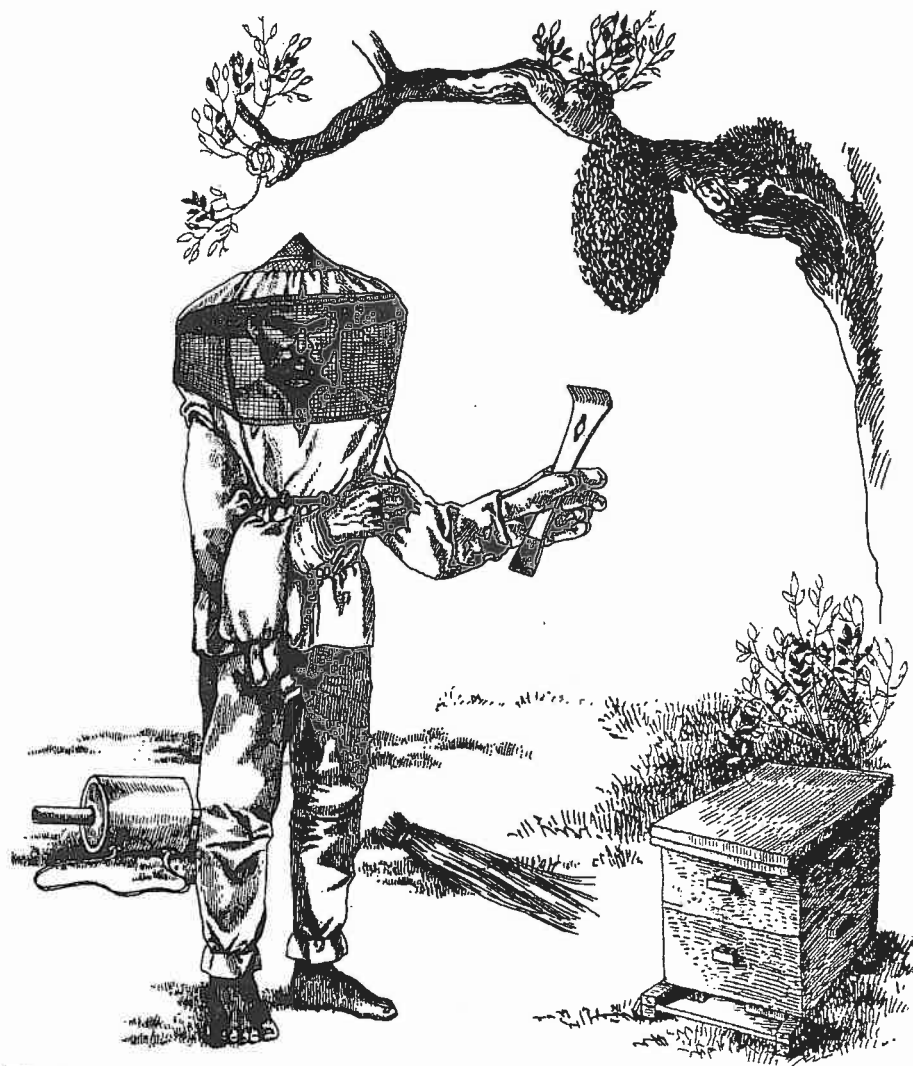


# A BEEKEEPING GUIDE

*for the tropics and subtropics*

*by*

Harlan HD Attfield



*a* **Vita** *publication*

# Table of Contents

	<b>Page</b>
<b>Preface</b>	1
<b>Introduction</b>	3
<b>The Bee Colony</b>	5
<b>What Bees Need to Live</b>	10
<b>Beehives</b>	14
<b>Beekeeper's Equipment</b>	39
<b>Resources</b>	63
<b>References</b>	64
<b>APPENDICES</b>	85
Appendix 1	86
<i>Some Honeybee Forage Plants in the Tropics and Subtropics</i>	
Appendix 2	89
<i>Making A Wax Foundation Press</i>	
Appendix 3	92
<i>Kenya Top-Bar Hive</i>	
Appendix 4	94
<i>Round Wire Veil</i>	
Appendix 5	95
<i>Relative Toxicity of Pesticides to the Common Honeybee</i>	
Appendix 6	99
<i>Simple Uncapping Can</i>	
Appendix 7	100
<i>Belt-Driven Honey Extractor</i>	
Appendix 8	104
<i>Hot Water and Steam Wax Melters</i>	
Appendix 9	107
<i>Case Studies</i>	
Appendix 10	112
<i>Value-Added Products from Bees</i>	

**A Beekeeping Guide for the Tropics and Subtropics**

ISBN: 0-86619-329-4

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## *Preface*

*A Guide to Beekeeping in the Tropics and Subtropics* is written in clear straightforward language. It reflects the author's emphasis on preparing material that can be used easily by extension workers and do-it-yourselfers, regardless of cultural context or geographic location.

Harlan H.D. Attfield is an Agro-Ecologist who specializes in small-scale, integrated farming programs, beekeeping, small-stock, and tropical vegetable gardening. He serves with Volunteers In Technical Assistance (VITA) and has published numerous articles and books detailing his experiences.

The majority of illustrations in this book are by the late Marina Maspero, who contributed her talent to several of the author's publications. Contributions from other artists are credited within the book.

The author wishes to thank Dr. Michael Burgett, Professor, Department of Entomology, Oregon State University, Corvallis, Oregon USA and Dr. Thomas E. Rinderer, Research Leader, Honeybee Breeding, Genetics & Physiology Research, United States Department of Agriculture, Baton Rouge, Louisiana USA, for their careful review of this publication. Both men are well known for their extensive knowledge of bees and beekeeping around the world.

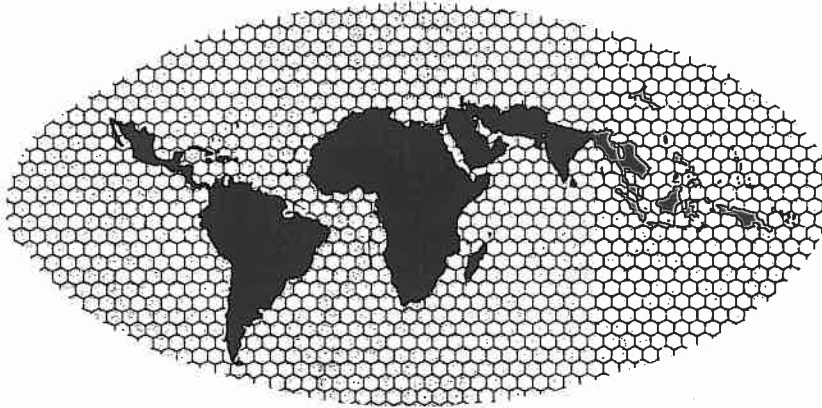
Dr. Diana Sammataro, Department of Entomology, Ohio State University, Columbus, Ohio USA, kindly contributed information on making comb foundation and processing honey and wax.

Special thanks to Henry Mulzac for his generous contribution of illustrations from his book *Practical Beekeeping For The Developing World*.

Barbra Bucci, former Executive Editor for VITA, contributed her considerable expertise to the typesetting and layout of this book; final production was done by Urban Cabin in Oakland, California USA.

Finally, thanks would not be complete if the author failed to mention the late Edward Hand. Ed was an expert beekeeper, an enthusiastic teacher, and a valued friend and mentor.

# Introduction



Keeping bees can be fascinating. It can also be profitable. Selling honey and wax can provide extra income. Beekeepers in some countries rent their colonies to farmers whose crop yields and profits increase from honeybee pollination. The beginning beekeeper will need to have some knowledge of the habits of bees and good locations for the beehives. Beekeeping is not for everyone. Before taking bees into your care try to spend some time with an experienced beekeeper. Appendix 9 contains a few case studies from around the world. These illustrate how projects can differ, depending on the location and materials available.

Honeybees are the most widely studied insects in the world. There are many types (species) of honeybees and many differences between them. This guide provides an overview of beekeeping in the tropics and subtropics. It explains hive management techniques and offers insight into the life of the “common honeybee,” *Apis mellifera* and the “Asian honeybee,” *Apis cerana*. There are many *races* of these two honeybees, and they often require very specific techniques and equipment to hive them successfully. Experienced beekeepers, extension agents from your Department or Ministry of

Agriculture, local universities and, possibly, non-government agencies, can help beginning beekeepers determine which type of bee is best for their area and which management techniques to follow.

Another honeybee of interest is the Africanized *Apis mellifera*. In 1956 queens from South Africa were introduced to Brazil. The bees mated (hybridized) with bees of European origin. The new “Africanized” honeybees quickly spread through South America, Central America, Mexico, and parts of the United States of America. These bees can be very aggressive, but beekeepers have learned how to adapt their techniques and manage them successfully. If you are in an area where Africanized bees are found, you should contact experienced beekeepers or local agencies for advice on how to hive and manage them.

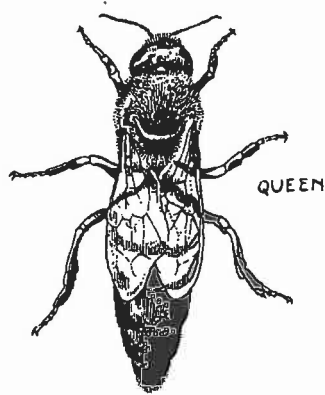
The author wishes you  
the best of luck, and,  
Good Farming



# The Bee Colony

Honeybees live in a home of wax comb. The comb is made of six-sided wax cells. These cells are very strong and house the brood (immature bees) during development and provide storage space for honey and pollen. In nature, bees usually live in a sheltered cavity, such as a hollow tree or rock crevice. The colony is composed of a queen, drones, and workers.

## The Queen



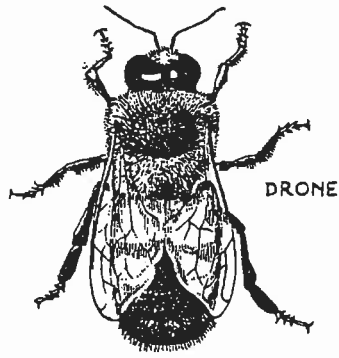
There is only one queen bee in the colony (family). As mother of the colony, her purpose in life is to lay eggs. She may lay several hundred eggs in one day. These eggs may hatch into drones (males), workers, or new queens. Queens that are good layers are prized by beekeepers.

It takes between 14–17 days for the queen to develop from an egg into an adult (average: 16 days).

Around the seventh day after hatching, the queen flies from the hive and mates with multiple drones. This is the only time in her life when the queen mates, though she may live two to five years. The queen is larger than the worker and longer than the drone. Her wings are shorter in proportion to her body length than those of the drone or worker. She has a long, tapering abdomen. When undisturbed, a mated, laying queen will usually be found on or near the comb containing the eggs in the hive. She is often attended by a circle of bees attending to her every need.



## The Drone



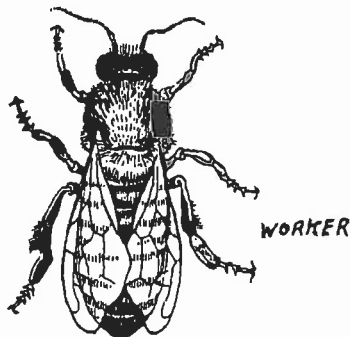
The number of drone bees in a colony varies seasonally. There may be none when the bees have little food, but up to 1,000 during the honey collecting season. When the honey season is over and food and water become scarce, the drones are driven out of the hive to die.

It takes between 23–25 days for a drone to develop from an egg into an adult (average: 24 days).

The drone does no work in the hive. His only function in life is to mate with a virgin queen outside the hive. He dies after mating with her. The drones are the only male bees in the hive.

Drones are larger and fatter than the queen or the workers. Their bodies are not as long as the queen's. The drone has a short tongue which he uses to take food from workers and from stored honey in the hive. He does not have legs fit to carry pollen and he is unable to produce wax. He has no sting to defend himself. Children enjoy handling drones!

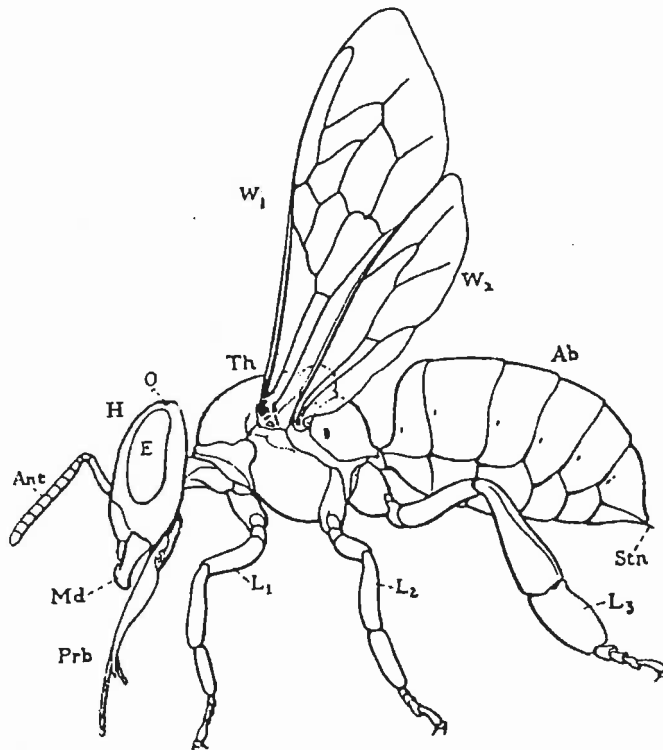
## The Worker



There are 5,000 to 75,000 worker bees in a colony. They do all the house and field work. Some workers go out of the hive to bring in water, pollen, nectar, and propolis (bee glue). Other workers remain in the hive to guard against enemies. Still others clean the hive, build wax

comb, nurse the young, and control the temperature of the hive. Workers eat honey which fuels the production of heat in cold weather and fan their wings which keeps the hive cool in hot weather. It takes between 18–22 days for a worker to grow from an egg into an adult (average: 20 days).

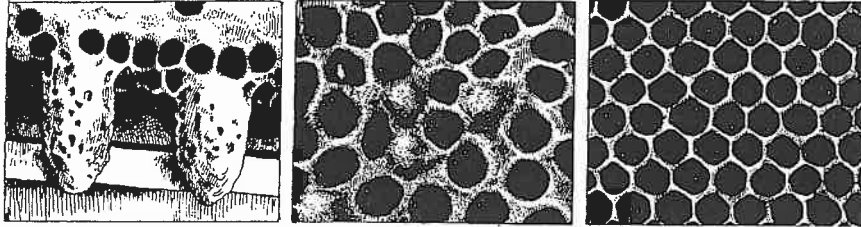
During the honey collecting period, workers live about six weeks. Workers have special legs equipped with pollen baskets. They also have glands that produce wax and the scent necessary for carrying out their many duties. Workers are smaller than either the drones or the queen. They have a sting, which is barbed on the end. When a worker stings something, the stinger and venom sac remain behind, resulting in the death of the bee.



External structure of a worker bee as seen when the hairy covering is removed. Ab, abdomen; Ant, antenna; E, compound eye; H, head; L<sup>1</sup>, L<sup>2</sup>, L<sup>3</sup>, legs; Md, mandible; O, ocelli; Prb, proboscis; Stn, sting; Th, thorax; W<sup>1</sup>, W<sup>2</sup>, wings (Courtesy, Dadant and Sons).

## Cells

The cells of the queen, drone and worker all differ, as shown.



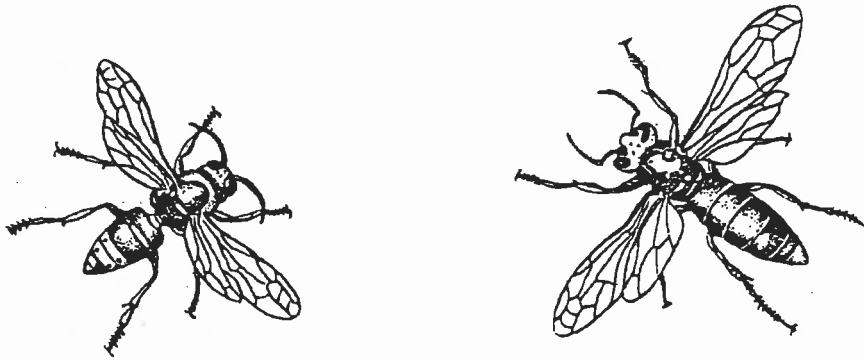
Queen cells

Drone cells

Worker cells

## Relatives of Honeybees

Wasps are not bees but are sometimes mistaken for bees (below). Their homes are made of mud or paperlike materials. Many wasps are parasitic, laying their eggs in or on the bodies of other insects or spiders. Wasps are not good for honey production.



Several kinds of bumblebees are found around the world. Although color varies a great deal, some common bumblebees are blue-black or black and yellow. They make their homes at or near ground

level, often in empty mouse nests. Like wasps, they are not good for honey production.

The smallest of the honey yielders are known by many people as stingless bees (*Melipona spp.*). However, it is not completely correct to call them this because they *do* have stings although imperfect for use. These bees do not sting but bite instead. They resemble a honeybee somewhat, but are much smaller. They build their homes in the hollows of trees, rocks, walls, keyholes, and roof cracks. Although these bees store honey, the yield is too little to warrant keeping them.

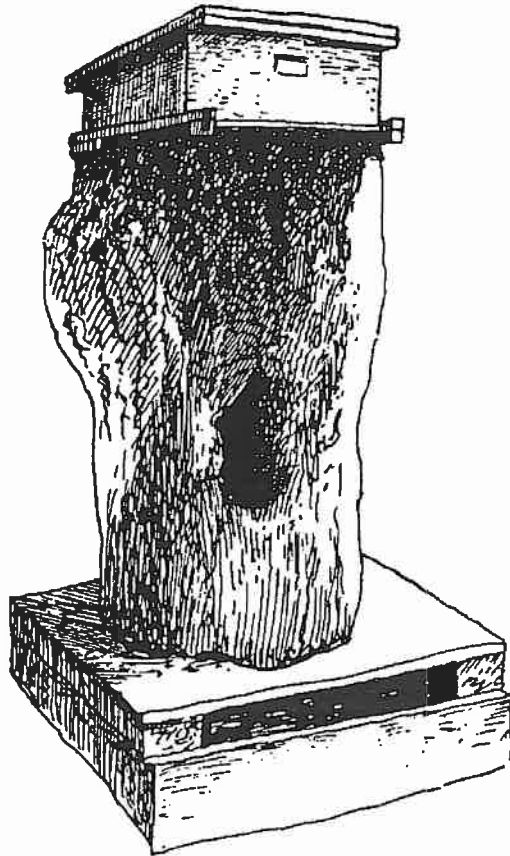








Figure 7. Log hive. Also called a bee gum.

