "rendered" into a saleable product. It is a good idea to keep light colored wax separate from the old dark wax. Wax is rendered by heating it with boiling water**. Never heat beeswax directly on a fire or a stove!** Hot wax is very flammable. People have burned down their houses by improperly heating beeswax.

Don't melt beeswax in an iron pot. It will stain the beeswax a dark color. Use aluminum, stainless steel or galvanized vessels for rendering beeswax.

Heating beeswax in water is the only safe way to melt it. The heat melts the wax and the water removes the dirt and debris. There are several ways to render the wax. All methods are based upon floating the wax or straining the wax.

Floating the wax. Place the wax in a large pot and fill it about one third with water and about one third with wax pieces. Bring the pot to a low simmer and hold that temperature until all the bits of wax are melted. Turn off the heat and let the pot cool down. The wax will float to the top of the water and solidify. Take the hard cake of wax and scrape the debris and dirt off the bottom.

If the wax is very dirty or if it the comb is old brood comb, it will have little skins left behind when the bee larvae emerged as adults. These skins are not easily separated from the wax by simple boiling. In this case the wax can be put into a cloth or burlap bag along with some rocks

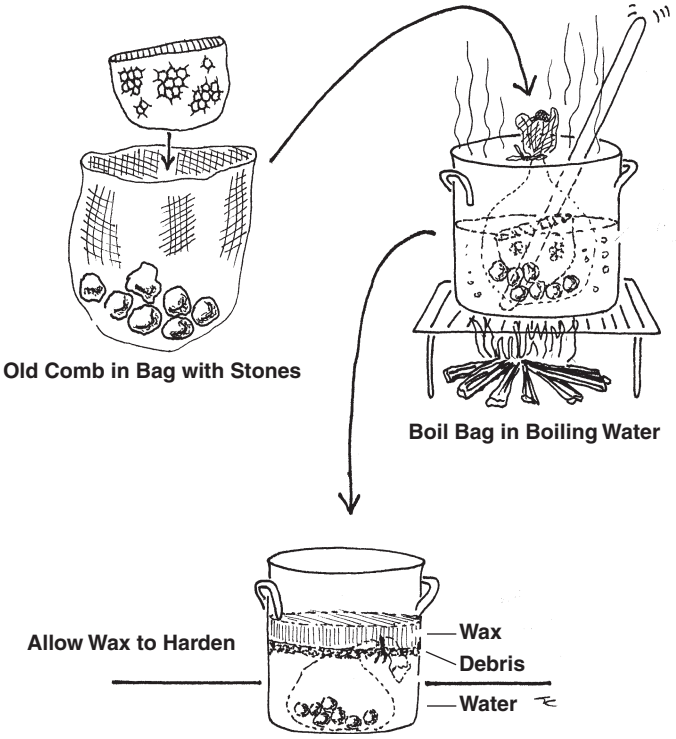


Figure 24. Rendering Beeswax (after Gentry)

to weigh it down (Fig. 24). Place the bag into the pot and boil it thoroughly. Take a large stick and poke and stir the bag occasionally to help the wax float out of the bag and up to the surface of the water. Let it cool and the wax should be very clean and free of debris although it will be a much darker color than the wax from the honeycomb.

Straining the Wax. The other method of rendering the wax is to heat the wax and water mixture and place it into a fabric or burlap bag while still hot; and twist and wring the clean wax out of the bag. Be sure and catch the wax into a clean container and let it harden.

Rendering a clean saleable product usually takes more than one straining or boiling but the effort is well worth it. Pound for pound beeswax is the most valuable product of the beehive and it never spoils! Most of the beeswax sold in the world is produced by beekeepers in developing nations. It is highly prized for the production of medicine, cosmetics and candles. Find a dealer who is buying beeswax in your area; they cover the earth looking for beeswax.

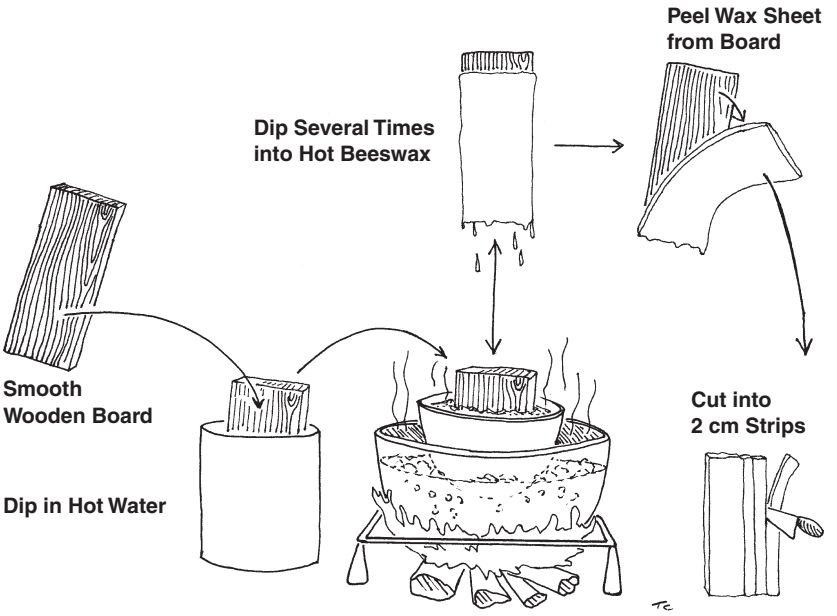


Figure 25. Making Beeswax Starter Strips (after Gentry)

Beeswax Starter Strips. The beekeeper may want to save some of the wax to make starter strips for new top bars (Fig. 25). Take the clean wax and put it into a small pot. Put that pot into a larger pot of water and boil the water in the outer pot. This is the way to safely melt beeswax. When the wax is melted, take a smooth flat "dip board" and wet it with hot water. Briefly dip the board into the hot wax, pull it out and let the wax harden, then dip it again and again until the wax is a few millimeters thick, then let it harden completely. Peel the wax off the board and cut it into 2 cm strips. These "starter" strips should be fashioned to new top bars so that the bees will make nice straight combs.

Slumgum. The black residue left behind is called "slumgum" and it usually contains some beeswax. The only practical way to recover more wax involves expensive steam heated equipment. The small scale beekeeper should take the slumgum and form it into small balls and use it to bait new hives. Rub it inside the new hive or leave a small ball of it inside the empty hive to induce new swarms to move into the hive.

Section VII

Honey Bee Predators, Diseases and Other Problems

Like all living things, honey bees have predators and diseases that affect them. In most cases, proper management by the beekeeper will keep these worries to a minimum. In other cases the beekeeper must be alert to these dangers and act quickly to protect the bees.

Some problems are present everywhere honey bees live, others are specific to some parts of the world. This list is only designed to cover the most common and prevalent problems. The beekeeper should consult with local experts for help with local beekeeping problems.

Predators

People. Honey bee colonies are valuable assets, and like other assets they may be stolen or destroyed by other people. In some cases children may pester or destroy honey bee colonies just for the fun of it. Some beekeepers keep their colonies hidden behind walls or shrubs and paint them colors that will blend in with the surroundings. If people don't know where the colonies are then they can't steal them. Alternatively, the colonies can be placed high up in trees or close to home to make them difficult to steal.

Monkeys and Babboons. These animals are known to bother honey bee colonies in some areas. They are known to disturb colonies by removing the covers and opening hives to get honey. Some species are deterred by stings, and some are not. If these animals are a persistent problem, the beekeeper can try to fasten down the lids to keep curious fingers out of the hives.

Other Mammals. Other large animals are known to destroy honey bee colonies in order to eat the honey and/or bee larvae. Bears are famous for breaking into colonies and once they get a taste of honey it is nearly impossible to keep them away. Skunks and honey badgers both love the taste of honey and honey bees. They would cause much more damage if they were bigger and more powerful. Domestic livestock are also implicated in damage to beehives. Typically cattle or horses may try to scratch

themselves on beehives and when they get stung they panic and kick or topple beehives, which leaves them vulnerable to destruction by other invaders.