# What Bees Need To Live

In order to live and produce honeybees use the following:

- |   |  |
|---|--|
|  Beeswax |  Pollen                     |
|  Nectar  |  Sticky material (optional) |
|  Water   |  A home                     |

## Beeswax

Bees use beeswax in order to make wax comb. They store honey and pollen and raise their young in the wax comb. Workers produce beeswax in wax glands located on the underside of their bodies. As it is made, beeswax changes from a liquid into tiny wax scales. Workers then use these wax scales to build comb.

Workers must eat large amounts of honey or nectar to produce wax. They keep the hive temperature between 92° and 97°F (33° and 36°C) while making wax.

Many beekeepers help their bees to start making wax by putting thin sheets of beeswax foundation in the wooden or bamboo frames of the hive. The foundation wax fits into hive frames and forms the base of the honeycombs. It helps speed up comb construction and gives the bees a guide to follow for building straight and easy-to-remove honeycombs.

## Nectar

In order to make honey, bees must have nectar. Nectar is a liquid, sugary substance produced by flowers and is the raw material of honey. Honey is the bees' main carbohydrate source of food. Nectar is generally one-half to three-fourths water. After the

workers carry nectar to the hive, they evaporate most of the water and thicken it. They then seal the full honeycomb cells with a thin layer of wax.

Many flowering plants make nectar, but only a few grow abundantly or produce enough nectar to be considered good sources. The best sources of nectar vary from place to place. As a beekeeper, you will want to know the plants in your area that are best for honey production.

Appendix 1 lists some honeybee forage plants found in the tropics and subtropics. (*For a more complete list see references 1,12,17,29,35,65,66.*)

The days when a good number of plants have nectar to be foraged by honeybees is called a honeyflow period. If the nectar yield is abundant from a large number of the plants of a single kind, it is called a major honeyflow period. When the amount of nectar plants is available in large numbers, providing one or two major honeyflow periods, and minor honeyflow periods during other parts of the year, then beekeeping can be successful. In the best beekeeping areas the unproductive period is not long in duration.

The color and flavor of honey depend on the kinds of plants from which bees collect nectar. Honey may be clear, golden, or even brown. Its flavor can range from mild to strong. Flavor and color are not necessarily related. Some light honey tastes strong and some dark honey is mild.

## **Water**

Bees must have water in order to live. Bees add water to honey before eating it. During hot weather, they may stop collecting food and start collecting water to cool the hive. Some water is obtained from nectar, but a colony that cannot collect water from other sources will die within a few days. Beekeepers often maintain an open supply of water during dry periods.

## **Pollen**

Bees need flowers from which to collect pollen. Pollen is the only source of protein for bees. Pollen is the powdery material found in most flowers, which fertilizes other flower parts to produce seeds. Many wild flowers, weeds, trees, and agricultural crops produce pollen that bees can use.

Workers place pollen in pollen baskets on their hind legs and carry it back to the hive. The pollen is stored as “beebread” in the cells of the honeycomb. Later it is fed to young bees. Pollen is needed before and during the honey-producing season so the young bees will have plenty of food.

As the bees move from flower to flower, the tiny grains of pollen stick to their bodies. This is how bees provide their important service of pollination, or uniting the male and female parts of the flower so that seed is produced. Farmers are greatly appreciative of this service, which increases their productivity. (*See references 1,35,59,60,61.*)









## **Sticky Material**

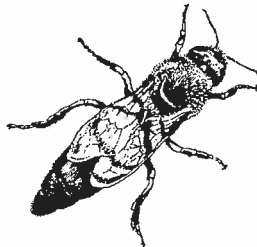
Propolis is a sticky, gummy material that some species of bees collect from tree and flower buds. Bees use propolis to seal cracks and to waterproof the hive. Lacking propolis, some bees will use paint or asphalt for this purpose. (*See references 35,71,79.*)

## **A Home**

To keep bees, you will need to provide them with a home or “hive.” Bees need a place to raise their young, to build their wax comb, and to store their pollen and nectar. They also need a hive for protection from wind, rain, heat, cold, and pests.

## Points to remember when building a hive:







-  The hive should be built so that it will be easy to remove the surplus honey.
-  After the surplus is collected it should be easy for the bees to start storing honey again in the hive.
-  The hive should be well-made so that it will house the bees for many honey-producing seasons.
-  There should be enough space in the hive for bees to build new combs for brood rearing and food storage.
-  The entrance hole of the hive should be just big enough to let the bees come in and go out. If the hole is too big, however, it will be difficult for the bees to defend their stored honey from pests.
-  The hive should protect the bees from cold or hot weather. In a warm country the hive should be placed in partial shade.
-  There must always be a supply of water nearby, as well as a good source of nectar and pollen within 3-5 kilometers (2-3 miles).
-  A hive should be placed where the bees are unlikely to sting anyone.





# Beehives

Many types of beehives are used by beekeepers all over the world. The hive used will depend on materials available in the area. Some materials from which beehives can be made are:

-  Wood.
-  Straw woven into rope that is twisted around in a rectangle, circle or square.
-  Large rectangular cans such as empty kerosene tins.
-  Tree trunks, which are cut into sections and hollowed out.
-  Clay or mud jars and bricks.
-  Bamboo or woven reeds coated with clay or mud.

Wooden tiered hives with moveable frames are used by many beekeepers throughout the world. It is important to make like parts exactly the same, and keep all the dimensions the same so that the parts will fit together well and can be easily interchanged with the parts of other hives. The combs of movable frame hives are very strong due to the wood that supports them on all four sides.

This type of hive allows the beekeeper to remove honey-filled combs without disturbing the brood nest. Additionally, the honey combs are not damaged during honey extraction and can be returned to the colony to be used again and again. Additional chambers (boxes) can be added if more space is needed for brood

rearing or honey storage. Conversely, chambers can easily be removed to reduce the size of the colony.

Although the tiered hive is in popular use throughout the world the design offers some possible drawbacks. In short, this type of hive may be too intricate and complicated in some rural areas. Craftsmanship, and sometimes special tools and machinery are required, to manufacture the various hive parts. Wood for the frames must often be seasoned for at least a year to prevent warping and misalignment. The initial cost of these hives is often three times more expensive than simpler hives, and the extracting equipment might be difficult to fabricate without support from local machine shops.

When using movable frame hives, special attention must be given to the space left between the frames, floor (bottom board), walls, and cover inside the hive. For some hives this “**bee space**” is 6mm (1/4”) to 8mm (5/16”). If the space is not just right the bees will not be able to pass through, and they will seal it up with propolis. If the space is wider than needed for passage, the bees will build honeycomb in it. Neither of these conditions is good for the beekeeper. The bee space between two frames should be as exact in distance as between two *naturally* built honeycombs. This distance is the thickness of a honeycomb and two honeybee thoraces (the thorax is the middle part of the bee’s body where the wings are attached). A gap this size allows two bees to pass each other between the frames while being on the facing surfaces of the combs (Figures 8 and 27).

Wooden hive parts should be made from light, well-seasoned wood. Some common trees used in the tropics and subtropics are: **pin**es (*Pinus spp.*), cypress (*Cupressus spp.*), East African pencil cedar (*Juninpersus procera*), West African **émiré** (*Terminalia ivorensis*), *Piptadeniastrum africanum*, **pochote** (*Bombacopsis fendleri*), **piney** (*Hardwickia pinnata*), **muninga** (*Pterocarpus angolensis*), **Eucalyptus spp.**, and **teak** (*Tectona grandis*). Contact your agriculture or forestry agency to identify suitable sources of wood in your area. (See references 1,12,17,29.) The outside of the

hive should be painted with a light-colored exterior paint to prevent the wood from weathering too quickly. A mixture of equal parts of old crankcase oil and kerosene can be applied as “paint” for the outside of the hive. When possible all hive parts should be assembled with a waterproof glue before being nailed securely.

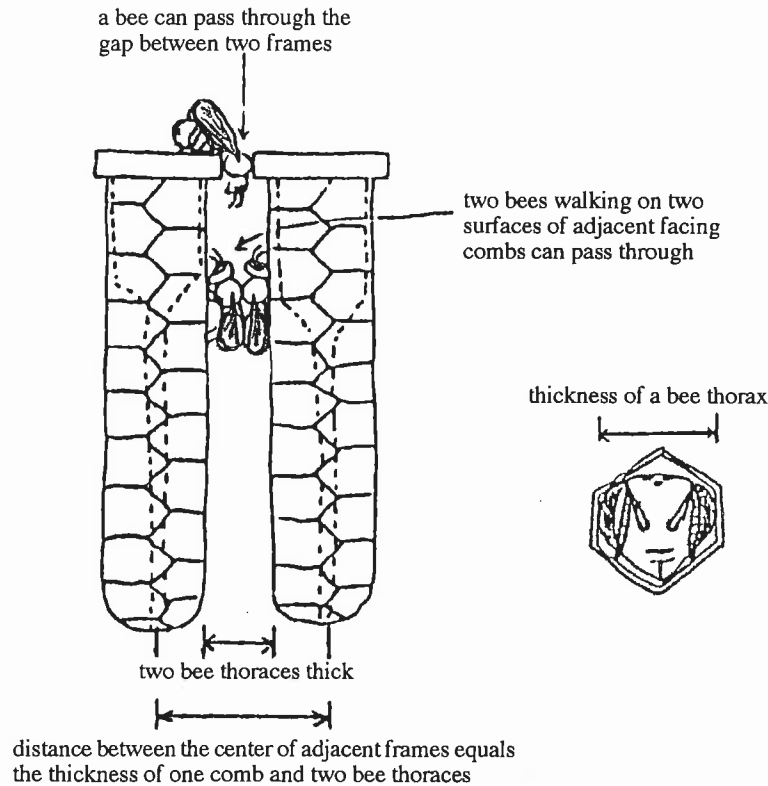


Figure 8. Bee space between two facing combs (Redrawn by Dr. Lisa Bird from *The Sustainable Agriculture Newsletter*, SIBAT, Manila, Philippines).

Following is a description of a removeable frame hive. The popular Langstroth hive — and *modifications* of it — has been used successfully with *Apis cerana* and *Apis mellifera* in many countries. However, *Apis cerana* is usually managed in smaller hives. Keep in mind that the hive you choose will depend on the *size* and

specific *space requirements* of the bee you intend to hive. It is *very* important that you contact your agricultural agent, extensionist, or Department (Ministry) of Agriculture for advice. **Don't waste time and money on hive equipment that is not suited to the honeybees in your area! Use uniform standards if they are available.** (For more information on movable frame hives see references 1,12,13,14,17,23,45,47.)

## Removeable Frame Hive (Langstroth Hive)

Figure 9 shows the Langstroth hive and its various parts.

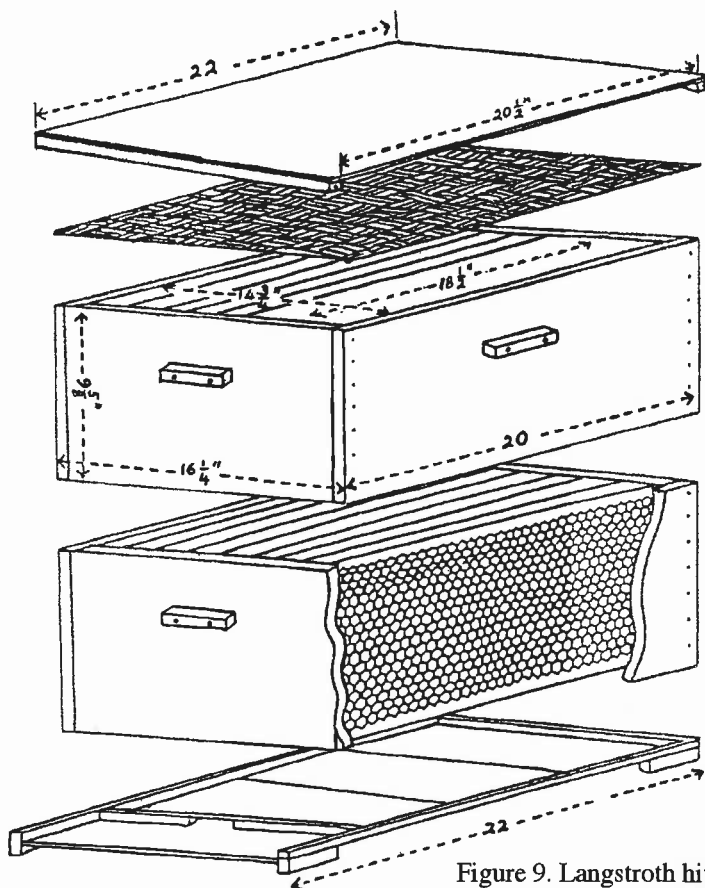


Figure 9. Langstroth hive.

1. **Bottom board** This is the floor of the bee hive and can be made by using a piece of wood 55.88cm long X 41.28cm wide X 1.91cm thick (22" X 16-1/4" X 3/4"), or by joining two wooden boards together and nailing them in position.

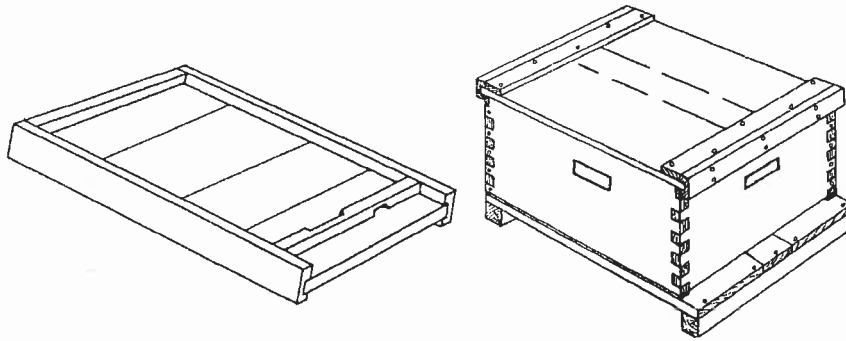


Figure 10. Two popular bottom boards (*Courtesy, Miller, FAO, and S. Adjare, Beekeeping in Africa*).

Along the edge of both sides is nailed a wooden strip 55.88cm X 1.91cm X 1.27cm (22" X 3/4" X 1/2"); and another wooden strip 37.46cm X 1.91cm X 1.27cm (14-3/4" X 1/2") is nailed along the back edge.

The front is provided with another strip of wood that is 37.47cm X 1.91cm X 1.27cm (14-3/4" X 3/4" X 1/2") and has an entrance 7.62cm long X 0.97cm in height (3" X 3/8"). If needed, the entrance opening can be made larger.

2. **Brood chamber** This provides space for eggs and brood although sometimes the queen will lay eggs in a few combs in the honey super. The brood chamber is a rectangular box without a top or bottom and is made of 1.91cm (3/4") thick wood. Figure 11 shows three commonly used corner joints for the construction of brood and super chambers.

Its length on the outside is 50.80cm (20") and on the inside 46.99cm (18-1/2"); its width on the outside is 41.28cm

(16-3/4") and on the inside 37.47cm (14-3/4"); and it height is 24.46cm (9-5/8"). A rabbet (shelf) 1.27 (1/2") deep and 0.97cm (3/8") wide is cut along the entire inside top edge of both width boards. The "side view" of Figure 27 shows how the wooden frames rest on this shelf.

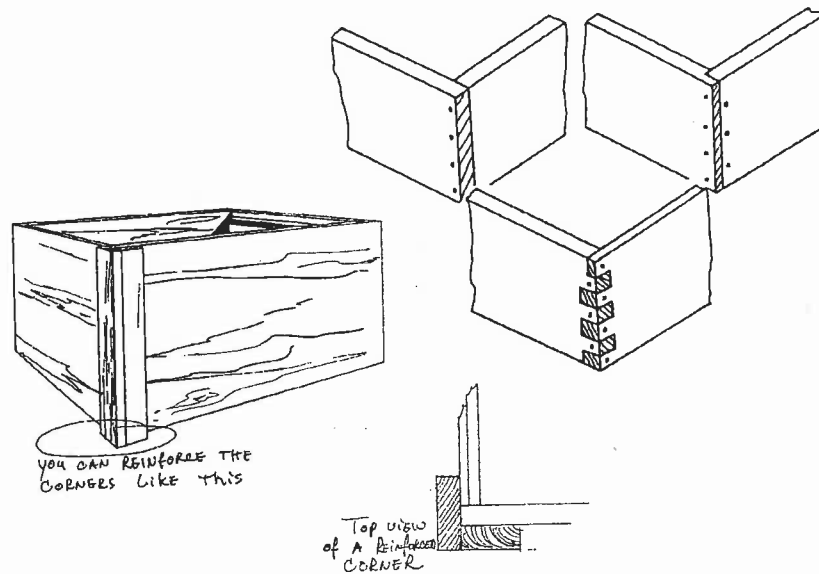


Figure 11. Upper left: Box corner; Upper right: Special box corner; Below: Finger joint. (Courtesy, FAO and S. Adjare, *Beekeeping in Africa*).

3. **Honey super** This is the storage area for surplus honey. Wooden frames support the wax comb. More honey supers are added to the hive if the bees need more space.

The dimensions of the super and the super frames should be the exact size of the brood chamber and brood chamber frames.

4. **Wooden frames** [for brood chamber and honey super]  
Generally 9–13 frames are used for smaller bees. For the larger "European bee" 9–10 frames are commonly used.

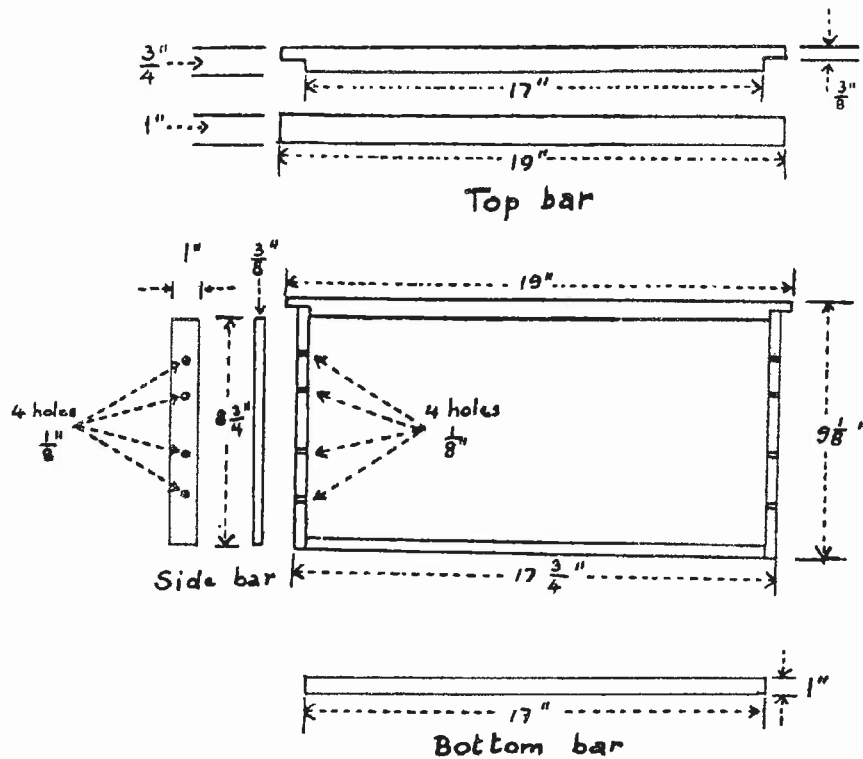


Figure 12. Langstroth frame.