Colonies should be placed on stands to limit access by the small animals and placed behind fences or barriers to keep out livestock. To protect against bear attack, special precautions must be taken. It is important to completely protect the colonies before the bears get into them. Once the bear gets a taste for honey it is almost impossible to keep them out. Electrified fences are particularly effective in preventing bear attack when used *before the bear gets a taste of your beehive!* Another plan is to construct a platform high above the reach of bears and place the colonies on the platform.

Birds. Birds are ideally suited for catching insects on the wing and devouring them, and honey bees are no exception to that fate. Flying honey bees are defenseless against attack by birds. In most cases losses from birds are not a problem. There are however some species of bird like the bee-eaters, swifts, shrikes and honeyguides which are known to seek out honey bee colonies or may attack colonies in large numbers. These birds are especially a problem when the beekeeper is trying to raise queen bees. The loss of a queen while on her mating flight is especially damaging.

In cases where bird problems occur, it may be a temporary migration of the birds through the area. If the birds are resident to the area, first try to frighten the birds away with scarecrows or noisemakers. If this fails, killing the predators may be necessary, in this case, be certain to consult local laws. In many areas of the world, there are strict laws which protect bird populations.

Toads. Toads, frogs and lizards are known to prey on honey bees in some parts of the world. In some cases the honey bees are eaten when they pass near the reptile while foraging; of more concern however are the cases when the reptiles sit by the entrance and kill bees as they enter and leave the hive. Losses from reptile attack are rarely a problem. In the rare case where bee losses are sizeable, the colonies should be placed on hives stands 60 cm high to keep them above the jumping height of the offending animals. Similarly, keeping the beeyard clear of weeds and brush will minimize the places for the predators to hide.

Ants. Ants are found wherever honey bees are, and like honey bees they are highly socialized, with a queen, workers and males. Usually ants pose no threat to honey bees, but once they target a honey bee colony they can be a minor nuisance or they can devastate the colony by taking honey, pollen, brood and even adult bees. Colonies under attack are irritable and aggressive as result of the constant onslaught by the ants.

Weak colonies are most likely to be attacked. Keeping colonies strong is a primary defense against ant attack. Hanging the colonies by wires strung from posts or trees, or placing the hive stands where the legs are standing in cans filled with motor oil or smeared with grease, greatly decreases the risk of ant attack. In some areas spraying insecticides on the ground to kill ground dwelling ants may be effective. Be *very careful* because the insecticides can also kill honey bees or taint the honey!

Wax Moth. Another damaging insect is the wax moth (Fig. 26). The wax moth does not kill honey bees directly, but it totally destroys the comb in the hive. The adult wax moth enters the hive and lays eggs throughout the combs. The eggs hatch and the larvae (maggots) eat through the combs. They leave behind a tangled mess of destroyed combs and rotting webs. The larvae cannot live on wax alone, they depend on pollen stored in the combs and the cast off skins left behind by developing honey bee brood. The moth larvae especially love the old dark brown or black brood combs.

Weak colonies are most likely to be attacked. Keeping colonies strong is a primary defense against attack by wax moths. Combs that are removed from the hive for storage will soon be destroyed if not protected in some way. Hives that have "died out" or where the bees have absconded must be quickly protected from moth destruction. Several options are available; the

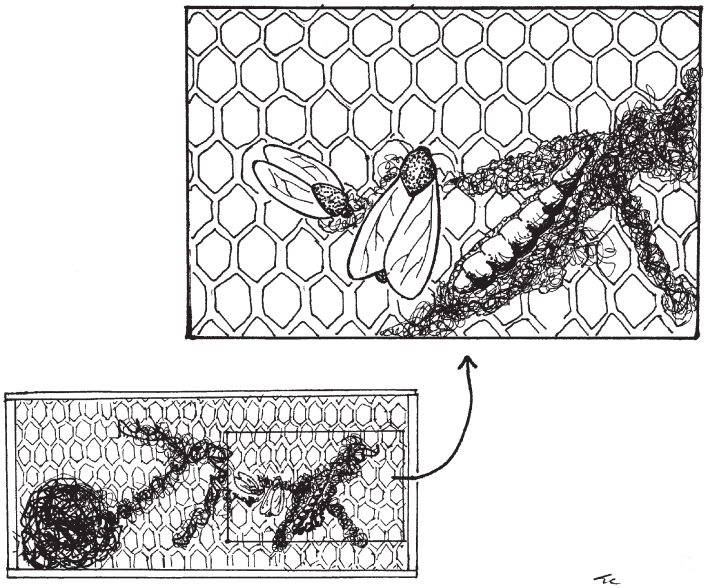
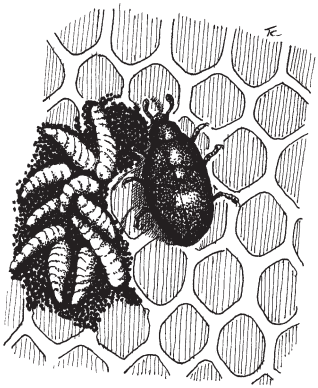


Figure 26. Wax Moth Damage

combs can be rendered for beeswax, since moths will not attack blocks of pure beeswax. The combs can be dispersed and placed into healthy colonies that will protect the combs. Alternatively, the combs should be hung up in a sunny well-lighted area that will keep the moths away. The moths dislike sunlight and fresh air. Finally, the combs can be placed in an airtight bag or box and treated with "moth crystals" containing paradichlorobenzene (PDB). These crystals evaporate slowly and kill the larvae and adults but not the eggs, so the crystals must be replenished when they are gone. The combs must be "aired out" before they are given back to the bees, because they hate the smell of PDB. Finally, some researchers have questioned the safety of PDB because it dissolves into the beeswax and is present in all products made from the beeswax.

Beetles. Hive beetles come in two varieties, large and small (Fig. 27). The large hive beetle is particularly damaging because the honey bees cannot harm it. The beetle can feed on young brood and honey and chew large holes in the combs. They tend to be more numerous during the rainy season. The best defense is to keep the hive entrances small (about 1 cm) which will act as a physical barrier to the large hive beetles.

Large Hive Beetle



Small Hive Beetle

Figure 27. Hive Beetles

The small hive beetles are attracted to bee colonies by the smell of stored honey and pollen. Like their large cousins, the honey bees are not able to kill the beetles because of their thick shells, but the mite larvae are readily removed by the house bees. The maggots of the small hive beetle soon ruin unprotected combs in weak colonies or in open containers. The best defense is to keep honey bee colonies strong and free of disease.

Termites. Termites do not affect honey bee colonies directly. They infest and destroy wooden structures and a wooden beehive is not immune to attack. The best defense is to avoid placing wooden hive structures directly in contact with the ground. Hanging beehives by wires or ropes is probably the simplest and best precaution against termites.

Wasps and Hornets. Wasps, hornets, yellow-jackets, bee-pirates and beewolves are a group of stinging flesh eating insects. Some species are present wherever honey bees are found. They cause serious losses in tropical and subtropical Middle East, Asia and Japan. In other regions of the world they prey on honey bees but apparently are no real threat to a healthy honey bee colony.

Most hornet species attack individual bees near the hive entrance (Fig. 28). In some cases the hornets may team up and completely slaughter a hive of honey bees. An example of this slaughter is when *Vespa mandarina* (a large wasp found in Asia) attacks colonies of the European honey bee (*Apis mellifera)*. The wasp is 15 times the size of the honey bee. It readily kills individual bees and takes them back to the wasp nest. Once the hive is sufficiently weakened the team of wasps moves into the hive and slaughters all remaining honey bees. They subsequently carry off stored honey as well as the larvae and pupae. It is curious to note the Asian Honey Bee *(Apis cerana)* is much more successful in resisting attack by these wasps. They defend the hive by "balling" the much larger insect. They kill the wasp by concentrating their body heat in the center of the ball.

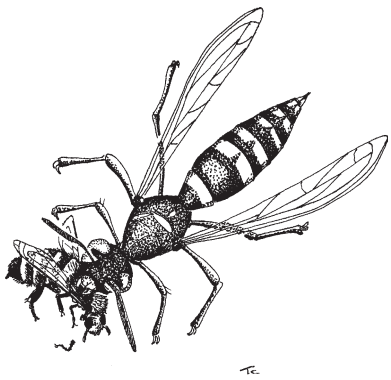


Figure 28. Hornet and Honey Bee

Beekeepers get some level of protection by destroying individual wasps with a large "swatter" shaped like a badminton racket. In the Middle East some beekeepers employ people for this express purpose. Other control measures involve the use of wasp traps or covering hive entrances with mesh or screen with 1cm openings.

Pseudoscorpion. The pseudoscorpion is small bug that is sometimes found inside honey bee colonies (Fig. 29). It will sometimes feed on sick or injured honey bees but is usually much more interested in feeding on other insects like wax moth larvae and honey bee mites. In some parts of the world it is known as the "beekeepers friend."

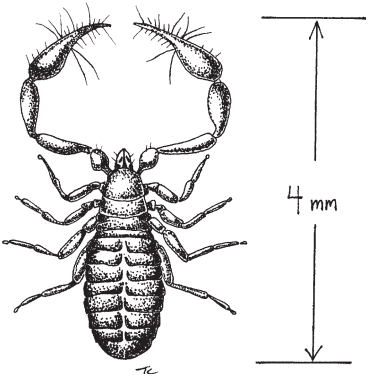


Figure 29. Pseudoscorpion

Diseases

Brood Diseases

American Foulbrood Disease. The most devastating disease of honey bees is American Foulbrood Disease (AFB) (Fig. 30). AFB is caused by a bacterial germ called *Bacillus larvae.* This bacteria is highly contagious and causes the honey bee larvae to die in their cells and then melt down into a small black scale. The population of the colony quickly collapses as successive generations of larvae die. The colony will become weak and the brood combs will have a scattered pattern and many capped cells will have sunken or broken caps. The brood has a rotten or "foul" smell. If a stick is pushed into one of the cells with a dead larvae and pulled out, the remains of the dead larvae will adhere to the stick and will be pulled out like a thick glue.

All colonies with AFB should be immediately burned and the ashes buried deep in the ground. AFB is highly contagious to all other colonies in the area. If the colony is left alone, other colonies will rob out the diseased colony and take the disease back to all the other colonies in the area, and they will soon die of a similar fate. The organism is highly contagious and produces spores that can last in the environment for more than 70 years! That is why infected colonies, combs and bees should be completely burned and buried deep in the soil.

Although there are antibiotics that can be used to control and prevent the disease, good hygiene is the simplest and most effective means to prevent it. Don't buy colonies or hives unless they have been inspected to make certain that they are not infected. Don't feed honey or pollen unless it comes from clean colonies. Check all colonies periodically to make certain that they are free from disease.

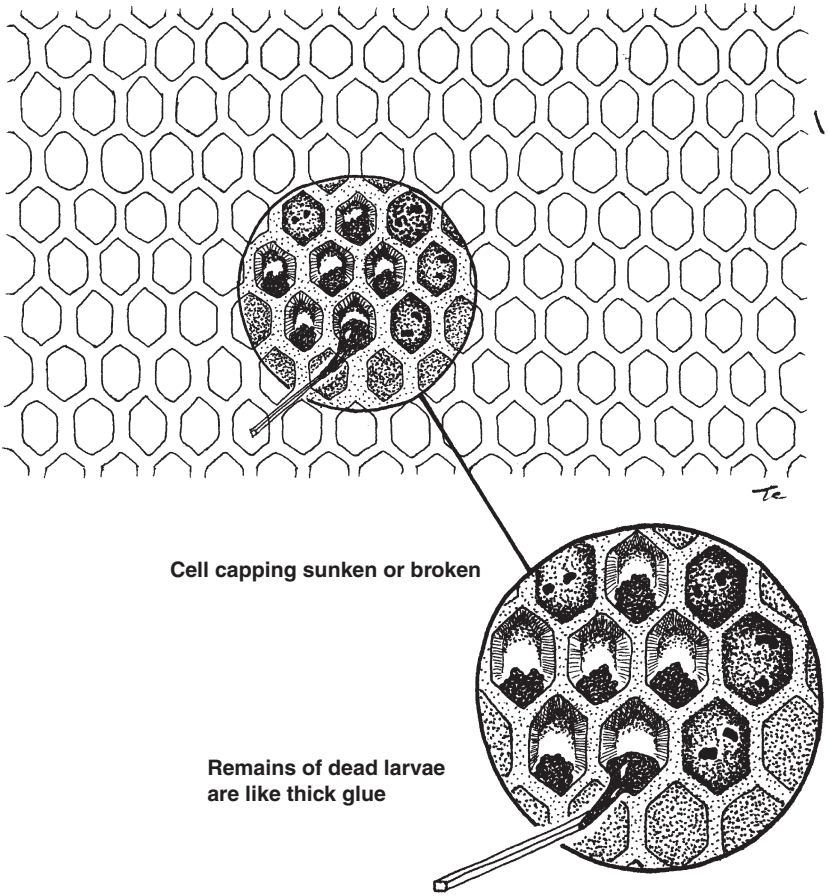


Figure 30. American Foulbrood Disease

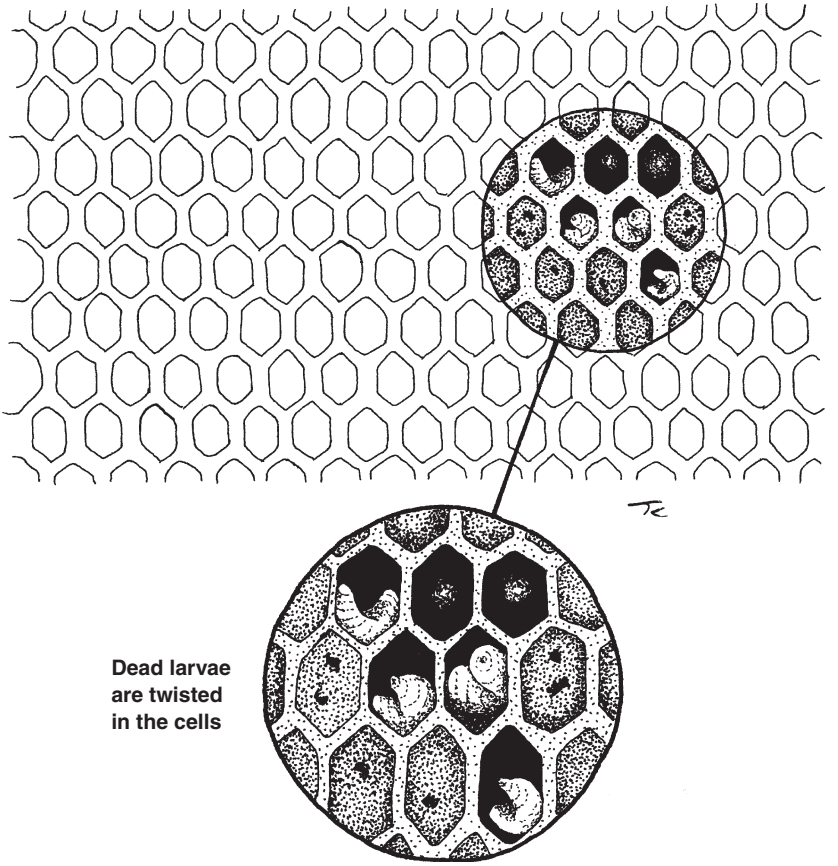


Figure 31. European Foulbrood Disease

European Foulbrood Disease. Another bacterial disease of honey bees is called European Foulbrood Disease (EFB) (Fig. 31). EFB is caused by *Melissococcus pluton* or in some books it is called *Streptococcus pluton*. This disease is usually found in colonies that have been weakened or stressed in some way. They usually recover when the source of stress is removed. A good example would be a weak hive that is saved by the arrival of a good honey flow. EFB is similar to AFB in that the larvae die but the dead larvae are all twisted up in the cells, while with AFB they always lie in the bottom of the cell. If there is any chance that the problem is AFB the hive should be burned and buried. If it is clearly EFB, the hive might be saved. But be certain to prevent robbing by other colonies or the disease might spread throughout the area.