The Hoffman self-spacing frame shown in Figure 14 requires careful milling to create the “shoulders” that, when touching, keep the frames at the correct spacing. Simple frames, without wooden shoulders or staples, can be properly aligned using a spacing bar (Figure 15), that mechanically arranges the frames, or the Stoler spacer shown in Figure 16. The frames can be wired so they will support wax comb or sheets of wax foundation. This can be done by drilling three or four holes in each side bar and then stringing tinned wire (28 gauge) tightly through the holes (Figure 13). Good wiring prevents the foundation and combs from sagging and allows the beekeeper to handle the combs at any time. If beeswax foundation sheets are available, they should be used. Foundation is made by passing thin sheets of wax through a roller-mill having surfaces that emboss a raised pattern

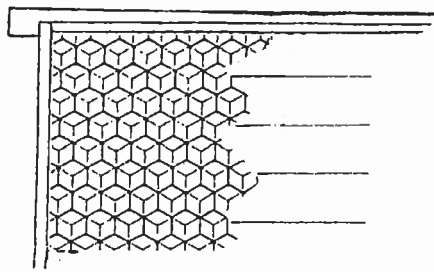


Figure 13. Enlarged cut-away view of a sheet of wax foundation supported by horizontal wires.

of hexagons on each side of the sheet. Forming trays can also be used to produce patterned sheets of foundation. Another way of making foundation is by using incised plastic sheets that serve as dies. A thin plain sheet of wax is placed between them and pressure applied to emboss the pattern of hexagons on each side of the sheet.

The hexagons are used by the bees as a *foundation* (or starting point) from which to begin building the sides of their cells (referred to as “drawing out foundation”).



Figure 14. Hoffman self-spacing frame.

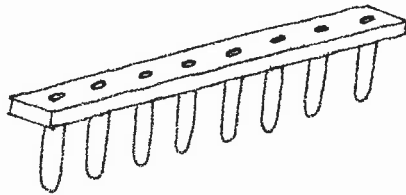
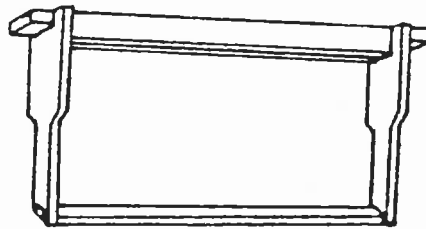


Figure 15. Spacing bar (rake). The tines, which are often tapered at the ends, are inserted between the frames and moved back and forth until the frames are aligned (Courtesy, Dr. Lisa Bird).



Top View



Figure 16. The Stoler frame spacer is a specially cut strip of metal which attaches to the rabbets (shelves) of the brood chamber and honey supers.



Comb built on foundation will be even, sturdy, and last for many, many years. As different types of bees differ in size, so does the cell size of their combs. It is important that the correct *size* of hexagonal cells be used when making foundation. The following Table shows how cell size can differ.

### Approximate Number of Comb Cells for Various Bees

(Number of cells on one side of comb.)

	Cells per Sq. Centimeter	Cells per Sq. Inch
European Bee ( <i>Apis m.m.</i> )	177	27.65
Asian Bee ( <i>Apis cerana</i> )	256	40.00
African Bee ( <i>Apis mellifera</i> )	206	32.20

Appendix 2 provides a description of how to make a simple wax foundation press and a few addresses to write for foundation-making equipment.

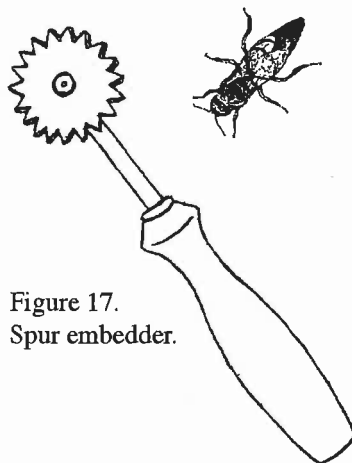


Figure 17.  
Spur embedder.

Wax foundation sheets can be attached to wired frames by dripping a thin layer of melted beeswax along the wires and then pressing them to the foundation sheet. Wax foundation sheets can also be attached to the wires with a small tool called the “spur embedder” (Figure 17).

The spur embedder is heated in hot water and then rolled along each wire, which is pressed to the

foundation sheet. The hot, metal “wheel” of the spur embedder melts the wax foundation all along the length of each wire. The melted wax foundation quickly cools leaving the sheet nicely secured in the frame. To make the job of wire-embedding easier, many beekeepers start by fastening an edge of the foundation sheet with melted (heated) beeswax in the groove on the lower side of the top bar. Figure 18 shows this groove. If the frame is used again, the groove may be cleaned with a nail or piece of hard wire. New foundations are now available that have built-in reinforcement and requires no wire.

Even without embossed foundation, plain sheets (full or cut into strips) can be used to help guide the bees during comb building (Figure 19 and Appendix 2).

If wax foundation is not available, pieces of old comb from a wild hive can be tied to the frames to help the bees begin storing honey and rearing brood (Figure 20).

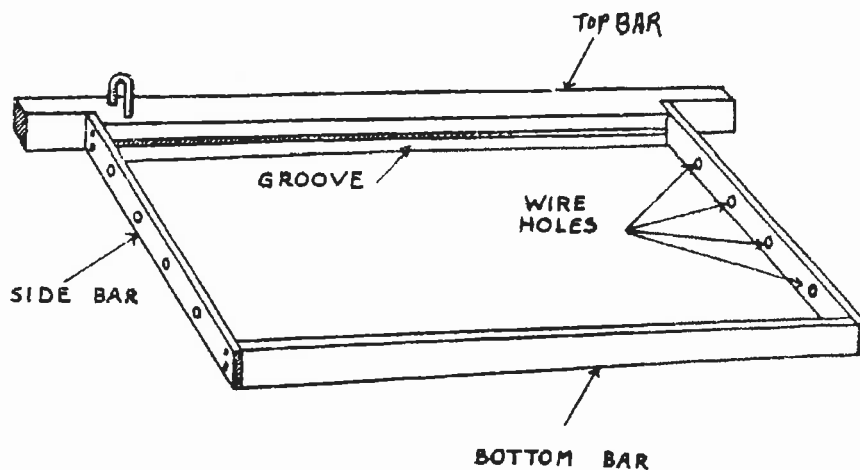


Figure 18. Foundation is inserted and attached to the groove on the underside of the top bar.

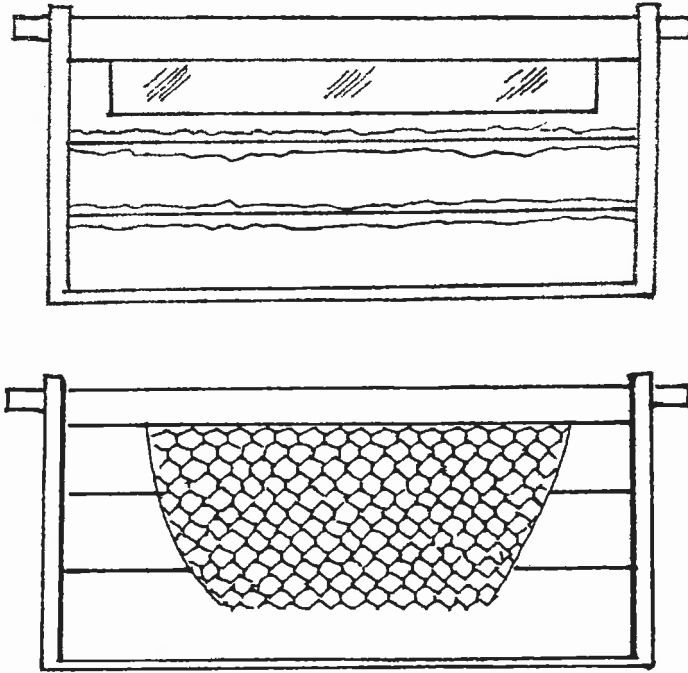


Figure 19. Strip of plain wax secured on the top bar (top). Wire supports should be coated with wax. Bees will “draw” comb from this guide. (Source: *Agroforestry Technology Information Kit, IIRI, Philippines.*)

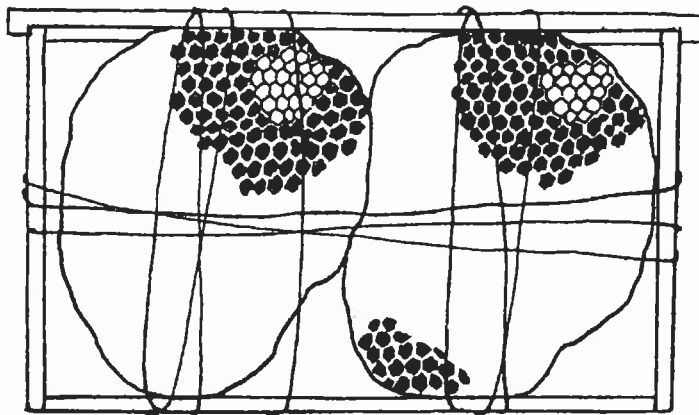
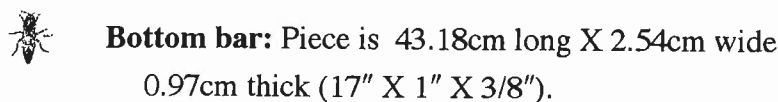
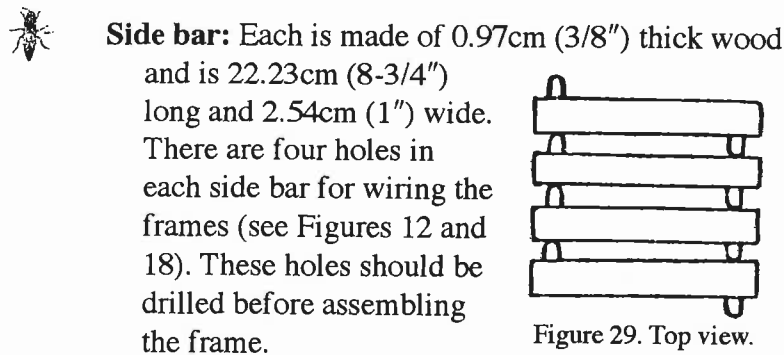
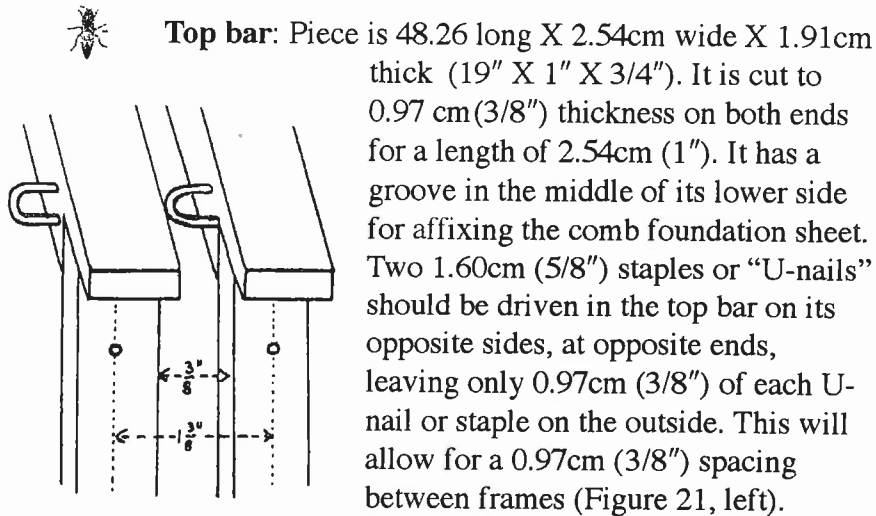


Figure 20. Tying old comb to a frame.

### Dimensions for the staple-spaced frame:



- 5. Inner cover** This can help to insulate the bees from heat and cold. It also keeps bees from building comb and propolis under the outside cover. The inner cover is made from wood, fiber mat, or jute sackcloth cut to the same length and width as the honey super.

Some beekeepers don't feel the need for inner covers when using tight-fitting flat-top outer covers.

6. **Outside cover** This protects the frames and supers underneath. A *flat-top cover* can be made of 0.97cm (3/8") thick boards nailed to a rectangular frame 5.08cm (2") high, all covered with galvanized sheet metal, tar paper, or other waterproof material. A simple, flat-top cover is shown in Figure 9 and 10. The boards are nailed to two strips of wood made to overlap the front and back top edge of the hive body. Any cracks are filled neatly with coal tar spread from the outside surface of the cover. Clay, putty, or other crack sealants can also be used.

A *sloping-top cover* is shown in Figure 23. It is usually made to fit loosely over the hive and is provided with a 2.54cm (1") diameter screened ventilation hole on the front and back. Although some beekeepers prefer a cover that sheds rainwater quickly, it can be an expensive add-on to the hive.

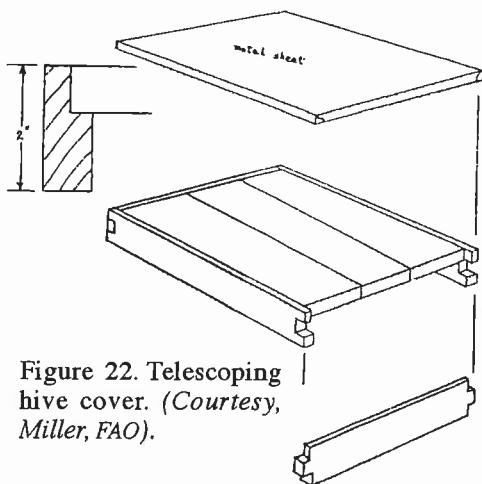


Figure 22. Telescoping hive cover. (Courtesy, Miller, FAO).

Figure 22 shows a telescoping cover which rests on the

inner cover and hangs over the top edges of the hive body. Some beekeepers prefer this design because it affords more protection than a flat cover. However, the cost of production increases.

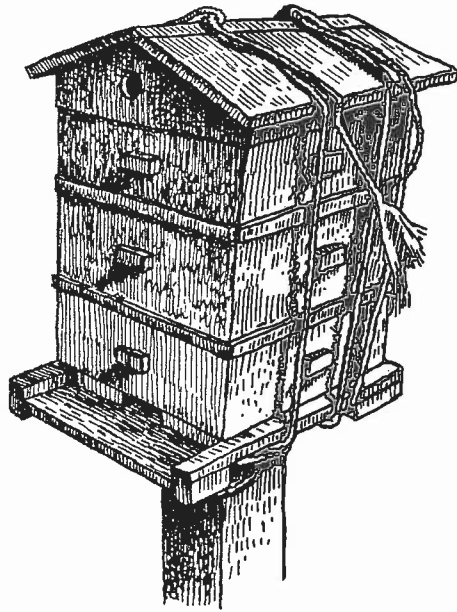


Figure 23. Pole stand.

7. **Handles** For ease in handling, one handle should be placed in the center of each side of the brood chamber and honey super—a total of four handles on each chamber or super.

8. **Stands** Most beekeepers prefer to place their beehives off the ground on a wooden, rock, or brick stand so the bees can better protect their home from ants, termites and toads. Figure 23 shows a pole stand.

The pole is made with a log about 10.16cm (4") in diameter and well-soaked in wood preservative (solignum) or a mixture of equal parts old crankcase oil from the petrol station and kerosene or paint thinner. It is then buried in the ground leaving 30.48cm (12") or more, above the ground. A board (also soaked in wood preservative) 40.64 X 30.48cm (16" X 12") is nailed or screwed in place on the top of the log. The hive is placed on this platform and sometimes tied down with ropes to prevent disturbances. Fig. 24 shows hives raised one foot (30 cm) off the ground using a rail stand.

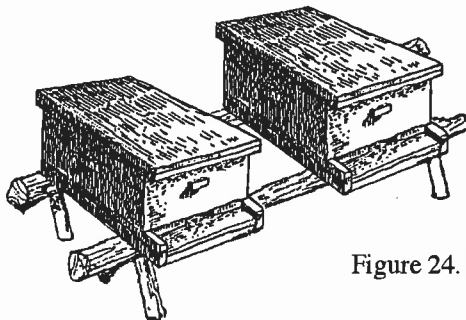


Figure 24. Rail stand.

Fig.25 shows a folding-iron stand constructed from 20mm diameter mild steel tube of 2mm thickness. A similar stand can also be made from wood. This type of stand is sometimes used when beehives are migrated (moved) from place to place in search of nectar, or when providing growers with bees for crop pollination. However, this type of stand is often difficult to construct and can be expensive.

Fig 26 shows a leg stand that raises the hive 15.3-30.48cm above ground level.

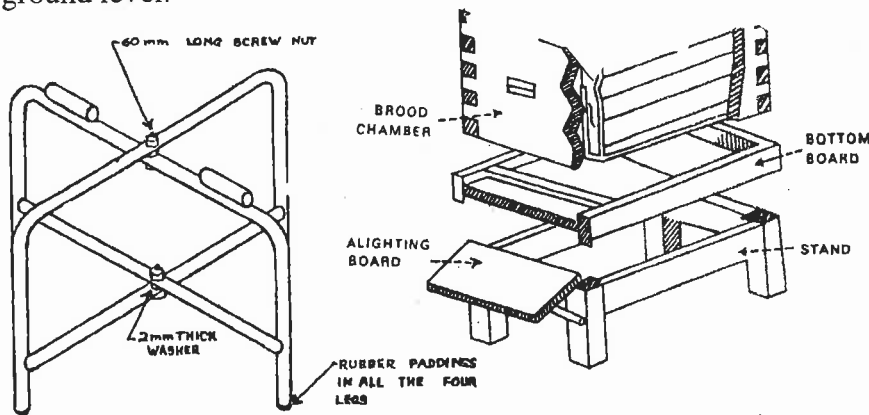


Figure 25. Metal folding stand.

Figure 26. Leg stand (*Beekeeping In India, Dr. Sardar Singh*).

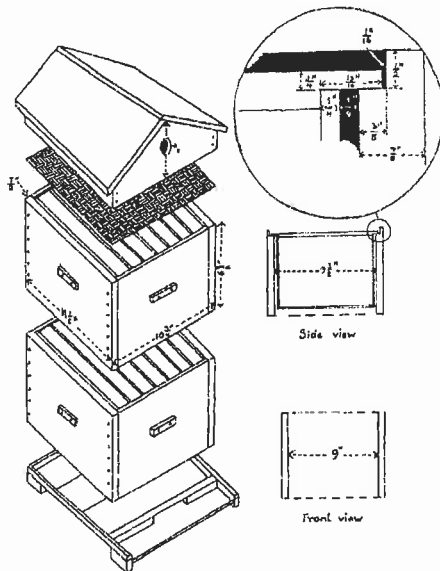


Figure 27. The Right Beehive. Over the years beekeepers have experimented with different sizes of beehives. Today our knowledge of honeybees allows us to make informed choices. We have found that Asian honeybees are more productive when housed in smaller beehives. Most countries have established **standards**, so that equipment can be easily interchanged between beekeepers. The old Newton hive, at left, was popular in India and Bangladesh in the first half of the 20th century, but gave way to the more efficient Modern Indian Standard Beehive.

## Additional Hive Equipment

### Queen Excluder

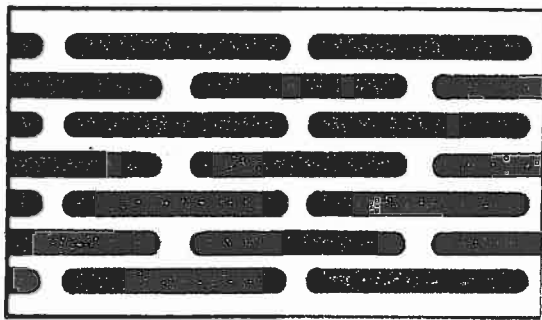
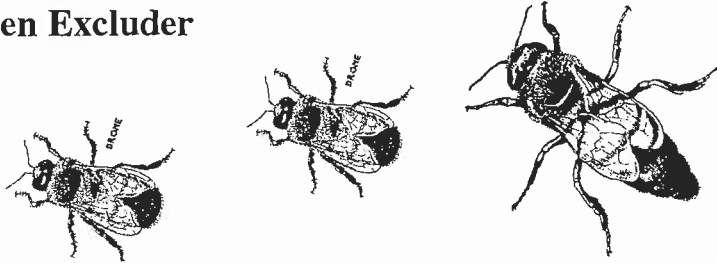


Figure 30. Small section of a stamped-metal excluder.

Queen excluders are made of wire or stamped metal (Figure 30) with openings that permit only the worker bees to pass through. The queen excluder is placed between the brood chamber and the honey super(s).

Vertical models also exist that can be placed between frames of brood and honeycomb in single-story hives. Workers can pass freely through the openings but the larger bodied queen is excluded. Using a queen excluder will not allow the queen to lay eggs in combs meant to contain only honey. *Optional for many beekeepers.*

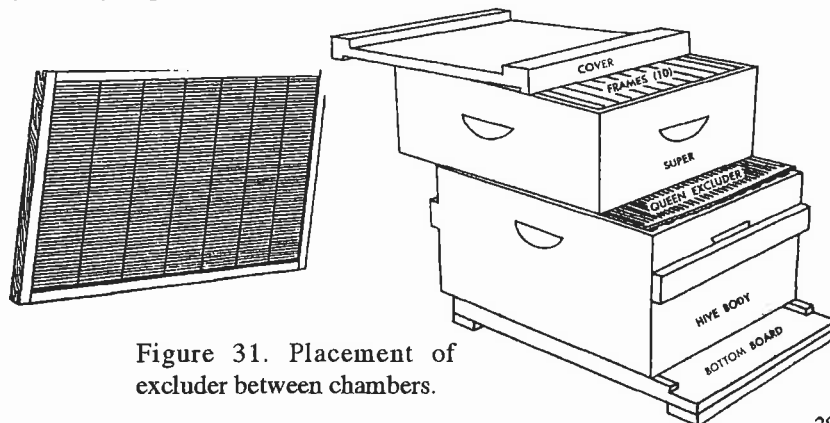


Figure 31. Placement of excluder between chambers.



## Pollen Trap

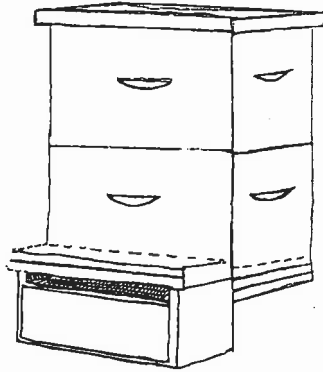


Figure 32. Pollen trap.

Pollen traps are box-like devices placed at the entrance to the hive with an opening that allow the bees to squeeze through while scraping the pollen pellets from their legs (Figure 32). The pollen pellets fall into a tray and are later collected by the beekeeper. Pollen traps are useful to beekeepers who want to obtain some pollen to sell or feed their bees during periods of dearth. (*For more information see References 12,17,45.*)

## Division Board

The division board is a wooden partition that serves as a movable wall and is used to reduce the space inside the brood chamber so that small colonies, occupying only a few combs, can more easily keep the brood warm and well-protected from pests or periods of cold (Figure 33).

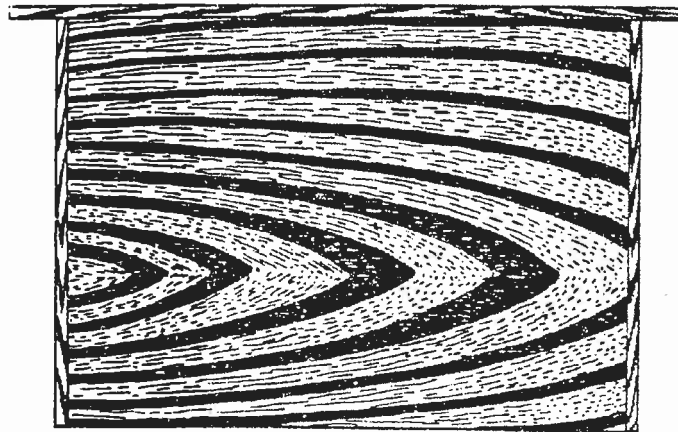


Figure 33. Division board.

## Feeders

At certain times of the year (i.e. periods of dearth, delays in the honeyflow, or when establishing new colonies), many beekeepers feed their colonies a sugar syrup solution (commonly, 1/2 water and 1/2 sugar) as a supplement, or mixed with medicines that control various diseases. Two popular designs are the frame-type feeder and the pail or jar feeder. The frame-type feeder consists of a wooden frame with plastic or masonite sides caulked with butyl rubber to prevent leaking. The frame feeder is usually placed against one of the sides inside the brood chamber. When the feeder is filled, float small pieces of wood, straw, or styrofoam on the surface of the syrup to prevent the bees from drowning.

The pail or jar feeder is easy to make. All that is needed is a small container—a tin or glass jar—with a removable lid. Tiny holes are made in the lid. The sugar-water mixture is placed in the container and the lid is replaced. The container is then turned upside down and placed on the top of the frames of the hive body. An extra brood box *without* any frames is placed over the feeder and topped with the hive cover. This prevents the building of combs above the frames. The bees will go under the container and extract the sugar-water from the tiny holes in the lid. Feeding should be done with care, as this often causes robbers from other colonies to attack the weaker colonies having cans of sugar-water.

## Entrance Reducer

Entrance reducers are usually made of wood and adjust the size of the opening to the colony. If the colony is weak, a small opening is

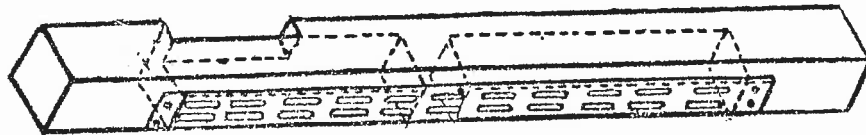


Figure 34. Entrance reducer.

more easily defended. At other times of the year, when the colony needs more ventilation, the entrance reducer can be turned one way to expose a larger opening (See figure 10). Figure 34 shows a reducer with two openings covered with wire or a rustproof metal plate on which holes have been cut or punched out. The slots are cut wide enough for the worker bees to pass through but are too small for mice, large moths, and drones to enter.

## Simple Beehives

There are many kinds of simple, one-chamber hives used around the world. Beekeepers can be very clever in selecting inexpensive materials for building their hives. Fixed-comb beehives, like the Cylinder Hive, have been used for thousands of years. It is usually made from bark, or hollow logs split in half and fastened with rope or wire. Figure 35 shows the Bundo Bark Hive used in Zambia. Unfortunately, with these hives much damage to the colony often occurs when the honeycombs are removed from the hive.

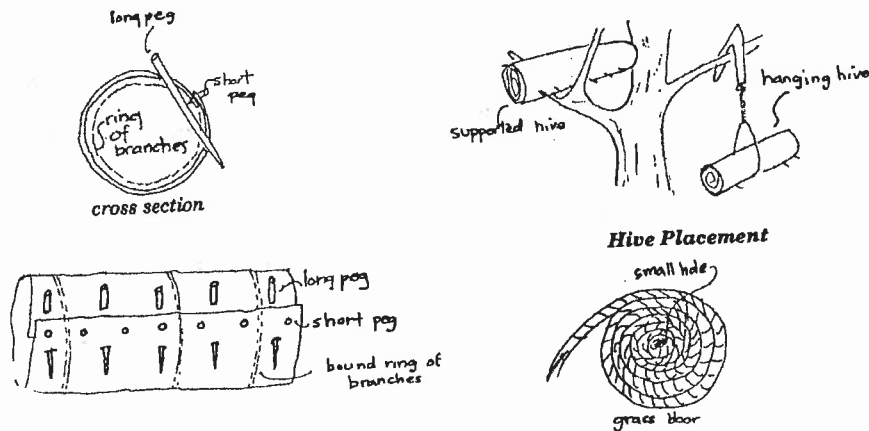


Figure 35. Bundo Bark Hive.

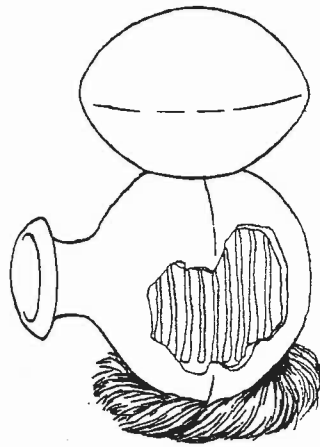


Figure 36. Pot Hive.

Figure 36 shows a Pot Hive. It is very inexpensive, but is a very poor container for bees. Like the Cylinder Hive, it does not allow the beekeeper easy access to inspect the bees' activities, and the honeycombs are destroyed during harvesting. Often a smaller pot is placed over a hole cut into the lower pot and used like a honey super.

The Tree Trunk Hive (Figure 7 and 37) is used by some beekeepers when a colony of bees are found living in the trunk of a **dead** tree. If the tree is not too large, the section holding the colony is cut out and secured to a stand. Some beekeepers add a super with moveable frames to the top when the bees need more space for honey storage.

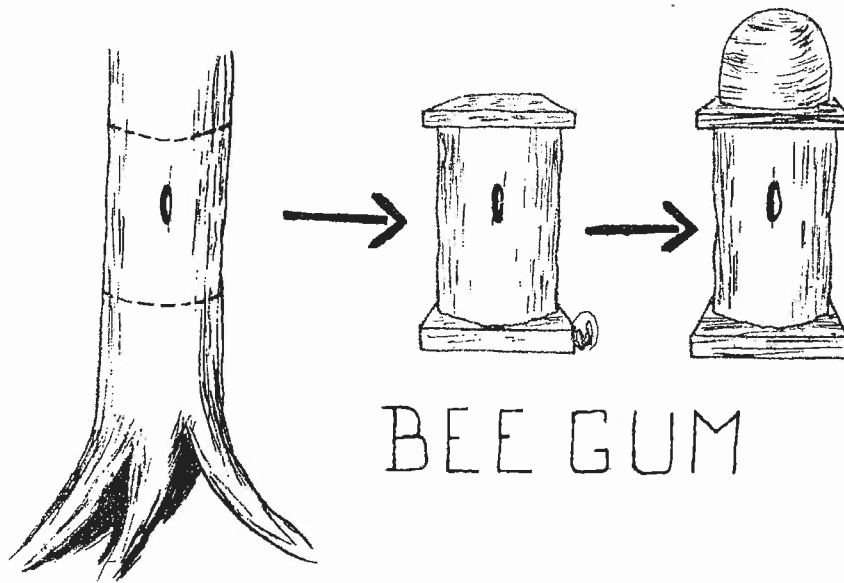


Figure 37. Tree Trunk Hive (Courtesy, Daniel Driscoll).

Beehives can also be made from woven straw, reeds, or bamboo and fitted with simple top-bar moveable frames. Figures 38 and 39 show examples of Straw Skep Hives. Figure 40 shows a hive woven from reeds (or bamboo) and coated with clay or mud. The length and width of this hive can vary depending upon the type of honeybee housed. These hives are simple to make, but last only a few honey seasons because the material weakens with age and exposure to the elements.



Figure 38. Straw Skep with simple top-bar combs.  
(Courtesy, Henry Mulzac and John Zago.)

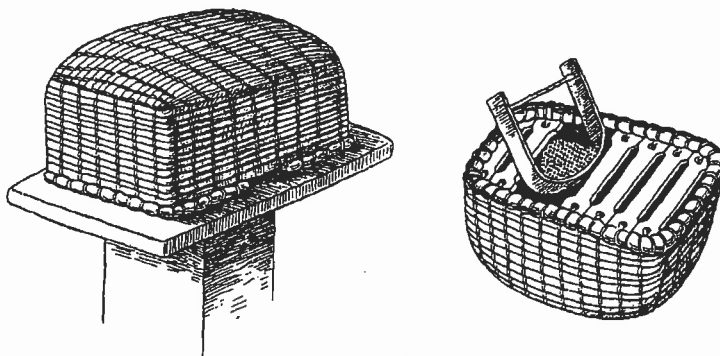


Figure 39. Straw Skep with moveable frames.

Figure 41 shows a Kerosene Tin Hive. These hives are difficult to manage. The thin metal provides poor insulation in cold weather and no protection against the heat of the sun which can easily melt the honeycomb.

Box hives of this type are sometimes fitted with staple-spaced frames or “transitional” frames (Figure 42). The transitional frame is similar to the staple-spaced frame but saves money by using only half side-bars and eliminating the bottom bar.

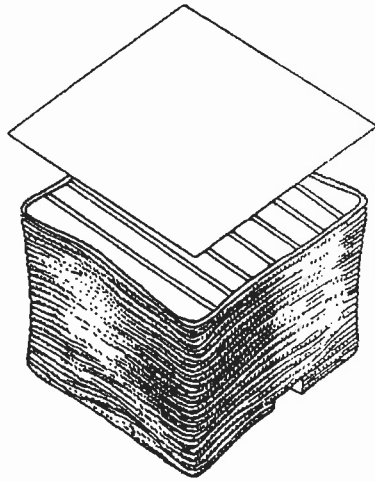


Figure 40. Woven “Rope” Hive.

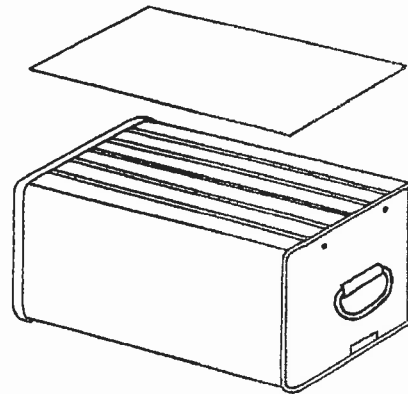


Figure 41. Kerosene Tin Hive.

### Improved Simple Hives

Two single-tiered hives proven very successfully in many parts of the tropics and subtropics are the Kenya Top-Bar Hive (K.T.B.H.) and the Long Hive. Figures 43 and 49 shows the various parts of these hives. Hives of this type can be hung from tree limbs or pole supports, or placed on stands. Three types of top bars are in common use: the flat top-bar, the grooved top-bar, and the beveled (V-shaped) top-bar. Long Hives are often fitted with modified frames consisting of a top-bar and two side-bars (Figure 51). The Kenya Top-Bar Hive usually holds 27 top-bars and the Long Hive as many as 30 frames.

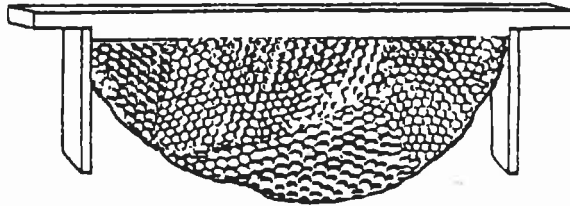


Figure 42. Transitional frame.

Flat top-bars are merely strips of wood that span the width of the hive body (Figure 45). A bead (line) of melted wax is placed down the

center of each top bar to show the bees where to build their combs. Unfortunately, sometimes the bees fail to follow this guide and build combs that bridge the top-bars, making the removal of the frames impossible. Using beveled or grooved top-bars will ensure that properly spaced, individual combs are constructed.

The V-shaped frame (Figure 46), rubbed with some beeswax, provides the bees with a good starting point from which to securely fix their combs. Care should be taken by the builder to make sure that the pointed edge is at the exact center of each top-bar.

The grooved top-bar (Figure 47) allows the beekeeper to attach strips of wax inside the groove to form a guide for the bees. Combs built on these starter strips will be firmly attached to the top-bars.

A modification of the grooved top-bar for use with the Kenya Top-Bar Hive is shown in Figure 48. The addition of wooden or bamboo splints helps to strengthen the combs in the hive.

Long hives are usually managed with top-bars fitted with side-bars, as shown in Figure 51.

Dimensional drawings for the Kenya Top Bar Hive and the Long Hive can be found in Appendix 3.

Note the entrance to each hive is placed either on the side or the front of the hive body.

# Kenya Top-Bar Hive

Figure 43. The hive can be hung or placed on stands.

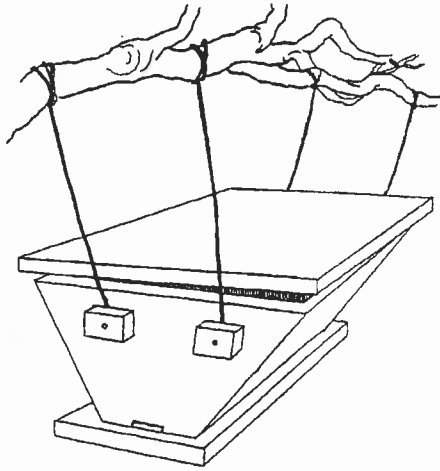


Figure 44. Placement of top-bars. The entrance to the hive is placed on the side or front of the hive body.

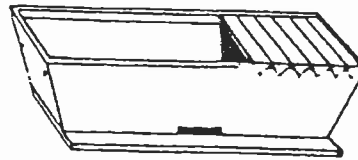


Figure 45. Flat top-bar.

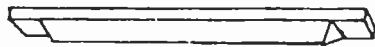
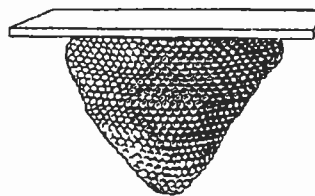


Figure 46. V-shaped top-bar.