Chalkbrood. A third disease of honey bee larvae is called "chalkbrood" (Fig. 32). This disease is found primarily in colonies that are weak and stressed. It is caused by a fungus that infects the larvae and kills them. After the larvae die they become mummified and are covered with the white fungus. These white "mummies" are commonly thrown out of the hive and are found at the hive entrance; after time, the mummies turn black. This is an indication that the beekeeper needs to closely examine the colony to determine the source of the stress. Check the health of the queen, the food stores and the ventilation. Any problem that weakens the colony should be corrected and the problem usually goes away.

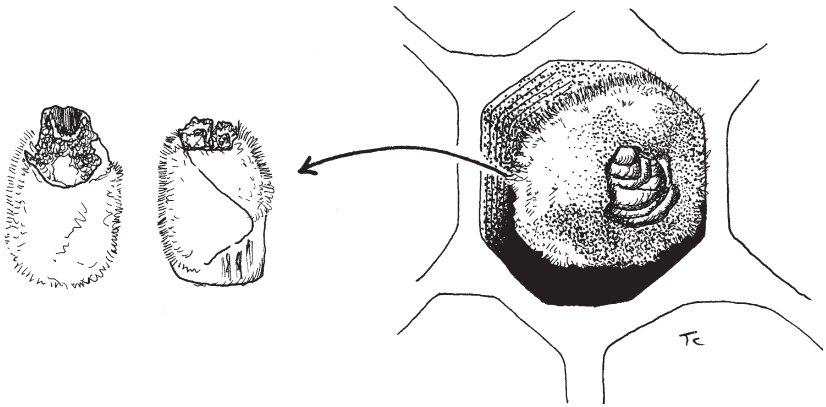


Figure 32. Chalkbrood Mummies

Mite Diseases

Tracheal Mite. The tracheal mite is a microscopic mite *(Acarapis woodi)* that lives in the windpipe of the adult honey bee. It is also known as the "Isle of Wight" Disease. In European honey bees it has been devastating and caused massive losses in industrialized nations. These mites can be controlled by special chemicals. These treatments are not a permanent solution. In developing nations the honey bee populations are usually well adapted to these mites and seem to handle them on their own. The best defense is to use local honey bee stocks and keep the colonies strong with a young fertile queen.

Varroa mite. The varroa mite is a relatively large mite that attacks the larvae and pupae of honey bees (Fig. 33). They are visible as black specks in the white colored honey bee pupae. They are most numerous on the drone pupae. The scientific name of the mite is *Varroa jacobsoni.* When infecting susceptible honey bee colonies an apparently healthy colony will suddenly collapse and the hive will die with large supplies of pollen and honey. It is obvious that they did not starve. The larvae have been killed by the varroa mites and they cannot replace their dead sisters. These mites have caused significant losses in industrialized nations and several chemicals are used to control the mites. Most honey bee stocks in the developing nations are somewhat resistant to these devastating mites. Africanized honey bees in particular are known to attack and kill these mites.

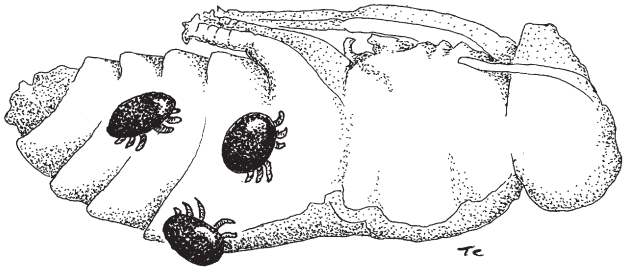


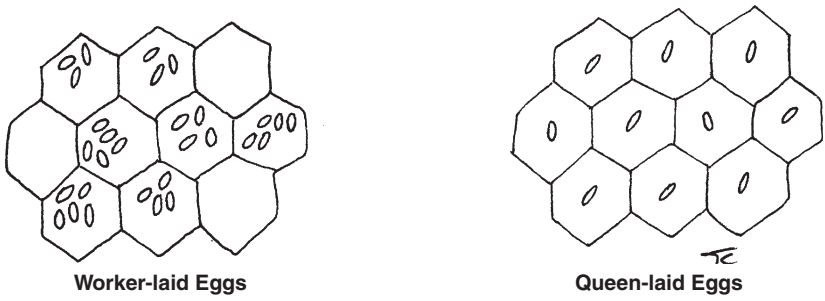
Figure 33. Varroa Mites on a Honey Bee Pupa

Other Problems

Insecticide Poisoning. Inappropriate application of insecticides can produce massive losses in honey bee colonies. When honey bees are exposed to insecticides while foraging in the field they may die before they return to the hive, or they may return to the hive and die there. In the later case, piles of dead bees may suddenly appear in front of the hive. Nothing can be done to help these colonies other than try to support the colonies

until they can recover sufficient populations of workers. This may require combining several weak colonies and rendering or storing excess combs until new swarms can be obtained. Be sure to use insecticides carefully around honey bees. If insecticides must be used, use every means possible to minimize exposure to the bees. The best advice may be to move them to another area until the insecticide threat has passed.

Laying Workers. In cases where a colony has lost a queen, and has not been able to replace her, one or more worker bees may start to lay eggs (Fig. 34). These eggs are infertile and will always result in a drone. It is easy to know a worker is laying eggs because they put many eggs into one cell. A fertile queen never puts more than one egg in a cell. In colonies with laying workers, the population will soon collapse because there will be no workers to sustain the colony. Attempts to introduce a fertile laying queen are always unsuccessful because the colony recognizes the laying workers as if they were queens. The only remedy for this situation is to disperse the colony. Take the combs and shake the bees off and place the combs into other colonies. Take the hive and store it until a new swarm is available. If the hive is left alone, the colony will collapse and the beetles and wax moths will turn it into a rotten mess.



Worker-laid Eggs **Queen-laid Eggs**

Figure 34. Evidence of Laying Workers (after Gentry)

Section VIII

Glossary

Afterswarm: The first swarm to leave a colony is the "prime" swarm. Swarms that leave the colony later are called the afterswarm. The afterswarm usually contains an unmated (virgin) queen and is much smaller than the prime swarm.

Apiary: The place where honey bee colonies are kept, it is also called a "beeyard."

Balling: Worker bees kill strange queens and some wasps by clustering into a tight "ball" around the queen. The workers kill her by pulling her legs, antennae, stinging and smothering her.

Bee Brush: A soft brush, feather or handfull of grass or leaves that is used to gently brush bees from the combs.

Bee suit: A set of clothing that is designed to decrease the chance of being stung by honey bees. Clothing that is white or light colored and closely woven works best. Modern beesuits often have a veil attached by a zipper.

Beeswax: A soft waxy substance that is produced by glands in the body of the honey bee. It is used by the bees to construct combs in the hive. It is used by people for candles, cosmetics and medicine.

Brood: The immature (baby) stages of the honey bee, including the egg, larvae and pupae.

Brood comb: The combs that contain brood. They are usually in the center of the colony and are much darker in color than the honeycomb.

Brood nest: The part of the colony where brood are reared.

Cappings: The thin wax covering over cells containing honey. It also refers to the mixture of wax and honey that is left when the honeycomb is prepared for extraction. Cappings are the source of the best quality beeswax.

Cell: The small six sided chamber in the comb that is used to store pollen, honey or to rear brood.

Chalkbrood: A disease of honey bee larvae caused by a fungus. The dead larvae are eventually thrown out of the hive and they appear at the hive entrance as chalky white mummies.

Cocoon: The thin silk covereing spun by the honey bee larvae as they prepare to change from larvae to pupae to adult honey bee.