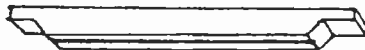


Figure 47. Grooved top-bar.

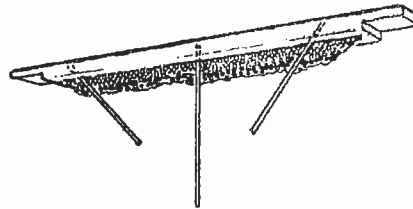


Figure 48. Nightingale modified grooved top-bar using bamboo or wood splints to give added support to the frames.

*Illustrations courtesy of Intermediate Technology Publications, Inc.*



## Long Hive

Figure 49. The hive can be hung or placed on stands.

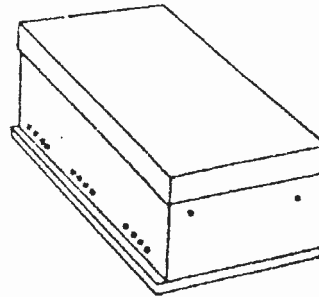
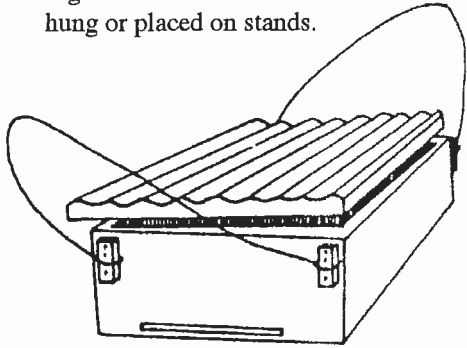


Figure 50. Entrance to the hive is placed on the side or the front of the hive body.

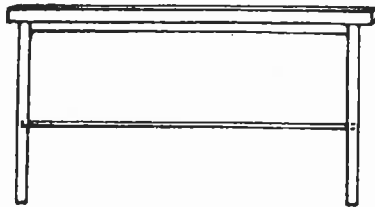
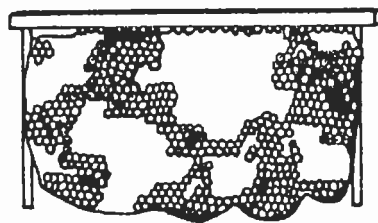


Figure 51. Frame commonly used in the Long Hive. The cross-bar offers added support to the comb.



*Courtesy, Food and Agriculture Organization of the United Nations.  
Drawings by, S. Townsend, Beekeeping in Africa by S. Adjare.*

# Beekeeper's Equipment

Beekeepers use a few pieces of simple equipment to make their work easy and protect them from stings.

## Bee Veil

The veil is used to protect the neck and face from bee stings. The veil can be made from black 12-mesh wire screen, netting or nylon mesh 45.72 cm (18") wide. A dark-colored screen is the easiest to see through, but any color will do. Apart from the black screen, all parts of the veil and hat should be light in color, to avoid upsetting the bees. It should fit snugly around the circumference of the hat brim.

At the back center of the netting are sewn two "tapes" each 137.16cm (54") long. At the front are sewn curtain rings about 20.32cm (8") apart. (*See Appendix 4 for another design.*)

When the veil is put on, the tapes are passed under the arms and through the rings. Pulling the tapes tight pulls the edge of the netting tight against the shoulders. The remaining tape is passed back under the arms to stretch the front flat and is then brought, again, to the front to be tied (Figure 52).

## Gloves

These are used to protect the hands from bee stings. Gloves used in beekeeping are usually the "work-type." They are often made of soft leather or canvas-type cloth. Sleeves are sewn to the glove tops to protect the beekeeper's arms from stings. The sleeves can be tightened to the arms by the use of string or elastic bands. Many beekeepers prefer to work without gloves.

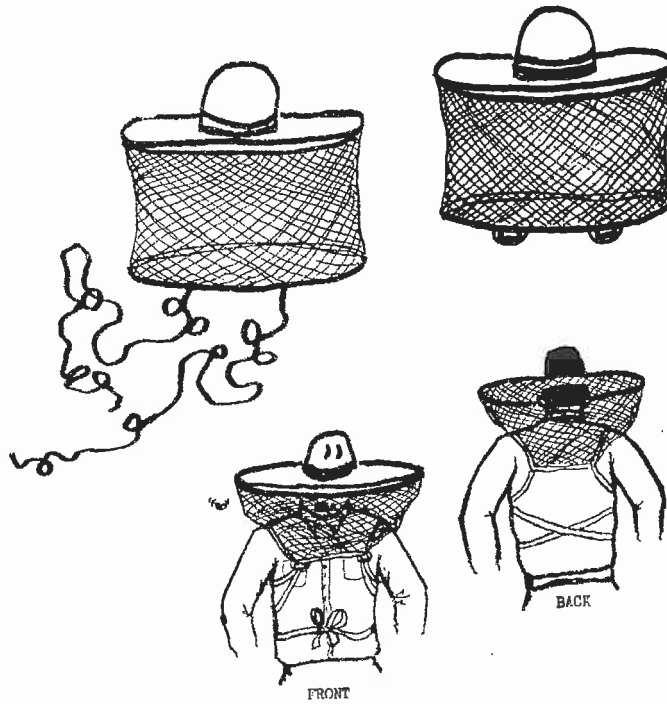


Figure 52. One of many styles of bee veil.

## Smoker

Smoke is used to distract the bees. When worker bees smell smoke, they fill themselves with honey. It is difficult for a bee with a full stomach to sting because it cannot double-up. Light puffs of smoke at the entrance and on top of the opened hive are usually enough to subdue the bees.

Some beekeepers use a straw torch and blow smoke into the hive. This is not good because burnt grass is also blown into the combs making the honey dirty. The hot embers could singe the bees making them apt to sting.

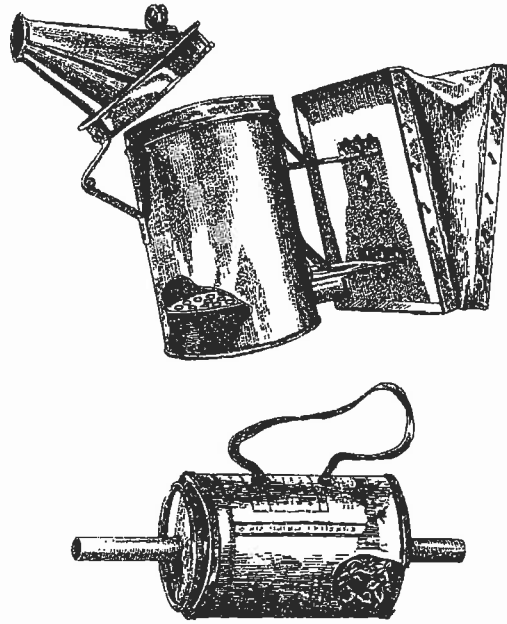


Figure 53. Above: Bellow smoker; below: Can smoker.

In most countries a smoker is used in which the burning materials is contained inside. Figure 53 shows a smoker with a bellows attached and a more simple smoker made from a round tin and a couple of pieces of metal tubing.

In some Asian countries beekeepers prefer to calm their bees by mist-

ing them with water from a hand sprayer, but, beekeepers in most parts of the world find gentle puffs of smoke more effective.

The best material to burn in the smoker is old, dry jute-sacking or rotten wood, since these burn slowly and give off a cool smoke. Rags, cotton waste, wood shavings, cowdung, dried corn cobs, and dry leaves also make good fuel for the smoker.

When the can smoker is used the material should be lighted nearest the longer mouthpiece tube so that the smoke is filtered through the unburned fuel. The longer tube can be wrapped with a layer of cloth so it does not burn the lips.

## Hive Tool

This helps to pry apart the hive boxes and frames. It can be purchased from a bee equipment company or made by the beekeeper from an old truck "leaf-spring" cut to 20.32cm or 25.40cm (8" or

10"). The sharp edge is used for scraping wax and propolis from inside the hive (Figure 54).

## Brush

A brush with soft hairs (like camel-hair) is useful to brush the bees off combs and supers. A large, strong quill (feather) also works well to clear bees from combs. If neither of these are available a handful of reeds or grass can be used.

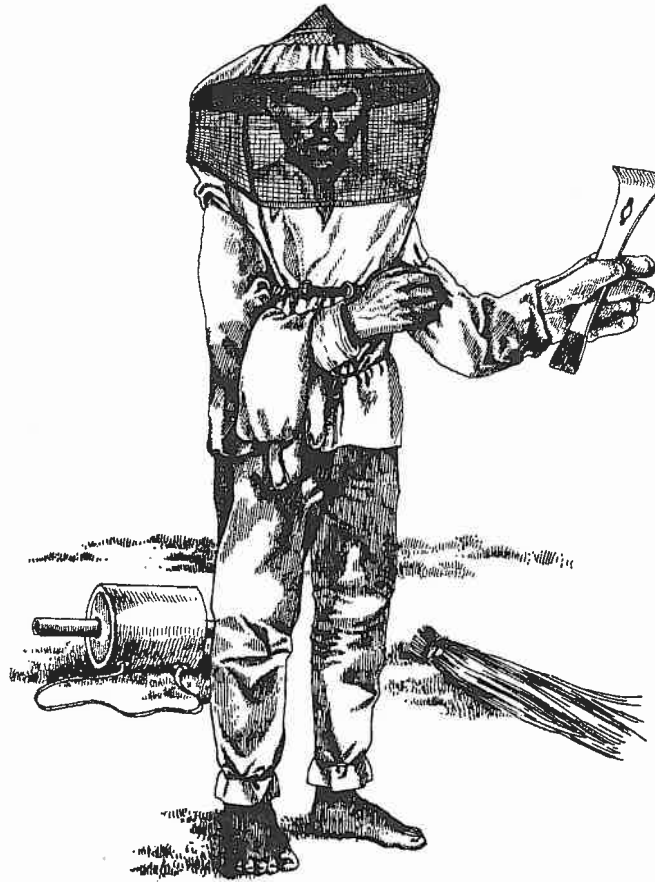


Figure 54. A beekeeper ready to work his bees. It should be noted most beekeepers wear shoes or boots to protect their feet from stings.

# First Lessons In Beekeeping

## Attracting A Swarm To A New Beehive

The best bait for new hives is beeswax. The odor of beeswax is very attractive to bees and no other bait will last as long in the hive. If foundation, combs, or frames beaded with wax are not available, the beekeeper can simply rub the inside of the hive with a small cake of beeswax. When V-shaped top-bars are used the beekeeper should rub wax against the edges to serve as a guide for the bees during comb building.

Other baits that are commonly used include sweet juices and syrup, lavender spray, whole limes, and lemon grass rubbed inside the hive. Some beekeepers in Africa treat the inside of their hives with the smoke from a fire of dry cow dung.

## How To Move Bees Into A New Home

Bees are best moved when they are swarming. Swarming is a process of producing a new colony. Bees usually start swarming when a colony has become overcrowded just before the honey season. Bees may also swarm or leave the hive when food sources or water become scarce, when there are small food reserves in the hive, or when the hive is damaged.

Before the bees swarm, the queen lays a single fertile egg in each of the specially prepared queen cells. She then leaves the hive, with about half the bees, in search of a new home. The remaining bees in the hive wait for a new queen to emerge from her cell.

Swarms may be found hanging on tree limbs or under overhangs of buildings. Once a swarm is located, it should be caught im-

mediately and transferred to a hive. Figure 55 shows a swarm of bees that have landed on a tree limb. With a hard shake, the bees are knocked into the beekeeper's basket and then shaken into the brood chamber of an empty hive.

When a swarm is located high in the branches of a tree a "bag" made of jute sack or cloth mesh, attached to a long pole, can be used to dislodge and capture the cluster. For more information on capturing swarms and removing bees from a wild nest (*See references 1,12,17,18,28,48*).

Bees in a swarm seldom sting, but a face veil and smoker will make the transfer safer.

Bees may also be transferred from a tree, house, or old hive to a new hive. The best time to transfer them is during the honeyflow season.



Figure 55. A beekeeper in Bangladesh collecting a swarm.

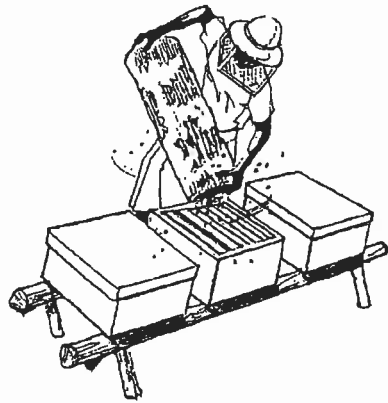


Figure 56. Transferring bees from an old hive to a new one.

One way to transfer bees to a new hive from a tree or building is to first get the smoker ready and be sure to wear proper clothing. Then the smoker is used continuously and noise is made by hitting the tree or building with a board or hammer. Soon a swarm should come out and collect on a nearby tree limb or other object. The old comb may then be cut out and sections of it tied into frames

with string. The swarm is then shaken into the new hive and left undisturbed for a few days. It won't take long for the bees to fill the rest of the frames with wax comb and begin storing food and raising young.

## Inspecting The Colony

The best time for inspecting the colony is a bright, sunny day when the bees are working normally. Bees should not be disturbed on cold, rainy, or windy days or at night.

Many beekeepers, who tend very aggressive colonies, prefer to conduct their work early in the morning or late in the afternoon when the bees tend to be calmer.

After lighting the smoker, the hive should be approached from the side to avoid blocking the bees' entrance. A few puffs of smoke should be given at the entrance. The inner cover should be lifted a little with the hive tool, and smoke blown into the hive, and the inner cover replaced. After a few moments, the inner cover should be removed and placed upside down against the hive. The frames should be pried apart with the hive tool, taken out, and examined



one by one. They should be handled carefully over the open hive and turned as shown in Figure 57.

During this work, the queen should always be kept in mind. The frame on which she is located should be placed back in the hive early. The frames should be handled gently and crushing the bees should be avoided.

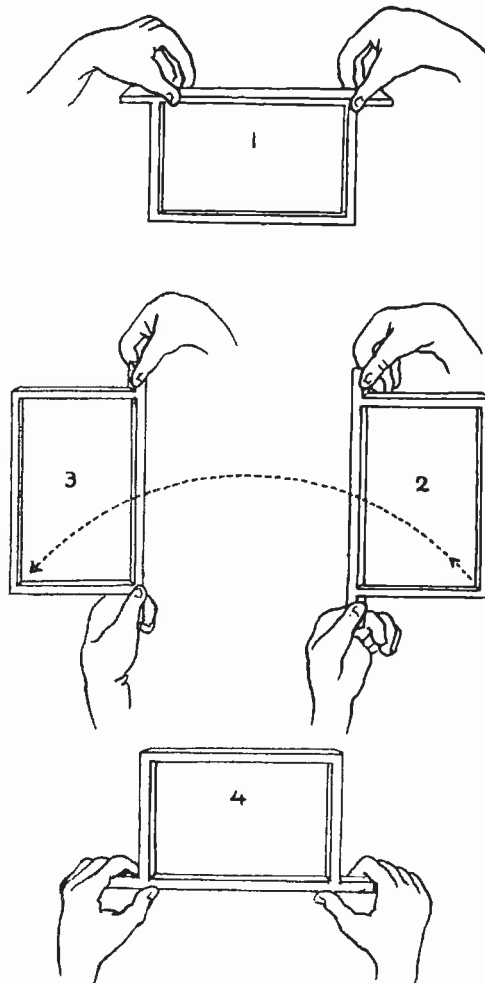


Figure 57. Handling frames.

If you should be stung by a bee, the sharp edge of a hive tool or fingernail should be used to take out the stinger as quickly as possible. Never squeeze it out with your finger tips. Rubbing only causes more irritation. Some persons are allergic to bee stings. If stung by even a single bee, they develop a rash over their body and have difficulty breathing. For most people, however, pain is felt for only a few minutes, with any swelling lasting for just a short time.

After inspection of the colony is finished, all the hive parts should be carefully returned to their proper places. Opening the hive too often will upset the life of the colony and could cause them to abandon their home in search of a quieter place to live.

## Helping A Colony Make More Honey

There are many things that can be done to help bees make more honey. Experience will make the beekeeper more aware of ways to increase honey production. A few ways to make beekeeping a success are listed below:

✿ **Do not keep colonies that are mean and hard to handle.** Keep only those colonies that are calm and quiet, produce lots of honey, swarm little, and defend their hives against moths, wax beetles, ants, and robber bees from other hives.

✿ **Prevent swarming.** About one-half of the bees are lost when they swarm. A crowded brood chamber is one of the main causes of swarming. Always make sure that bees have enough room in the brood chamber and honey super by adding additional brood boxes or supers before the ones in place are completely filled.

✿ **Locate hives properly.** Hives should be placed near good sources of nectar, pollen, and water. The hives should be protected from direct wind, hard rains, and flooding.

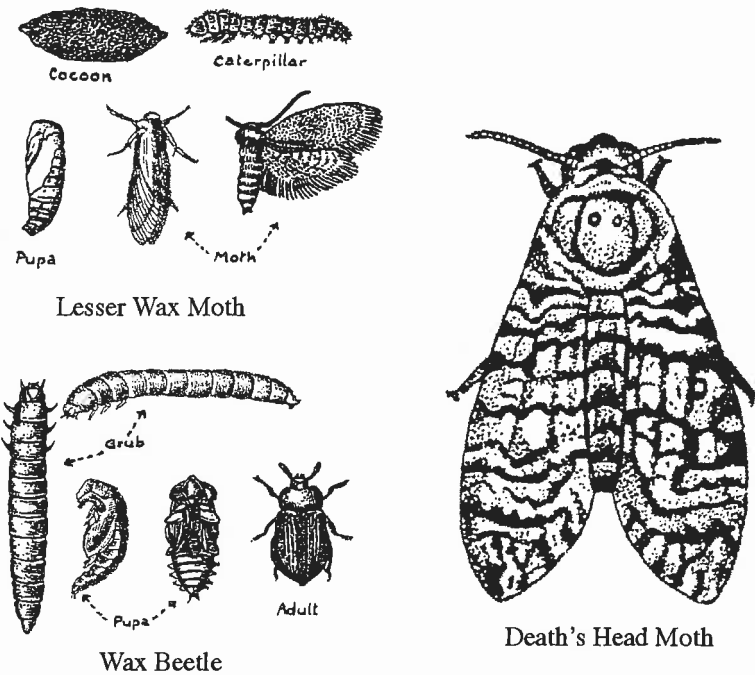


Figure 58. Common enemies of the honeybee. During routine inspections of the hive look carefully for pests and remove them.

🐛 **Timely visits.** Getting a good honey crop is a year-round job. Bee colonies should be checked every month (except during cold winter days) for honey and pollen supply, population, and the condition of the queen and brood.