Colony: The honey bee colony is a self sufficient unit consisting of the queen, workers and brood, and sometimes drones. It may be living in a natural hollow, or a hive prepared by man.

Comb: A wax structure composed of many cells; used for storing pollen, honey or for raising brood.

Drone: A male honey bee. It is larger than a worker bee and has no stinger.

Egg: The first stage of the honey bee life-cycle. It is usually laid by a queen bee.

Fixed comb hive: A man-made home for a colony of honey bees where the combs cannot be moved or removed without cutting or destroying them.

Foraging bees: The honey bees assigned to fly from the hive to gather pollen, nectar, water or propolis.

Foulbrood: One of several diseases of brood that kill the brood. The dead brood decay and produce a "foul" smell in the colony. These diseases are usually caused by bacteria and are highly contagious from one colony to another.

Hive: A man-made home for a honey bee colony.

Honey: A very sweet liquid product made from plant nectar by honey bees. It contains less than 18.6% moisture and high concentrations of glucose and fructose. The flavor of the honey reflects the flavor and aroma of the blossoms that provided the original nectar.

Honey extractor: A machine that pulls honey out of the honeycomb without breaking or destroying the comb. It uses centrifugal force to move honey out of the combs.

Honey stomach: A large sac at the end of the esophagus that holds honey, nectar and water. It is used by the honey bee to carry liquids from place to place.

House bees: Honey bees assigned to duties within the hive, like cleaning cells, feeding larvae, tending the queen or making honey from nectar.

Larva: The second stage in the life-cycle of the honey bee. A larva emerges when the egg hatches.

Larvae: The plural form of larva.

Mating flight: The young queen flies from the hive and mates with many drone (male) honey bees. She will mate with up to 17 males over several days. She stores the sperm cells in her body and begins to lay eggs. Once she begins to lay eggs, she will not mate again.

Moveable comb hive: A man-made home for a colony of honey bees; the combs can be moved or removed without cutting or destroying

them. The combs are not encased in a wooden or plastic frame and are rather fragile.

Moveable frame hive: A man-made home for a colony of honey bees; the combs are encased in a wooden or plastic frame and can be moved or removed without cutting or destroying them. The frames can withstand rough handling and can be placed into a honey extractor without damage.

Nectar: A sweet sugary liquid that is produced by plant flowers. This liquid is the starting material for the production of honey by honey bees.

Nectar flow: A period of time when plant flowers are full of nectar.

Nuc: Short term for "nucleus."

Nucleus: A very small colony, used to start a new colony, to requeen a larger colony, or as a home for a young virgin queen until she has mated.

Ovaries: A pair of organs inside the body of the queen that produce honey bee eggs.

Pheromones: Chemical odors that are released by the honey bees to communicate. Pheromones are used to signal alarm, hive location, the presence of a laying queen or to identify friend or foe.

Pollen: Small dust-like particles produced by plant flowers. The particles are produced by the male part of the flower. Pollen provides a source of protein and fat and is an important part of the honey bee diet. Pollen is required for the colony to raise brood.

Propolis: Plant resin and gum collected from plants and used to varnish or seal the inside of the hive.

Prime swarm: The first swarm to leave a colony is the "prime" swarm. The prime swarm usually contains the old queen and is the largest and most valuable swarm of the season.

Pupa: The third stage of the honey bee life-cycle when the honey bee is sealed inside the cell. In this stage the organs of the larvae are those of an adult honey bee.

Pupae: The plural of pupa.

Queen bee: A fertile female honey bee. She is the mother of all honey bees in the colony.

Queen cell: A special cell that hangs vertically in the hive like a grape on a vine. It is the home of the queen bee until she emerges as an adult.

Queenless colony: A colony that has no queen. It will die unless they get a new queen.

Queenright colony: A colony that has a fertile queen honey bee that is laying eggs.

Requeening: The process of placing or replacing a new queen in a colony.

Robbing: The practice of honey bees removing honey from another colony for the benefit of their own. This generally occurs when very weak colonies are overcome by much stronger colonies.

Sealed honey: Honey that is completely finished by the honey bees and stored into honeycomb and sealed with a wax capping. This is a sign that the honey is ready to harvest.

Slumgum: Black tarry substance that is left after the honey and wax have been removed from the comb. It is composed of cocoons, pollen, dead bees and dirt.

Supersedure: The process the honey bee colony uses to replace an old failing queen with a young healthy queen.

Surplus honey: Sealed honey that is not needed by the colony to survive the period of dearth. This is the honey that is taken by the beekeeper. The beekeeper must be careful not to take honey that will be needed by the colony to survive the period of dearth!

Swarm: A large group of honey bees that leave the colony along with a queen. This group moves to a new location to start a new colony. This is the natural process of reproduction for the honey bee colony. Swarms are very valuable and can be used to start a new colony in a man-made hive.

Top bar hive: A type of moveable comb hive, a man-made home for a colony of honey bees; the combs can be moved or removed without cutting or destroying them. The combs are attached to "top bars" which serve as the top of the hive. The combs are not encased in a wooden or plastic frame and are rather fragile.

Tracheal mite: A very small eight legged parasite that lives in the windpipe of the honey bee. It saps the strength of the individual honey bees and may even result in the death of the entire colony.

Varroa mite: A very small eight legged parasite that sucks the living juices out of honey bee, larvae and pupae. It can be seen riding on adult honey bees.

Worker bee: A female honey bee whose reproductive organs remain undeveloped. Worker bees are by far the most numerous bee in the colony, they are responsible for conducting all the work of the colony except laying eggs.

Section IX

Sources for Information

International Beekeeping and Beekeeping Development Organizations

Asian Apicultural Association
Honey Bee Science Research Center
Tamagawa University
Machida-Shi
Tokyo, Japan 194 8610
Email njun@agr.tamagawa.ac.jp

Bees Abroad
Pentrebwlen
Llanddewi Brefi
Tregaron
Wales SY25 6PA
United Kingdom
Email site@beesabroad.org.uk
Web www.beesabroad.org.uk

Bees for Development
Troy, Monmouth, NP25 4AB
United Kingdom
Tel +44 (0) 16007 13648
Fax +44 (0) 16007 16167
Email busy@planbee.org.uk
Web www.planbee.org.uk

Intermediate Technology Development Group (ITDG)
Bourton Hall
Bourton on Dunsmore
Rugby CV23 9QZ
United Kingdom
Tel: +44 (0) 1788 661100
Fax: +44 (0) 1788 661101
Email itdg@itdg.org.uk
Web www.iteg.org

International Bee Research Association
18 North Road
Cardiff CF1 3DY
United Kingdom
Tel (01222) 372409
Fax (01222) 665522
Email ibra@cardiff.ac.uk
Web www.cf.ac.uk/ibra/

International Centre for Integrated Mountain Development (ICIMOD)
PO Box 3226
Kathmandu, Nepal
Tel: (9771) 525313
Fax (9771) 524509
Email icimod@icimod.org.np
Web www.icimod.org.np

International Beekeeping Journals

Beekeeping and Development: the journal for sustainable beekeeping.
Published four times per year by
Bees for Development
Troy, Monmouth
NP25 4AB
Phone +44 (0)16007 13648
Fax +44 (0)16007 16167
Email busy@planbee.org.uk
Web www.planbee.org.uk

Bee World: the international link between beekeeping science and practice.
Published by
International Bee Research Association
18 North Road
Cardiff CF1 3DY
United Kingdom
Tel (01222) 372409
Fax (01222) 665522
Email ibra@cardiff.ac.uk
Web www.cf.ac.uk/ibra/

Beekeeping Books

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Equipment Suppliers

Africa

S.M. McGladdery
32 Clough Street
Pietermaritzburg, 3201
South Africa
Tel (033) 3424990
Fax (033) 3424990 ask for fax
Email beekeeping@satweb.co.za
Web www.satweb.co.za/bees/

Australia

Superior Bee Suppies
6/10 Jijaw Street
Sumner Park Qld.
Australia 4074
Tel 617 3376 5404
Fax 617 3279 5501
Web www.superiorbee.com.au

Canada

Benson Bee Supplies
8358 Victoria Street
Box 9
Metcalfe, Ontario
Canada K0A 2P0
Tel. 613-821-2797

F.W. Jones & Son Ltd.
105 St. Regis Cres. S.
Toronto, Ontario
Canada M3J 1Y6
Tel. 416-783-2818

South America

JR Industria E Comercio de Colmeias
Av. Munhoz da Rocha 1.634CEP
83.750-000 Lapa-Parana'
Brazil
Tel (041) 622-1357
Email jrgaio@swi.com.br
Web www.swi.com.br/~jrgaio

Europe

Anel Standard Co.
Andrea Kalvu
105 P.O.
14231 Athens
Greece
Tel 30-1-2771180
Tel 30-1-2771180
Email pantelac@otenet.gr
Web www.anel.gr

E.H. Thorne (Beehives) Ltd.
Beehive Works
Wragby
Market Rasen LN3 5LA
United Kingdom
Tel 44+ (0)1 673 858 555
Tel 44+ (0)1 673 857 004
Web www.thorne.co.uk

Nid D'Abeilles
30 Rue Des Etats Unis
69800 St Priest
France
Tel 00 33 4 78 21 82 00
Tel 00 33 4 72 28 87 82
Email eric.page@wanadoo.fr
Web www.nidabeilles.com

Spürgin GdBR
Teninger Strasse 1
D-79312 Emmendingen
Germany
Tel 0049-7641-8484
Tel 0049-7641-8493
Email info@spuergin.de
Web www.spuergin.de

Thomas Apiculture
86 rue Abbe' Thomas
F-45450 Fay-Aux-Loges
France
Tel +33 (0)2.38.46.88.00
Fax +33 (0)2.38.59.28.28
Email thomapi@wanadoo.fr
Web www.apiservices.com/thomas

United States

American Bee Journal
51 S. 2nd Street
Hamilton, Illinois 62341
USA
Tel 217-847-3324
Fax 217-847-3660
Email ABJ@dadant.com
Web www.dadant.com

Bee Culture
623 W. Liberty Street
Medina, Ohio 44256
USA
Tel 330-725-6677
Web www.BeeCulture.com

Brushy Mountain Bee Farm
610 Bethany Church Rd.
Moravian Falls, North Carolina 28654
USA
Tel 336-921-3640
Fax 336-921-2681
Email sforrest@wilkes.net
Web www.beeequipment.com

Dadant & Sons, Inc.
51 South 2nd Street
Hamilton, Illinois 62341
USA
Tel 217-847-3324
Fax 217-847-3660
Email dadant@dadant.com
Web www.dadant.com

The Walter Kelly Co.
3107 Elizabethtown Road
PO Box 240
Clarkson, Kentucky 42726
USA
Tel 502-242-2012
Fax 502-242-4801

About the Authors

Randy C. Lynn, DVM, MS, DACVCP
IDEXX Pharmaceuticals, Inc.
4249-105 Piedmont Parkway
Greensboro, North Carolina 27410
USA
336-834-6506 (work)
336-834-6502 (work fax)
336-643-4494 (home)
randy.lynn@idexxpharma.com

BS 1977, The Ohio State University
MS 1980, The Ohio State University
DVM 1983, The Ohio State University
Diplomate, American College of Veterinary Clinical Pharmacology

During his undergraduate training Dr. Lynn was trained in beekeeping by Dr. Walter Rothenbuhler, a pioneer in the research of genetics and disease in European honeybees. Following graduation from veterinary school in 1983, he joined the Guilford-Jamestown Veterinary Hospital as an associate before opening the Georgetown Animal Clinic in Kernersville, North Carolina in 1984. In 1985, Dr. Lynn entered corporate practice with positions at Schering Animal Health, Ciba-Geigy, which became Novartis Animal Health, and Blue Ridge Pharmaceuticals which became IDEXX Pharmaceuticals, Inc. He has served in technical services, research and development and regulatory affairs. Dr. Lynn is a diplomate of the American College of Veterinary Clinical Pharmacology and a fellow of the American Academy of Veterinary Pharmacology and Therapeutics. He continues to work part time in small animal practice and is active in short-term missions to Nicaragua, Honduras and Mongolia. He has owned honey bees since 1990 and currently operates approximately 50 moveable frame and moveable comb beehives.

Todd Cooney, DVM
2132 E 100 North
Kokomo, Indiana 46901
USA
765-452-6051 (work)
765-452-7641 (work fax)
765-452-1831 (home)
cooneydog@juno.com

1986 DVM, Purdue University

Dr. Todd Cooney is a mixed animal practitioner in Kokomo, Indiana. He graduated from Purdue University in 1986, along with his wife Lesa, who is also a veterinarian. They have four children, and a few too many animals.

Section X

Homemade Equipment

Diagrams by Nasser Kraria and Brett Adamson

Kenyan Top Bar Hive
- —For African and European Honey Bees
- —For Asian Honey Bees

Tanzanian Top Bar Hive
- —For African and European Honey Bees
- —For Asian Honey Bees