🐛 **Remove pests from the hive.** A serious pest of some honey bees are parasitic mites. Tiny mites (*Acarapis spp.*) can live in the bees body (thoracic trachea), while larger mites (*Varroa spp.*) — visible to the eyes— attach themselves to the bodies of honeybees. Mites can shorten the life span of the bees and weaken the colony. Colonies infested by *Varroa* produce very little honey. There are various methods of hive fumigation that can control mites. Two commercially available fumigation strips are Folbex and Folbex VA. (For more information see 16,17,82,85,87,88,89.)

Other serious pests are those that come to breed in the hive, like some kinds of beetles and moths. These pests will lay their eggs in any combs not defended by the bees. The larvae (grub, worm-like young) feed on pollen and other food in the cells, chewing large holes and tunnels in the combs (Figure 58).

The legs of hive stands can be made ant proof with an application of sticky grease or "tangle-foot." Try to keep weeds and grass from growing up under the hives.

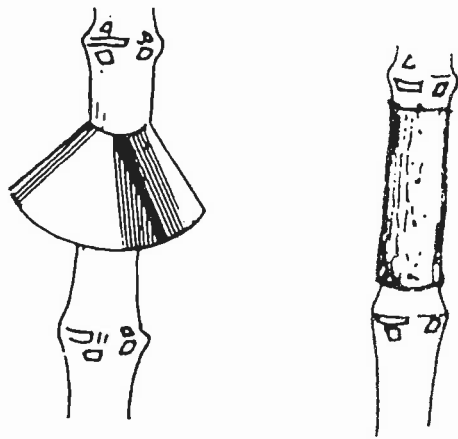


Figure 59. Tin Shields.

Mice, lizards and toads can also be troublesome to the colonies. Having the hives raised off the ground is usually sufficient to keep toads and frogs away. In some countries young children are employed to rid the apiary of lizards by snaring them with a noose of string or wire attached to the end of a long pole. Other bee-

keepers place their colonies on tall hive stands, or suspend them with wire, using tin shields on the legs (see figure 59 and 60).

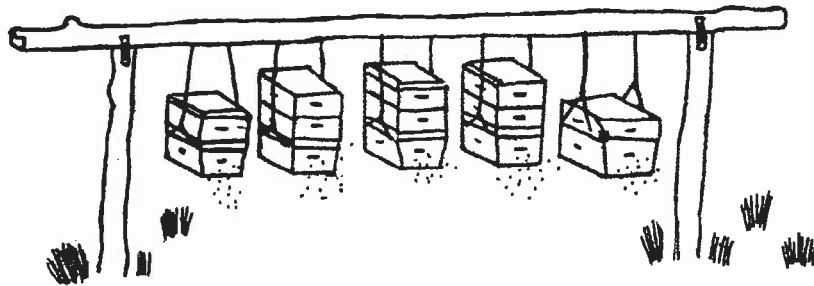


Figure 60. Top-bar hives suspended, South Africa.  
(Courtesy, Henry Mulzac and John Zago.)

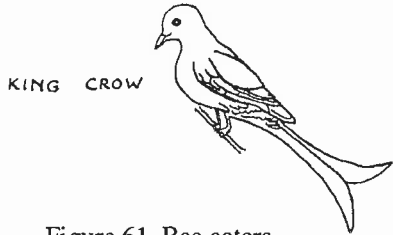


Figure 61. Bee eaters.

Sometimes birds will be noticed catching bees in the air and eating them. Usually the number of bees lost this way is not a serious problem to the beekeeper. Beekeepers in some countries have been known to shoot these birds or trap them with thin nets stretched high in the air.

Large animals, like the honey badger (ratel), can cause serious damage. For methods of control you

should seek the advice of an experienced beekeeper.







✿ **Watch for disease.** There are many kinds of diseases that affect honeybee brood and adults. It is extremely important that you be aware of which diseases occur in *your* region, and how to treat or control them. Check with experienced beekeepers, your local extension office, or university entomology department. You will learn that prevention is often the best way to control outbreaks of disease in the apiary (*References 12,16,17,82,84,86,88*).





✿ **Protect honeybees from harmful pesticides.**

Nothing is more sickening to a beekeeper than to visit an apiary (beeyard) only to find masses of dead bees at the entrance to the hives, killed by the improper use of pesticides. Bee poisoning should be of great concern to all beekeepers, and to the farmers whose crops benefit from the pollination services of honeybees. Education, and often legislation, is needed to deter some farmers from practices which endanger bees. There are hundreds of crops which benefit from the pollination services of honeybees. In many instances seed and fruit yield is greatly improved due to the work of honeybees. In some countries growers rent honeybee colonies for pollinating crops in order to obtain better yields. (*For a list of crops that benefit from pollination refer to references 59,60,61,62.*)

Most bee poisoning occurs when pesticides are applied to crops during the blooming period, but bees can also be harmed when they touch contaminated flowers or leaves, water, pollen and nectar. Drift from toxic sprays or dusts into the apiary or on to plants that bees are working often results in heavy losses. Bees collecting insecticides in the form of dusts, like Sevin, are particularly dangerous because they may be stored with pollen in the hive and later fed to the brood. Least toxic to bees are granular forms of pesticides.

Farmers should consider the following when hazardous pesticides are used around bees (Source: University of California Extension Service, USA):

-  With few exceptions, dusts are more hazardous to honeybees than sprays.
-  Applications by airplane are more hazardous to bees than by ground equipment.
-  Treating large areas and repeating applications may cause greater bee losses.
-  Time of application is important and depends on bloom period and attractiveness of crop. Treatments when bees are foraging in the field are usually the most hazardous. Treatments over colonies in hot weather when bees are clustering on the outside may cause severe losses. Treatments during the night and early morning before bees are foraging are the safest.
-  Treating a nonblooming crop with a hazardous material when cover crops, weeds, or wild flowers are in bloom in the field or close by may cause losses.
-  Location of bees is important. Colonies located in the field and treated over may sustain more loss than colonies not treated over at the edge or outside of the field. Colonies moved into fields after treatment may escape damage.

-  Covering colonies with burlap or dark plastic material for 1 or 2 hours during and after treatment in the early morning gives added protection. Colonies can be covered with dampened burlap 1 or 2 days without injury. Covering may be important when treating by airplane.
-  The kind and amount of pesticide used are important. Use the proper dosage of the safest material (on bees) that will give good pest control.
-  Read the label and follow approved local, state, and federal recommendations.
-  When using materials hazardous to bees, notify the beekeeper so that he may move, cover, or otherwise protect his bees.

See your agricultural agencies for more detailed information on the effect of pesticides on honeybees.

Beekeepers should make an effort to meet with the farmers in their area. They should find out what chemicals are being used and when they are applied. Close cooperation between growers and beekeepers can result in modification of the pest-control program so that little or no poisoning occurs. Appendix 5 provides a short list of pesticides and their effect on honeybees. (*For a more expanded list see References 92,94,95,96.*)

## **What To Do Before The Honeyflow**

To make a good job of beekeeping, make sure your colonies are “humming” with young bees at the time of the honeyflow. Young bees are the best gatherers of honey and pollen. The times of major and minor honeyflows vary from place to place.

In certain areas of some tropical and subtropical countries, major honeyflows don't exist, as nectar producing plants flower at regular intervals throughout year.

A successful beekeeper must learn to adjust hive management to seasonal changes in the life of the colony.

## Make A Seasonal Calendar

To be successful the beekeeper must know when nectar and pollen will be available to the bees during the year (Figure 62). A calendar which reminds the beekeeper what seasonal management will be required to keep the colonies strong and productive can be a valuable tool (Figure 63). It should be noted that in the tropics and subtropics the beekeeper might notice variations from year to year in the dates when honeyflows occur. Keeping track of these changes, using a calendar, will help the beekeeper plan ahead.

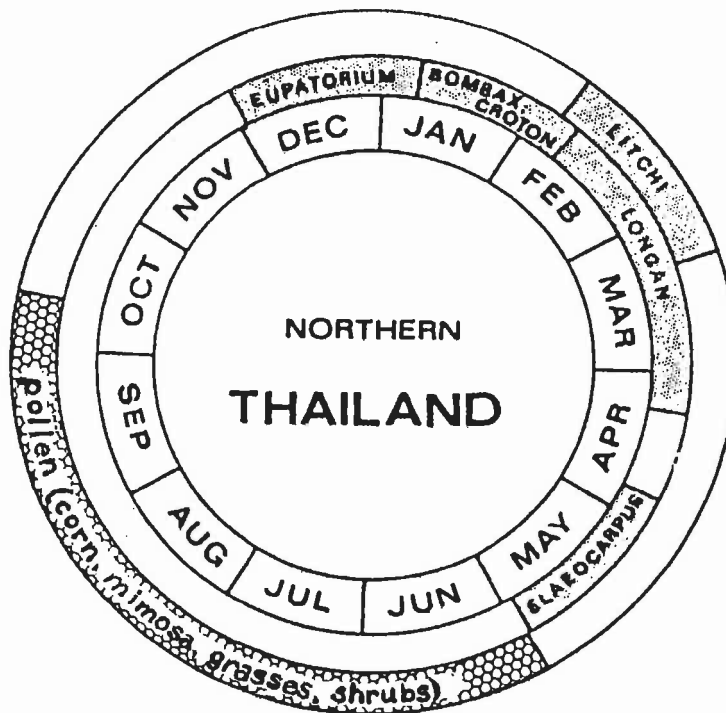


Figure 62. Floral calendar, in the form of a circular chart, indicating the periods of availability of major nectar and pollen sources in northern Thailand (Courtesy, Food and Agriculture Organization of the United Nation and P. Akratanakul, *Beekeeping in Asia*).



**Figure 63. Floral and Work Calendar for a Coconut Locality in Selangor, Malaysia**

MONTH	1st cycle: 11	12	1	2	3	4
	2nd cycle:	5-6-7	8	9	10	
WEATHER	: Heavy Rain	Light Rain	Drought	Drought	Light Rain	Moderate Rain
NECTAR (in addition to coconut)	: gelam	-----coffee-----	-----rubber-----	-----rambutan-----	-----durian-----	-----many ornamentals, weeds, shade trees-----
COLONY CONDITION	: WEAKENING	WEAK	V. WEAK	V. WEAK	STRONGER	V. STRONG
food	: use reserves	some nectar	some nectar	some nectar	more nectar	surplus nectar
comb-building	: stops	none	none	none	starts	very active
egg-laying	: less	little	little	none	starts	very active
other behavior	:					many queen cells for swarming
MANAGEMENT	: REHABILITATE	-----SAVE FROM-----	ABSCONDMENT	-----	PREPARE FOR SEASON	HARVEST INCREASE COLONIES
feed (honey, syrup, pollen substitute)	: redistribute honey combs	redistribute honey combs	honey combs or syrup	feed syrup, pollen subst.	feed syrup, pollen subs.	none
frame manipulations	:	save exposed combs from wax moth	save exposed combs	save exposed combs	reuse saved comb, prepare super combs	prevent swarming; use foundation wax, saved combs to stop congestion
hive manipulations	: combine weak colonies				move hives to flora (night)	use super hives split strong colonies rear queen bees
bait hives	:	set up bait hives			check, rehive baited colony	set up bait hives
pests	:		trap, burn nests of wasps			remove drone brood to get rid of mites

Source: The Sustainable Agriculture Newsletter, SIBAT, Manila, Philippines (reformatted by Joyce Coffland).

A swarm captured shortly before the major honeyflow and placed in a new beehive will probably use most of the honey they make to build combs for brood rearing and honey storage. The colony's honey stores should not fall below three kilograms (kg) (6-1/2 lbs) or about 2 full frames.

## **Before The Honeyflow**

Examine each beehive and clean the inside of pests and dirt. If a colony is below average strength, it can be helped by adding a frame or two of capped (sealed) worker brood from a stronger colony. Another good practice is to make the strength of all colonies equal, so they all require your attention at about the same time, and respond equally to one kind of treatment. New colonies can be fed a 50% sugar solution until the honeyflow begins.

Two or three weak colonies can be united (joined) to make one strong colony capable of producing a surplus of honey. One simple method of united two weak colonies is to place a sheet of newspaper with a few narrow slashes cut into it over the frames of the stronger colony. After the bottom board (floor) is removed, the other hive is placed on top of the newspaper. Within a day or two, the bees will have chewed the paper away. This method allows each colony's distinct scent to mix before the bees mingle. In a short while one of the queens will be lost naturally. If the beekeeper feels one queen is the better, he can dispose of the other before uniting the colonies (*References 1,2,3,5,7,12,17*).

Good queens are good layers! It's the queen's job to make sure there is a rapid build-up in the population of the hive before the main honeyflow. Without a strong population of young bees the colony will not be able to produce a surplus of honey for the beekeeper to harvest. Two other important traits of the queen, which are passed on to the colony, are temperament and inclination to swarm. Aggressive (mean) colonies are difficult to manage, and those that swarm frequently rarely have a population of bees large enough to produce a good surplus of honey.

In many temperate countries, beekeepers replace (requeen) inferior, old or ailing queens with new ones that they buy or raise. Raising queens is practiced among many beekeepers. However, in many tropical and sub-tropical countries requeening is not commonly practiced. (*If you are interested in how to raise queens and requeen a colony see References 50,51,53,56.*)

If a beekeeper wants to have more colonies, a strong hive can be divided. There must be lots of nectar available at this time for the operation to be successful. One or two combs containing worker brood—both young (uncapped) and old (capped)—and a comb of partially ripe honeycomb plus pollen, is transferred to a new hive body. Enough bees are then added to cover all the frames. The new hive must be taken to a new location at least 2-3 kilometers away to prevent the bees from returning to the “mother” hive (*References 1,3,5,7,10,12,17,18*).

## **Prevent Swarming**

Generally the swarming season comes just before the major honeyflow. Swarming is the colony’s way of satisfying its natural urge to reproduce itself. By this method, the number of bee colonies is increased. The desire to swarm varies among different colonies of bees. Swarming can be caused by an onrush of a sudden honeyflow, the sudden failure of the queen to lay eggs a hot or poorly ventilated beehive, lack of space for egg laying and honey storage, and honeycombs in the worker brood area. If the bees feel crowded, they will surely swarm—or worse, desert the brood and beehive completely. Be sure to keep beehives in the shade and, if necessary, make the entrance opening to the hive larger during hot periods. If the bees cluster at the entrance on warm nights, it could mean they are feeling crowded and need more frames or supers, although this is normal in a busy hive.

The natural order of the frames in the brood chamber should not be disturbed. Only poor, irregular combs, or combs filled with drones, should be removed. Combs of drones should be placed in the

honey super or outside the frames containing brood. In this way these frames will not act as barriers to the queen as she moves from one frame to another.

Frames in the brood chamber filled with honey and pollen should be moved to the outside of the brood area or into supers above. The frames should be carefully arranged with your fingers and spaced evenly apart. Prevent crowding by giving the bees enough well-drawn combs for brood rearing and honey storage. (*For more information on swarm control see References 1,3,7,8,12,17,28.*)

### **What To Do During The Honeyflow**

As nectar and pollen are being placed in the beehive, try to remain ahead of the bees by giving more frames and supers. The second super should be added between the first super and the brood chamber, not directly above the first super. Additional super may be added in the same way, just above the brood chamber and below the other supers.

Colonies should be examined once a week. Frames full of honey are removed to the sides of the brood chamber or placed in the honey super. New frames with wax foundation should be placed next to the frames containing brood but not between brood frames where they will act as barriers to the queen.

When the honeyflow begins to slow down, the frames containing capped honey are removed. Harvesting must start while the bees are still bringing in nectar, otherwise robbing of weak colonies by stronger ones may begin. Such lawlessness in the keekeeper's apiary (the place where beehives are kept) will often cause a weak colony to desert the beehive, leaving the brood to die. When selecting frames of honey, be sure not to take combs that are not yet sealed with wax. This honey has not fully ripened and still contains too much water. Honey of this type will ferment quickly and should be avoided. When harvesting the crop, take out a frame of filled honeycomb and hold it near the entrance of the hive to

shake or brush off the bees. The frames of honey are placed in covered empty supers and taken away for extracting (emptying the combs of honey). When the honeyflow has finished, unnecessary supers are removed, and the bees are left with a proper store of honey to last until the next honeyflow begins.

## Harvesting The Honey And Beeswax

### Honey

Beekeepers usually measure honey production in kilograms or pounds. The yearly production of surplus honey varies depending on the strength of the colony and the region where the beekeeping is taking place.

Probably the most efficient way to get honey out of the comb is to uncap, or remove, the thin cell covers with a warm knife and spin out the liquid honey with a honey extractor (Figure 67).

Thin, long-bladed knives can be used to cut-off the “cappings.” Heated knives work best. If two knives are available they can be placed alternately in a container of hot (preferably boiling) water. Other beekeepers invest in specially designed uncapping knives that are heated by electricity or steam.



Figure 64. Uncapping knife.

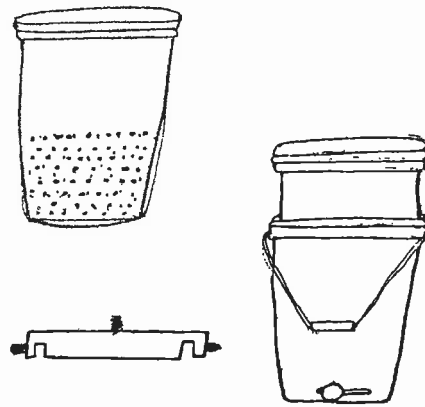


Figure 65. Simple uncapping container  
(Courtesy, J.C. Johnson and Dr. Diana Sammataro, USA).

A simple uncapping container can be made from two plastic (or metal) pails or drums. The inside container is perforated with holes which allow the honey to drain from the cappings. A piece of wood fitted with a large screw is secured to the top container. This provides a place for the frame to rest during the uncapping procedure. The outside container can be fitted with a honey gate or

piece of pipe. (Construction plans are provided in Appendix 6.) When the beekeeper has lots of frames to be uncapped larger tanks may be used (Figure 66).

A honey extractor can be made with a drum and basket fitted inside that holds two or four (or more) wooden frames. The honey is neatly removed and the combs returned to the hive to be refilled with more honey (Figure 67 and Appendix 7).

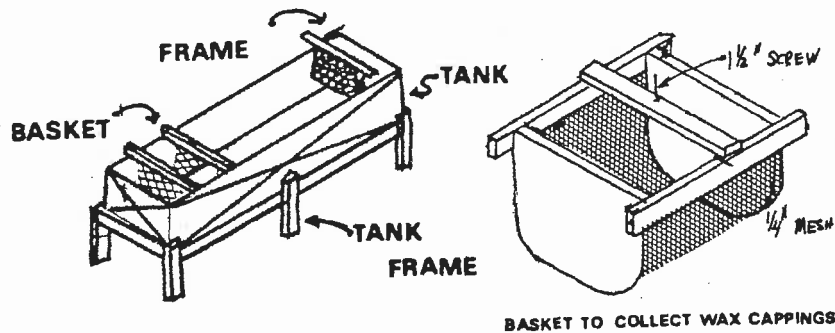


Figure 66. Uncapping tank. Although not shown, a honey gate is usually fitted to the tank to facilitate honey removal (Courtesy, Henry Mulzac, *Practical Beekeeping for the Developing World*).