Noah's Hive
- —For African and European Honey Bees

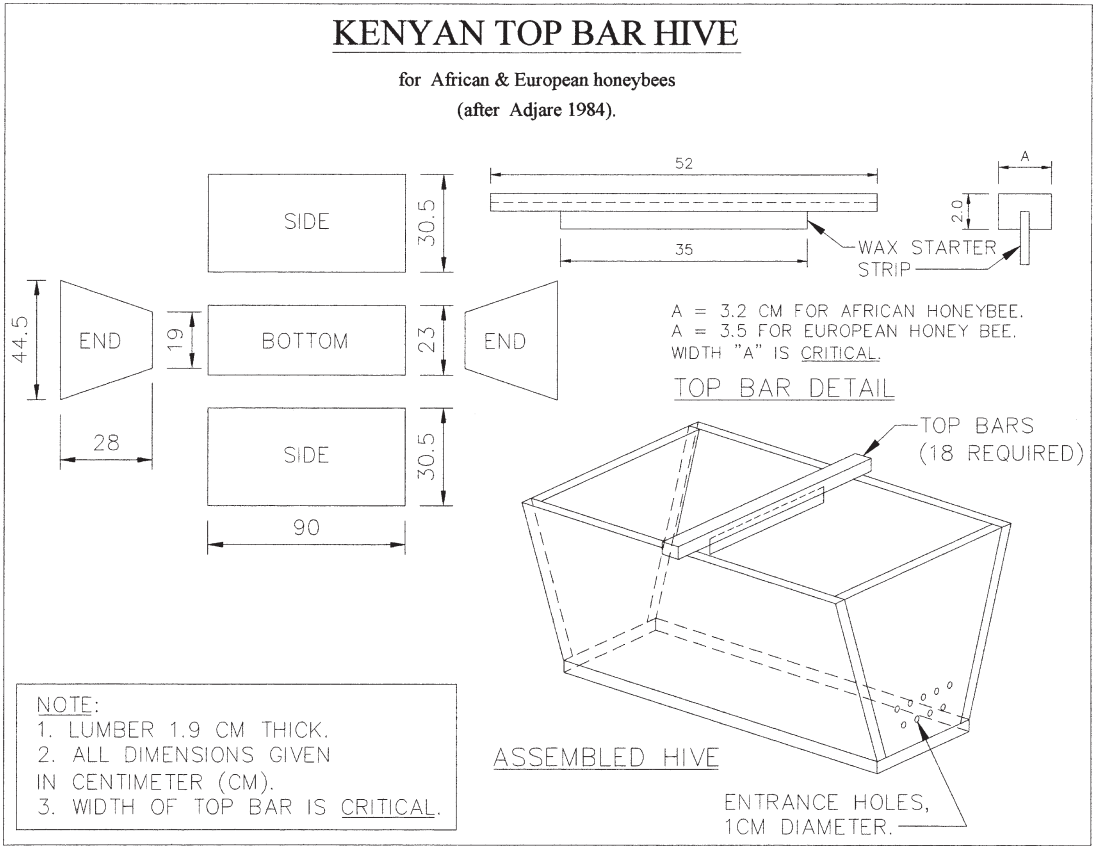
Zambian Veil

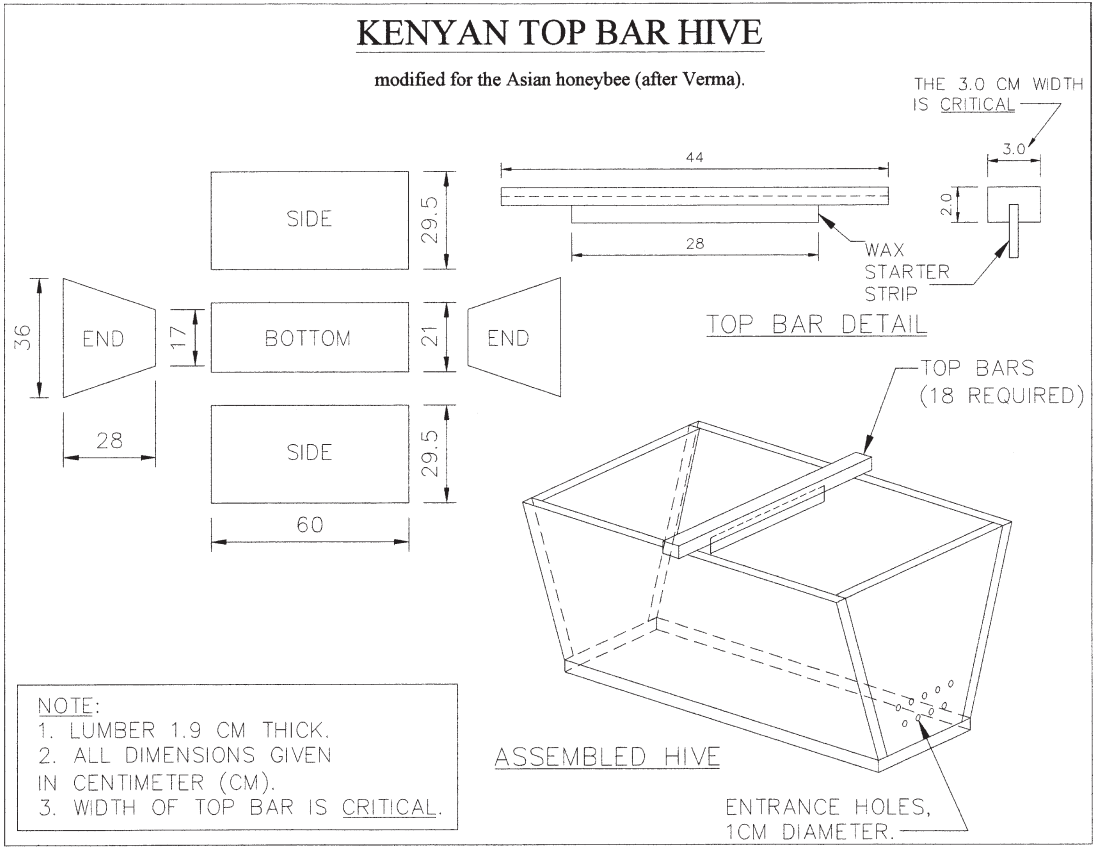
Round Veil

KENYAN TOP BAR HIVE

for African & European honeybees

(after Adjare 1984).

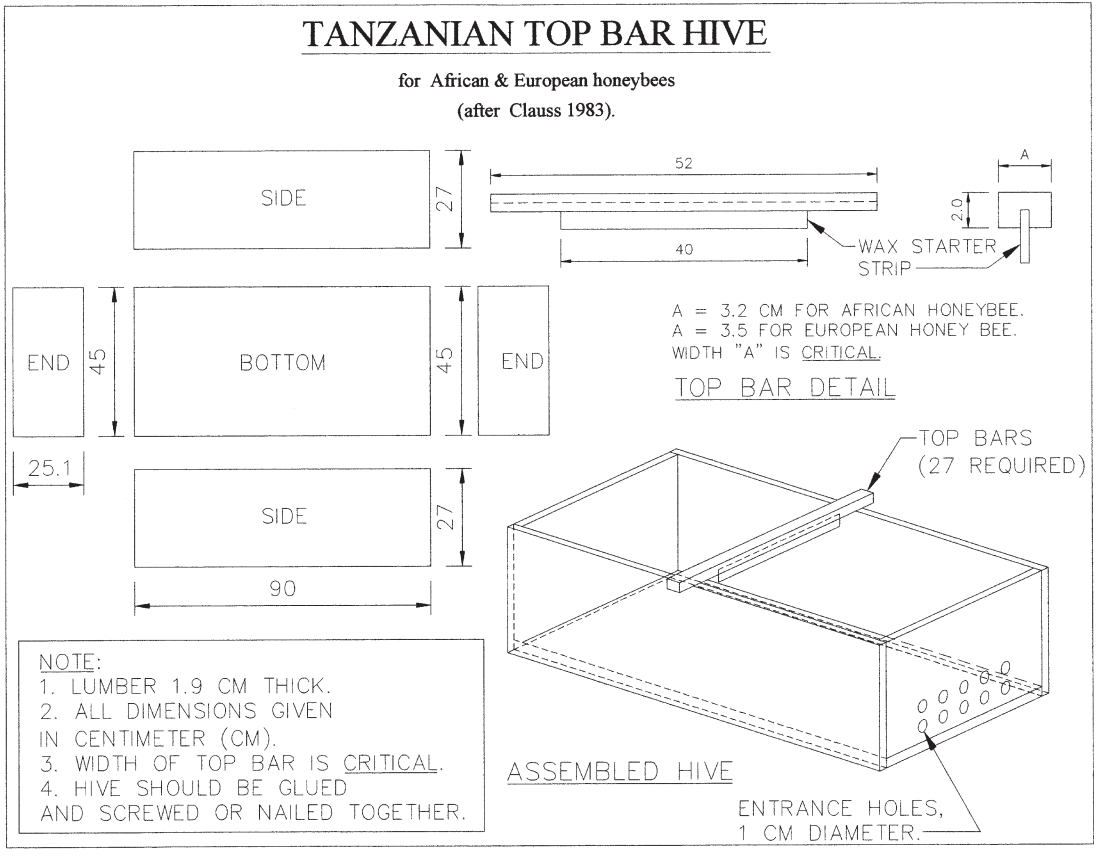



KENYAN TOP BAR HIVE
modified for the Asian honeybee (after Verma).
THE 3.0 CM WIDTH IS CRITICAL
3.0
2.0
44
28
WAX STARTER STRIP
TOP BAR DETAIL
SIDE
29.5
36
END
17
BOTTOM
21
END
28
SIDE
29.5
60
TOP BARS (18 REQUIRED)
NOTE:
1. LUMBER 1.9 CM THICK.
2. ALL DIMENSIONS GIVEN IN CENTIMETER (CM).
3. WIDTH OF TOP BAR IS CRITICAL.
ASSEMBLED HIVE
ENTRANCE HOLES, 1CM DIAMETER.