It may be too expensive to buy or make an extractor for the amount of honey produced by a few colonies. Several nearby beekeepers might like to share this expense.

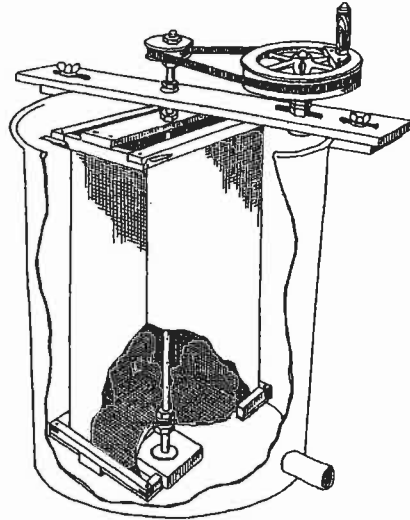


Figure 67. Honey extractor.

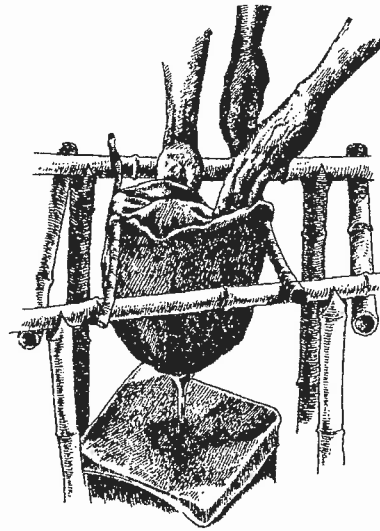


Figure 68. Squeezing-out honey.

A less expensive (but very wasteful) way to harvest liquid honey is to cut out the entire comb (leaving a 2.5cm strip along the top), squeeze the honey from it, and then strain the honey through a coarse cloth (jute sackcloth) to remove wax particles (see Figure 68). Although the crushed comb cannot be used again by the bees, you can melt it and sell the beeswax.

## Beeswax

The beginner can melt and clean wax in a large tub or pot. The bits of wax and comb material should be put in the tub or pot and covered with water. The container should be on a sturdy, fireproof stand so a fire can be built underneath it. Heat the water until it boils. The beeswax will rise to the top of the container. Be careful not let the water boil over the top of the container since the hot wax will burn.

When the wax is completely melted, strain the mixture through a piece of jute sackcloth or screen wiring. This will remove any remaining large particles. If the mixture is strained into a pail that is larger at the top than at the bottom, the wax cake can be removed easily after it cools and hardens. Pure wax will be on the top. Unwanted particles at the bottom of the cake can be removed by trimming and scraping. It can then be used to make candles or sold in the market.

If materials are available, one of the best ways to melt beeswax is with a solar wax melter. Dr. Diane Sammataro, Bee Expert, USA, provides the following description:

The principles of the design are simple: bits of wax are placed on a slanted metal sheet or tray inside a box. The box is then covered with glass and placed so the sun will shine inside the box. As the temperature rises (hot air, heated by the sun is trapped in the box and cannot escape through the glass), the wax melts, and drips off the tray into a collection pan. If the pan has slanted sides, it will make the removal of the cooled wax block easier. The inside of the box can be painted black, to absorb as much radiant heat as possible, and the top must be bee tight. When melting down wax, use only clean cappings and light colored wax. The dark older comb does not melt down completely. Any debris that collects on the bottom of the wax block in the collecting pan can be scrapped clean with a knife.

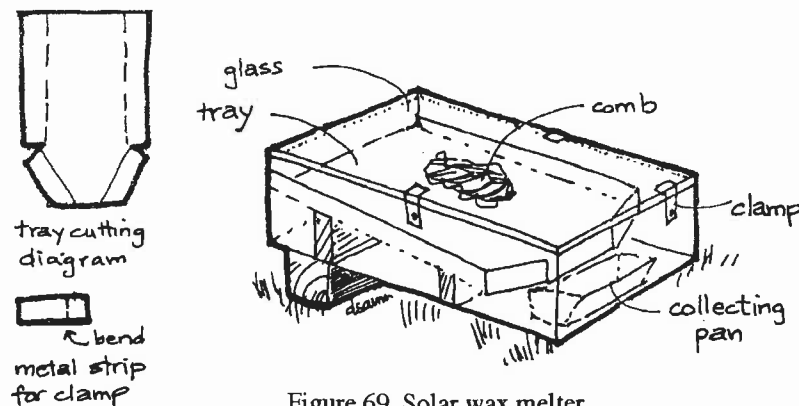


Figure 69. Solar wax melter.



Hot water and steam are often used to melt old brood and dark honeycombs. A useful description of these melters is provided in Appendix 8.

## **Value Added Products**

Honey and wax are primary sources of income. Pollen, propolis, royal jelly and other items can also be sold locally and abroad. Primary bee products can be added to other products often increasing the value of these secondary products (See Appendix 10).

## **Record Keeping**

Beekeepers should be encouraged to carry a notebook and pencil when visiting their apiary. Record keeping can help the beekeeper keep track of: when the hive was colonized, the productivity of the queen (and dates of requeening), the colony's temperament, tendency to swarm, times when pollen and nectar are being collected, when/if the colony required feeding, observed diseases (and treatment), and when and how much honey was removed. Many beekeepers use crayons to mark simple notes on the top or back of the hives. Others use sticks or stones arranged in different positions to denote: a weak colony, a colony that recently swarmed, one that needs feeding or requeening, etc. A simple record of the weight of each hive, taken at timely intervals (one month or every two weeks), is recommended. A scale is not needed for this practice. Lifting the hive to feel the weight will quickly indicate to the beekeeper the condition of the colony.

In addition to apiary records the beekeeper should keep a notebook containing information on purchases, hired labor, transportation costs, purchased or serviced equipment, and all other expenses, as well as income. In this way the beekeeper can determine the success or failure of the operation. Such records can also be helpful by calling attention to how best to reduce costs and maximize profits.

# Resources

The first place to check for information and materials is your local government agency (Ministry/Department of Agriculture-Apiculture Section) and universities. There are well over one hundred countries in the tropics and subtropics with government and/or university programs in apiculture (*References 97,98*).

The author's favorite source for information on all aspects of beekeeping is the International Bee Research Association in the United Kingdom. Their webpage ([www.cf.ac.uk/ibra/index.shtml](http://www.cf.ac.uk/ibra/index.shtml)) contains a wealth of information and many links to other sites.

If you are interested in anything related to bees or beekeeping, IBRA will likely have what you need. IRBA's specialist mail-order service supplies publications on bees and beekeeping from their own publishing house and others. Their coverage is comprehensive, and includes all bee species, bee pollination, beekeeping with honeybees, diseases and pests, hive products and their uses, nectar and pollen sources, and up-to-date lists of international beekeeping associations, beekeeping periodicals, and supplies of equipment.

IRBA publishes highly-respected quarterly journals (*Bee World*, *Journal of Apicultural Research*, *Apicultural Abstracts*) and maintains the world's most comprehensive library specializing in bees and beekeeping. The library contains over 32,000 reprints, 4,5000 books, 3,000 bound volumes of journals, translations and theses. It also has a collection of color slides, and beekeeping videos. IRBA can use their computer databases to answer queries, prepare specific bibliographies or carry out subject searches. Materials can be copied or lent to members. For membership information and a copy of IRBA's publications catalog write to:

**International Bee Research Association**  
**18 North Road, Cardiff, CF1 3DY, UK**  
(Internet e-mail: [ibra@cardiff.ac.uk](mailto:ibra@cardiff.ac.uk))

## **References. . .**

*(The Author used these references. Check with IBRA for newer publications.)*

### **BEEKEEPING (GENERAL)**

1. **Bees and beekeeping: science, practice and world resources** by E. Crane. Oxford UK; Heinemann Newnes (1990) 614 pp. Hardback. **Special offer: post free to UK address, 2.00 overseas surface postage.**

This book describes the scientific principles underlying beekeeping as it is practiced today in different climates and conditions worldwide. A feature of the book is that different sections are written at different levels according to how, and by whom, they are most likely to be used, and some interesting topics on which information is not readily available are given extra space.

2. **The hive and the honeybee** *edited by* Dadant & Sons. Hamilton, IL, USA; Dadant & Sons (1975) 3rd revision 740 pp. Hardback.

Each of the 22 chapters is by a well-known international specialist and together they present a comprehensive picture of modern beekeeping and a knowledge of honeybees and their products. Suitable for both practical use and classroom reference.

3. **The new complete guide to beekeeping** by R.A. Morse. London, UK; Robert Hale (1994) 208 pp. Hardback.

This is a comprehensive, illustrated guide to beekeeping for prospective and experienced beekeepers. It offers full instructions on how to start an apiary, advice on appropriate sites, equipment and obtaining bees. The author also covers all aspects of feeding, swarm-control, seasonal maintenance and honey extraction and presents a wealth of information on predators, diseases and requeening. It includes a chapter on the impact Africanized bees have had in the Americas.

4. **A handbook of beekeeping** by H. Riches. (1992) 166 pp. Softcover.  
A guide to the essentials of beekeeping, with chapters on preparing and packaging honey for sale, mead, wax, propolis and stings.
5. **The ABC and XYZ of bee culture** published by A I Root Co. Medina, OH, USA; A I Root Co (1990) 40th edition written and edited by R.A. Morse, associate editor K. Flottum 516 pp. Hardback.  
This beekeeping classic, first published in 1878, has been periodically revised and updated. The book contains articles by many commercial and scientific beekeepers. A well compiled glossary of apicultural terms.
6. **Background to beekeeping** by Ron Brown. (1998) 4th edition 120 pp. Hardcover.  
Revised by Ron Brown, this textbook, although primarily for the beginner and for those yet to start beekeeping, more experienced beekeepers will find much to interest them.
7. **The beekeeper's handbook** by D. Sammataro and A. Avitabile. Dexter, MI, USA; Peach Mountain Press (1998) 3rd edition 224 pp.  
A well illustrated book for the beginner with practical information on many aspects of bee management. Excellent reference for the experienced beekeeper.
8. **Guide to bees and honey** by T. Hooper. (1997) 4th edition 260 pp. Softcover.  
First paperback version of this classic manual for both beginners and the more experienced beekeepers. It includes a special preface on varroa.
9. **The biology of the honeybee** by M. Winston. (1987) 281 pp. Softcover.  
A very comprehensive and thoroughly readable account. Highly recommended for all beekeepers.

10. **Better beginnings for beekeepers** by A. Waring. (1995)  
68 pp. Softcover.

Clear and simple information for new beekeepers. It starts off with some basic bee biology on the life and history of honeybees, continuing with all the basics on equipment, feeding, wintering, manipulations, supering, swarms, honey extraction, etc. It also covers pests and diseases.

## **BEEKEEPING IN TROPICAL CLIMATES**

11. **The golden insect. A handbook on beekeeping for beginners** by S. Adjare. London, UK; Technology Consultancy Centre, University of Science & Technology. Kumasi, Ghana in association with Intermediate Technology Publications Ltd (1984) 104 pp.

A practical beekeeping handbook using the top-bar hive, aiming to put into the hands of Ghanaian and other African beekeepers information that they can readily understand and put to immediate use.

12. **Beekeeping in Africa** by S Adjare. Rome, Italy; FAO Agricultural Services Bulletin 68/6 (1990) 130 pp.

This is a practical guide and will provide much useful information for anyone starting beekeeping in Africa. The book provides information to help a beginner who has access to enough materials to build a top-bar hive, stock it with bees and manage it.

13. **Zambian beekeeping handbook** by B & R Clauss. (1991)  
108 pp. Softcover.

A well illustrated manual for low-cost/low-tech beekeeping with movable-frame and fixed-comb hives, with chapters on pests, bee plants, village beekeeping, honey and wax.

14. **New beekeeping in a long deep hive** by R. Dartington.  
Stevenage, UK; published by the author (1985) 38 pp.

The author explains his method of beekeeping developed during 10 years' use of a long hive made to his own design.

15. **Killer bees** (the Africanized honeybee in the Americas) *by* M. Winston. (1992) 162 pp. Softcover.  
Don't be put off by the title; this is an extremely readable introduction to Africanized honeybees and their management.

16. **Honey bee diseases and enemies in Asia: a practical guide** *by* P. Akkratanakul. Rome, Italy; FAO Agricultural Services Bulletin 68/5 (1987) 51 pp.

Useful supplement to *Beekeeping in Asia* (see 17 below); includes chapters on microbial diseases, parasitic bee mites, insects and invertebrates.

17. **Beekeeping in Asia** *by* P. Akkratanakul. Rome, Italy; FAO Agricultural Services Bulletin 68/4 (1987) 112 pp.

The first chapter describes briefly all the commonly recognized species of honeybees found in Asia. The remainder of the book deals with the biology and management of native *Apis cerana* and introduced *Apis mellifera*. The reader is instructed on bee forage and how to construct a floral calendar.

18. **Beekeeping in South Africa** *by* R.H. Anderson, B. Buys and M.P. Johannsmeier. Pretoria, South Africa; Department of Agricultural Technical Services Bulletin #394 (1983) revised edition 207 pp.

An informative teaching manual for beekeepers in South Africa. Of world-wide interest are the sections on South African nectar and pollen flora, diseases and pests, and legislation, as well as the sections on bee biology and management. Glossary in English and Afrikaans.

19. **Beekeeping in rural development** *by* N. Bradbear. London, UK; IBRA (1990) 16pp. Beekeeping provides rural people in developing countries with sources of income and nutrition. It is a sustainable form of agriculture which is not detrimental to the environment, indeed it provides economic reasons for the retention of native habitat. Color photographs.

20. **Beekeeping for honey production in Sri Lanka: management of the Asiatic hive honeybee (*Apis cerana*) in its natural tropical monsoonal environment** by R.W.K. Punchihewa. (1994) 232 pp. Softcover.

At last a truly comprehensive manual for beekeeping with *Apis cerana*, based soundly on research and practical beekeeping experience. High recommended.

21. **Information for beekeepers in tropical and subtropical countries - Leaflet 2: The management of Africanized honey bees** by N. Bradbear and D. De Jong. London, UK; IBRA (1985) 4 pp. This leaflet is available free of charge to beekeepers in developing countries.

Information on working with Africanized honeybees including clothing and equipment, apiary siting and colony management.

22. **Information for beekeepers in tropical and subtropical countries - Leaflet 3: *Varroa jacobsoni*** by N. Bradbear. London, UK; IBRA (1988) 4 pp. This leaflet is available free of charge to beekeepers in developing countries.

The leaflet describes *Varroa jacobsoni*, its biology, how to detect it and methods of control.

23. **A case of hives** by L. Heath. (1985) 73 pp. Softcover. How do you choose a hive? This book gives you all you need to know to make the right choices.

24. **Information for beekeepers in tropical and subtropical countries, Leaflet 4: The Asian hive bee: *Apis cerana*** by N Bradbear. London, UK; IBRA (1990) 8 pp. This leaflet is available free of charge to beekeepers in developing countries.

The biology and distribution of *Apis cerana* together with methods for the prevention of absconding.

25. **Beekeeping in rural development: unexploited beekeeping potential in the tropics, with particular reference to the Commonwealth** edited by Commonwealth Secretariat and IBRA.

London, UK; Commonwealth Secretariat (1979) 196 pp. Authors from different countries describe widely varying examples of beekeeping projects, and show the achievements and the difficulties encountered in various parts of the developing world.

26. **Bibliography of tropical apiculture** by E. Crane. London, UK; IBRA (1978) 380 pp. Funded by the International Development Research Centre, Ottawa, Canada. This Bibliography (BOTA) contains 4,045 entries and an author index; it's subdivided into the 24 parts.

27. **Honey bees in Oman** edited by R.W. Dutton, A.M. Mjeni and R.P. Whitcombe. Sultanate of Oman; produced by the Office of the Adviser for Conservation of the Environment, Diwan of HM for Protocol, Muscat, in collaboration with the University of Durham, UK (1982) 38 pp.

This full-color illustrated publication has been produced in both English and Arabic to encourage the understanding and protection of honeybees in Oman.

28. **Beekeeping of the assassin bees** by D. Espina Pérez. Cartago, Costa Rica; Editorial Tecnologica de Costa Rica (1985) 158 pp. After an introductory chapter on tropical beekeeping, the author describes the characteristics and behavior of Africanized bees, and discusses aggressiveness and its causes in honeybees (in general). Further chapters describe basic management techniques, swarming, migration and practical recommendations for beekeeping with the Africanized bee. There is a short list of literature consulted.

29. **Tropical and subtropical apiculture** by Food and Agriculture Organization of the United Nations. Rome, Italy; FAO Agricultural Services Bulletin 68 (1986) 283 pp.

A introduction to aspects of beekeeping encountered in developing countries of the tropics and subtropics. Technical information found in many standard beekeeping manuals is not repeated in this new book, which instead concentrates on the particular points which create problems for beekeepers in the tropics.



30. **Africanized honey bees and bee mites** edited by G.R. Needham, R.E. Page Jr, M. Delfinado-Baker and C.E. Bowman. Chichester, UK; Ellis Horwood Limited (1988) 572 pp. Hardback. This publication is a compilation of the reports presented at a meeting held in Ohio, USA in 1987. The resulting book is firstly a comprehensive, accurate and knowledgeable account of Africanized honeybees, their ecology and reproduction, population biology and behavior, and identification, and secondly of honeybee mites including *Varroa jacobsoni*, *Tropilaelaps clareae* and *Acarapis woodi*.

31. **Honey hunters and beekeepers: a study of traditional beekeeping in Babati District Tanzania** by G.M. Ntenga and B.T. Mugongo. Uppsala, Sweden; Swedish University of Agricultural Sciences Working paper 161 (1991) 82 pp. An in-depth study of traditional beekeeping practices within one district of Tanzania. The report suggests short and long term measures to help beekeepers to develop their activities. Helpful illustrations add much interest.

32. **Beekeeping for beginners** by K.I. Kigatiira. Nairobi, Kenya; Published by the author (1988) 38 pp. An introduction to beekeeping as it is practiced in Kenya top-bar hives are discussed. Dimensions and instructions are given for constructing a top-bar hive.

33. **A beekeeping handbook** produced by Ministry of Agriculture. Gaborone, Botswana; Beekeeping Section, Department of Crop Production and Forestry, Ministry of agriculture (1991) 3rd edition. 80 pp. A new edition of the useful and popular handbook first produced in 1980. A simple and well presented teaching book. Black and white photographs show young people working with *Apis mellifera adansonii* in southern Africa.

34. **Beekeeping in Zambia** by R.E.M. Silberrad. Bucharest Romania; Apimondia Publishing House (1976) 76 pp.