TANZANIAN TOP BAR HIVE

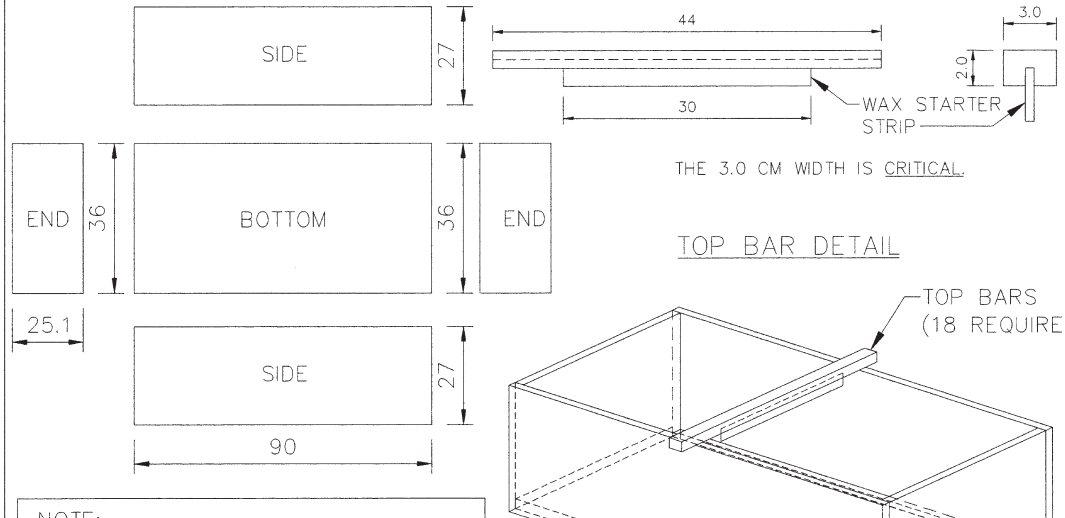
for African & European honeybees

(after Clauss 1983).



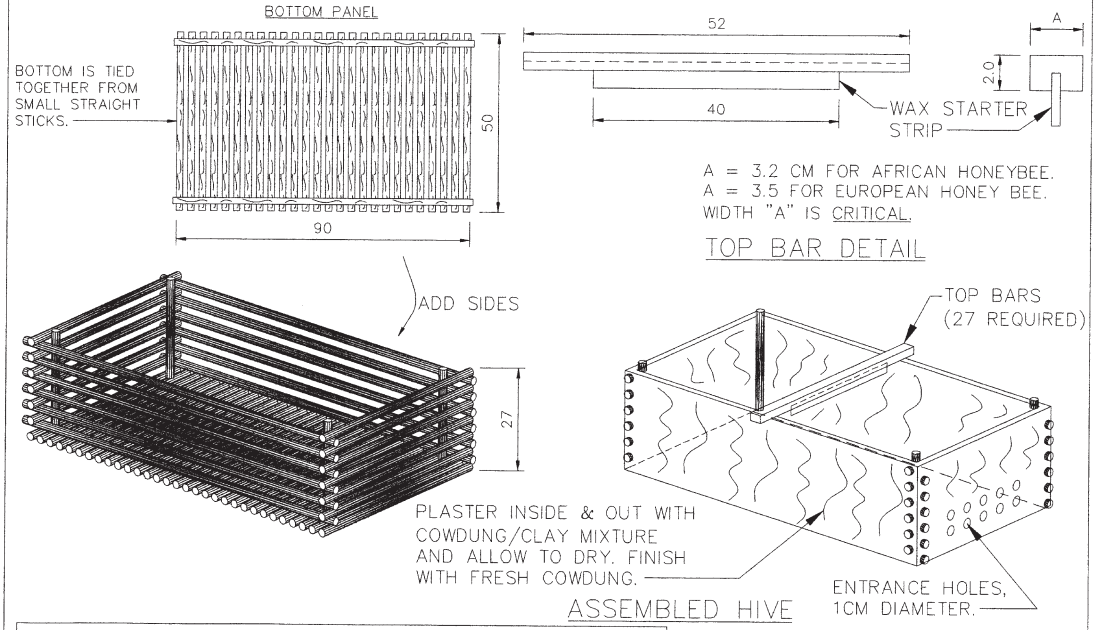
TANZANIAN TOP BAR HIVE

modified for Asian honeybee.



NOAH'S HIVE

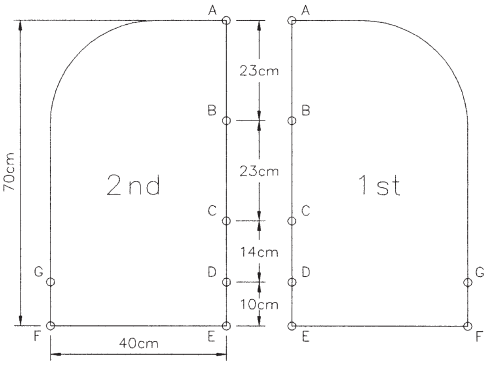
for African & European honeybees. (After Clauss 1991)

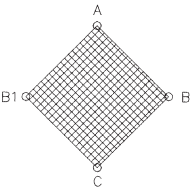


NOTE:
1. ALL DIMENSIONS GIVEN IN CENTIMETER (CM).
2. THIS HIVE IS BEST SUITED FOR HOT-DRY CLIMATES.

ZAMBIAN VEIL

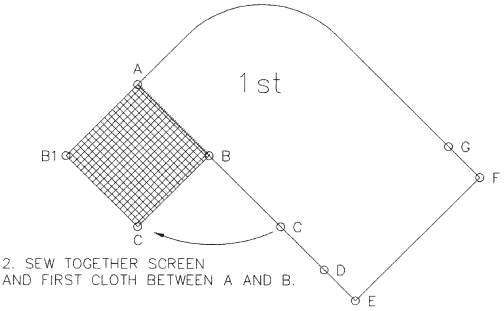
(after Clauss 1991).



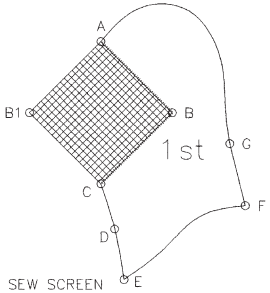


SCREEN WIRE
23 cm x 23 cm

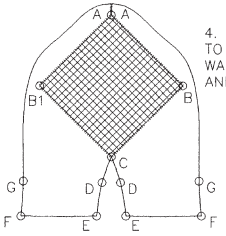
1. CUT THE 2 PIECES OUT OF LIGHT COLORED CLOTH. MARK THE POINTS A THRU G ON THE MATERIAL.



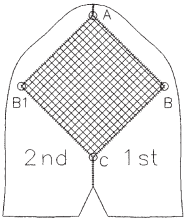
2. SEW TOGETHER SCREEN
AND FIRST CLOTH BETWEEN A AND B.



3. SEW SCREEN
AND CLOTH BETWEEN B AND C.



4. ATTACH THE SECOND CLOTH
TO THE SCREEN IN THE SAME
WAY, SEWING FROM A TO B
AND TO C AND AT LAST TO D.

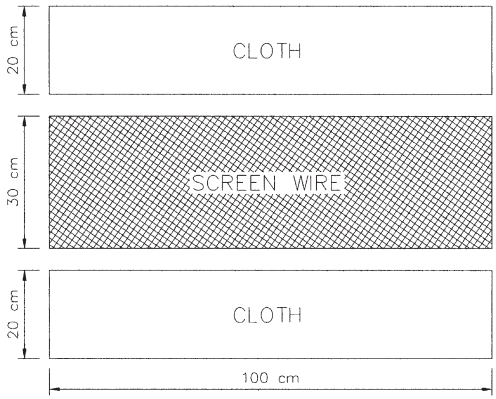


5. SEW THE BACK OF THE VIEL
TOGETHER BETWEEN A AND G
AND FINISH THE WORK
WITH HEMMING THE LOWER EDGE.

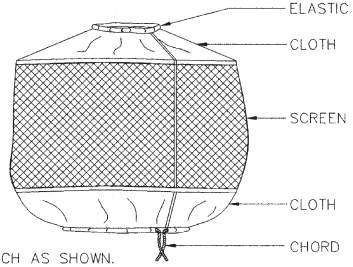
THE SLASHES BETWEEN D AND E AND BETWEEN F AND G MAKE IT EASIER TO PUSH THE LOWER EDGES OF THE VEIL INSIDE THE SHIRT.

ROUND VEIL

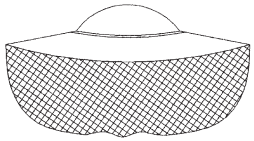
(after Gentry 1982).



1. CUT THE 3 PIECES OF MATERIAL AS SHOWN.



2. SEW AND ATTACH AS SHOWN.



2. VEIL SHOWN TOPPED WITH HAT.

Section XI

Index