The introduction of movable-frame hives is discussed in the context of traditional Zambian beekeeping.

35. **Bees and trees** by B. Svensson. Uppsala, Sweden; Swedish University of Agricultural Sciences Working paper 183 (1991) 80 pp.

This publication contains much useful information for those who would encourage beekeeping as part of community forestry activities. Useful lists of trees that, in addition to producing pollen and nectar, also have other purposes are recorded according to the vegetation zone in which they thrive.

36. **Beekeeping in integrated mountain development** by L.R. Verma. Edinburgh, UK; Aspect Publications with support from the International Centre for Integrated Mountain Development (1991) 367 pp. Hardback.

Frame hive beekeeping as a feature of rural development in the Hindu Kush and Himalayan region Asia. The first part of the book is intended to make planners and other experts aware of the importance of beekeeping for specialists more directly concerned. Use of *Apis cerana* and other insects in crop pollination is covered.

37. **Bees and beekeeping in Southern Africa** edited by R.H. Anderson and B. Buys. Cape Town, South Africa; South African Federation of Beekeepers' Associations (1990) 160 pp. Proceedings of the International Beekeepers' Symposium held at Stellenbosch, January 1990. Subjects covered include the following: pesticides and pests, botany, honeybee products and marketing and Cape and African bee biology and papers have references and there is an index.

38. **Full report of the First Conference on Apiculture in Tropical Climates, London, 1976.** London, UK; IBRA (1977) 220 pp. Includes 26 papers on: bee management in tropical climates; races and species of honeybees in the tropics and subtropics; tropical honey production and pollination; development programs in

tropical and subtropical countries. Many papers have references and there is an index.

**39. Proceedings of the Third International Conference on Apiculture in Tropical Climates, Nairobi, 1984.** London, UK; IBRA (1985) 270 pp.

Includes 50 papers on: apiculture and bee management problems in African countries, and in tropical Asia, America and the Pacific; pollination (and the protection of bees from insecticides), and diseases and pests; hive products; apiculture in integrated rural development and the special role of women. Most papers have references. Indexes by country and author.

**40. Proceedings of the Fourth International Conference on Apiculture in Tropical Climates, Cairo, 1988.** London, UK; IBRA (1989) 529 pp.

Over 100 papers covering many aspects of bees and beekeeping in the tropics. The Conference was the first in this series to hold a session on Africanized honeybees. Many papers have references and there is an author and subject index.

**41. Manual de apicultura** edited by M.M.F. de Camargo. São Paulo, Brazil; Editoria Agronomica Ceres (1972) 252 pp. *In Portuguese.*

This is a scientifically oriented book on beekeeping, with much information also on honeybees and relating especially to *Apis mellifera* in Brazilian conditions.

**42. La abeja africanizada** by D. Espina Pérez. Spanish edition of *Beekeeping of the assassin bees* (28 above).

**43. Apicultura tropical** by D. Espina Pérez and G.S. Ordetx. Cartago, Costa Rica; Editorial Tecnológica de Costa Rica (1981) 482 pp. *In Spanish.*

A third of this book deals with bees, native and introduced to tropical America, and the plants they forage on, with various useful lists. Techniques and equipment of modern beekeeping

are also described, and there are appendices on beekeeping finances and legislation, and on the beekeeping situation in Costa Rica and Cuba. Indexes of Latin and common names, references.

**44. Le point su l'apiculture: en Afrique tropicale** by B.

Villieres. Paris, France; Groupe de Recherche et d'Echanges (GRET) Dossier No 11 (1987) 220 pp. *In French.*

This book consists of five parts. Part I – reviews the history of beekeeping, the world honey trade and bee biology; Part II – beekeeping in West Africa; Part III – benefits of beekeeping and examples of low-technology equipment; Part IV – useful addresses; Part V – annexes describing bee biometry, bee forage, pollination in West Africa, IBRA, Apimondia, OPIDA.

## **BEEKEEPING EQUIPMENT**

**45. Beehive construction** by J. Corner. Ottawa, Canada; Department of Agriculture Publication No 1584 (1982) 21 pp.

How to construct a Langstroth hive and pollen trap with photographs and line drawings.

**46. Beekeeping: some tools for agriculture** by E. Crane. London, UK; Intermediate Technology Publications (1987) 22 pp.

This booklet was first published as a chapter in *Tools for agriculture: a buyer's guide to appropriate equipment.*

**47. Let's build a beehive** by W.R. Miller. Phoenix, AZ, USA; published by the author (1976) 92 pp. Hardback

Practical instructions on making beekeeping equipment with photographs and diagrams.

**48. Bait hives for honey bees** by T.D. Seeley and R.A. Morse.

Ithaca, USA; Cornell Cooperative Extension Information Bulletin No 187 (1982) 6 pp.

Swarming behavior and its relevance to making and siting bait hives and transferring bees to movable frame hives.

49. **The observation hive** by K. Showler. Bridgewater, UK; Bee Books New and Old (1985) 2nd edition 124 pp. Hardback.  
This book describes the history, construction, use and maintenance of observation hives. Photographs, diagrams and an annotated bibliography.

### **HONEYBEE BREEDING AND INSEMINATION**

50. **Queen rearing simplified** by V.A. Cook. Geddington, UK; British Bee Publications (1986) 63 pp.

The author's long established, simple system of queen rearing is described. His novel method of forming nucleus colonies for queen mating from a parent colony, placing them in a circle with entrances facing inward is also explained. Helpful advice on how to find queens is included. The book is clearly illustrated with 33 of the author's photographs.

51. **Breeding queens** by G. Fert. (1997) 104 pp. Softcover.  
This book offers good knowledge with step-by-step instructions.

52. **Queen rearing** by Devon Apicultural Research Group. Plymouth, UK; D.A.R.G. (1987) 20 pp.

The booklet includes notes on selection criteria, finding and marking the queen, several methods of queen rearing and the introduction of travelled queens.

53. **Queen management** by A.I. Root and Company. (1995) 49 pp.

Another book of selected articles from "Bee Culture" in the "Best of Bee Culture" series. A very readable book on a topical subject.

54. **Practical queen rearing** by C. Dublon. UK; Dublon & Sons (1987) 87 pp.

This manual with large diagrams and flow charts, presents two queen rearing programs, A and B. A is designed for beekeepers with less than 10 colonies, B for those with over 20. Beekeepers with 10-20 colonies can use either or both - it is possible to swap

between A and B at the start of each stage. The format and plastic cover makes the manual easy to use in the apiary if required.

**55. The instrumental insemination of the queen bee** *edited by* R.F.A. Moritz. Rome, Italy; Apimondia (1989) 176 pp.  
This edition is designed as a handbook for both the beginner and skilled operator.

**56. Rearing queen honeybees** *by* R.A. Morse. Ithaca, NY, USA; Wicaws Press (1994) 2nd edition 128 pp. Softcover.  
A practical guide for those who want to raise their own queens, whether it be a few or many. Now expanded to meet the need's of today's beekeepers, large or small.

**57. Queen rearing** *edited by* F. Ruttner. Bucharest, Romania; Apimondia Publishing House (1983) 350 pp. Hardback.  
English translation of the important monograph "Koniginenzucht" F. Ruttner, H. Ruttner, K. Weiss, H. Rembold, W. Fyg and G. Hanser describe techniques and research results, and draw on the work of Roy Weaver, W.C. Roberts, G. Piana and W. Rice. They bring together the 'how' and the 'why' of the subject. Bibliography, subject and author indexes.

**58. Breeding super bees** *by* S. Taber. Medina, OH, USA; The A. I. Root Co (1987) 174 pp.  
A "super bee" is defined as any bee with uniformly desirable characteristics that no other bees have. The author sets out to show how any beekeeper with a little knowledge of bee genetics and ability to instrumentally inseminate queens can rear such bees.

## **POLLINATION**

**59. Pollination of cultivated plants in the tropics** *edited by* D.W. Roubik (FAO, Rome). (1995) 198 pp. Softcover.  
Part of the FAO "Agricultural Services Bulletin" series. It covers the pollinators, the ecological and economic importance of polli-

nation, and all other aspects of pollination in the tropics. It also includes a glossary and appendixes on cultivated and semi-cultivated tropical plants, pollination contracts and levels of safety of pesticides.

**60. Honey bee pollination of important entomophilous crops** by R. Ahmad. Islamabad, Pakistan; Pakistan Agricultural Research Council (1987) 104 pp.

This publication lists the main fruit, fodder, seed, oilseed and vegetable crops grown in Pakistan and reviews the publications describing the pollination of these crops. The book will be of value to agriculturalists who wish to know the pollination requirements of the crops they are growing.

**61. Pollination directory for world crops** by E. Crane and P. Walker . London, UK; IBRA (1984) 170 pp.

Primarily intended for crop growers, this book will be of value to beekeepers. Each entry gives information on crop distribution and its uses, floral structure and pollination mechanism. Pollinating agents are identified as far as possible with recommendations for ensuring adequate pollination where appropriate. Publication was funded by the New Zealand Ministry of Foreign Affairs.

**62. Proceedings of the Third International Symposium on Pollination, Prague, Czechoslovakia, 1974** edited by OPIDA. Echauffour, France; Bulletin Technique Apicole (1975) 331 pp.

The proceedings are divided into five main sections: insect pollination of tropical plants; problems of pollination from cultivated plants; reciprocal adaption of plants and bees; breeding of wild bees; miscellaneous. More than half the reports are in English, the rest in French or German with English summaries. Most reports have references.

## **BEE FORAGE**

**63. Beekeeping in Malaysia: pollen atlas** by R. Kiew and M. Muid. Malaysia, Malaysian Beekeeping Research and Develop-

ment Team, Universiti Pertanian Malaysia (1991) 186 pp.  
The Atlas describes 95 plant species widely used by *Apis cerana* in Malaysia. Many species listed are common throughout the tropics. For each there is a picture of the whole plant, the flower and a picture of a pollen grain. This is accompanied by a description of pollen color and size, the plant's occurrence, importance for beekeeping, pollination requirement and any other relevant information.

**64. Forage for bees in an agricultural landscape** *edited by* A. Matheson. (1994) 75 pp; UK. Softcover.

What are agricultural changes doing to the bee populations? Find out how beekeepers and farmers can take action to protect and promote bees in our landscape.

**65. Bees and Trees** *by* D. Svensson. Uppsala, Sweden; Swedish University of Agricultural Sciences Working paper 183 (1991 ) 80 pp.

This publication contains much useful information for those who would encourage beekeeping as part of community forestry activities. Useful lists of trees that, in addition to producing pollen and nectar, also have other purposes are recorded according to the vegetation zone in which they thrive.

**66. Directory of important world honey sources** *by* E. Crane, P. Walker and R. Day. London, UK; IBRA (1984) 384 pp.

Listing 452 nectar-producing and 15 honeydew-producing plants reported as a major honey source. Economic uses of each plant, nectar or honeydew flow, honey and pollen production, chemical composition and physical properties of its honey. Valuable to honey traders, beekeepers, environmental scientist, nutritionists, specialists in agriculture and agroforestry. The Directory aims to improve honey production in developing countries. Publication was funded by IDRC, Canada.



## HONEY: INCLUDING ITS MARKETING AND USE

67. **Honey sources satellites** The database from which the “*directory of important world honey sources*” was produced was used to compile a series of six “*honey sources satellites*” on topics of special interest:

1. **Bibliography (with author reference codes); country codes; other abbreviations** by E. Crane, P. Walker and J. Fish. London, UK; IBRA (1986) 50 pp.

2. **Chemical composition of some honeys** by E. Crane and P. Walker. London, UK; IBRA (1986) 42 pp.  
Includes printouts for the 107 honeys whose composition was reported in the “*directory of important world honey sources.*”

3. **Physical properties, flavor and aroma of some honeys** by E. Crane and P. Walker. London, UK; IBRA (1986) 56 pp.  
Information for 294 honeys which were reported in the “*directory of important world honey sources.*”

4. **Honeydew sources and their honeys** by W. Crane and P. Walker. London, UK; IBRA (1986) 34 pp.  
Complete printouts are given for 15 important honeydew sources and their honeys mention in the “*directory of important world honey sources.*”

5. **Drought-tolerant and salt tolerant honey sources** by E. Crane and P. Walker. London, UK; IBRA (1986) 94 pp.  
Complete printouts for 98 plants reported in the “*directory of important world honey sources*” to be drought and/or salt-tolerant in at least one region of the world.

68. **Honey marketing** by H.R.C. Riches. Bridwater, UK; Bee Books New and Old (1989) 80 pp.  
The main objective of this book is to outline the way that honey should be handled and marketed so that it reaches the consumer in

the best possible condition. The book is intended mainly for beekeepers in the UK, but much of the information it contains on procedures for harvesting the honey crop and on storing, packaging and marketing honey is also relevant to other countries. EEC directives are detailed.

69. **Selling honey** by A.I. Root and Company. (1994) 46 pp; USA  
How to turn honey into money. Aimed primarily at beekeepers with only a few hives, it covers advertising, labelling, jars, selling at markets and craft fairs, gift shops and roadside stands. The chapters are by various well known authors, and are based on articles published in "Bee Culture."

70. **A book of honey** by E. Crane. (1980) 198 pp; UK. Softcover.  
A deservedly popular book telling the complete story of honey in a nutshell, starting with the bees themselves and how they make honey, what it's made of, uses in the home and cooking, and its history. Excellent value for the money.

#### **OTHER BEE PRODUCTS**

71. **Hive products: pollen, propolis and royal jelly** by R. Brown. London, UK; IBRA (1989) 9pp. Reprint from *Bee World*.

72. **Beeswax: production, harvesting, processing and products** by W.L. Cogshall and R.A. Morse. Ithaca, NY, USA; Wicwas Press (1984) 192 pp.

Comprehensive coverage of all aspects, including chemical properties secretion by honeybees, comb construction, grading, harvesting, preparation for market and exhibition, uses in art and industry and recipes for furniture creams and polishes. This is an appendix of patents and specifications. References.

73. **Simple methods of candle manufacture** by The Intermediate Technology Development Group. London, UK; ITDG (1975) 20 pp.

This booklet shows how, without expensive and sophisticated machinery, it is possible to manufacture candles. The book gives a general description of how a candle works and stresses the importance of the size of the wick, materials required and candle making techniques. Line illustrations of the simple equipment that may be used are included.

**74. Beeswax crafting** by R. Berthold. (1993) 128 pp; USA. Hardcover.

Learn all about beeswax and how to use it in art and the home. Discover how to make wax waterlilies, candles and polishes, how to do encaustic painting and batik, and much more. Also gives details of how to build a solar wax extractor and wax tank.

**75. Beeswax** by R. Brown. (1995) 3rd edition. 87 pp; UK. Softcover.

Excellent guide with an expanded chapter on candle making and more on wax casting. Covers the history and origins of beeswax, production and uses, making foundation and preparation for shows.

**76. Traditional candlemaking: simple methods of manufacture** by D. Millington. (1992) 40 pp; UK. Softcover.

An illustrated practical manual encompassing home use and small-scale commercial production, and evaluating the suitability of materials, methods and equipment. Includes a useful “troubleshooting” table.

**77. Super formulas: arts and crafts (how to make more than 360 useful products that contain honey and beeswax)** by E.C. White. (1993) 114 pp; USA. Softcover.

A recipe book for a wide variety of products containing beeswax, ranging from adhesives to vinegar, and including beer, mead, candles, batik, cosmetics, soaps and polishes and lots more. All clearly presented and based on the author’s experience.

78. **Propolis: a review** by E.L. Ghisalberti. London, UK; IBRA (1979) 26 pp. Reprint from *Bee World*. Photocopy only available.

79. **Beeswax and propolis for pleasure and profit** edited by Pamela Munn. (1998) 30 pp. Softcover.

The purpose of this book is to widen the horizons of beekeepers and explore new possibilities for gaining pleasure and profit from their bees by explaining the uses and values of beeswax and propolis.

### **HONEYBEE DISEASES, PARASITES AND PREDATORS**

80. **Beekeeping in Asia** by P. Akwatanakul. Rome, Italy; FAO Agricultural Services Bulletin 68/4 (1987) 112 pp.

The first chapter describes briefly all the commonly recognized species of honeybees found in Asia. The remainder of the book deals with the biology and management of native *Apis cerana* and introduced *Apis mellifera*. The reader is instructed on bee forage, how to construct a floral calendar, and how to recognize common diseases and pests in the hive.

81. **Mill Viruses of honeybees** by L. Bailey. London, UK; IBRA (1982) 9 pp.  
Reprint from *Bee World*.

82. **Honeybee pests, predators and diseases** edited by R. Morse and K. Flottum. (1997) 3rd edition. 730 pp. Hardcover.

This classic reference book has been extensively updated and improved. With photographs and illustrations this book is required reading for anyone remotely related to the fields of beekeeping, honeybee science or entomology.

83. **Information for beekeepers in tropical and subtropical countries - Leaflet 3: *Varroa jacobsoni*** by N. Bradbear. London, UK; IBRA (1988) 4 pp.

The leaflet describes *Varroa jacobsoni*, its biology, how to detect it and methods of control.

84. **World distribution of major honey bee diseases and pests** by N. Bradbear. London, UK; IBRA (1988) 25 pp.

Reprint from *Bee World*.

85. **Varroa! Fight the mite** edited by Pamela Munn and Richard Jones. (1997) 34 pp. Softcover.

In response to demands by beekeepers for more information on how to control varroa, IBRA has published a book containing international contributions on this important problem.

86. **Honeybee brood diseases** by H. Hansen. (1977) 28 pp; Denmark. Softcover.

An excellent practical guide to identifying brood diseases and varroa in the hive. Fully illustrated with color photos accompanying brief text, this book concentrates on what you actually see when examining your combs.

87. **Living with varroa** edited by A. Matheson. (1993) 58 pp; UK. Softcover.

The best starting point for beekeepers wanting to learn more about this parasite. A readable account of varroa biology and control, both chemical and biotechnical.

88. **New perspectives on varroa** edited by A. Matheson. (1994) 164 pp; UK. Softcover.

Catch up on 25 years' experience, as scientists from east and west Europe pool their knowledge. Topics covered include: breeding resistant bees, secondary pathogens, non-chemical control, use of plant oils and heat treatment, fluvalinate resistance and new chemical controls.

89. **Control of wax moths: physical, chemical and biological methods** by H.D. Burges. London, UK; IBRA (1978) 10 pp.

Reprint from *Bee World*.

90. **The bee-eaters** by C.H. Fry. Waterhouses, UK; T & A.D. Poyser (1984) 304 pp. Hardback.

Beekeepers will be interested in this colorful family of insect-eating birds which sometimes include worker and drone bees in their diet. Twenty-four species are described and illustrated and maps show their distribution. References and glossary.

91. **Honey bee predation by bee-eater, with economic considerations** by C.H. Fry. London, UK; IBRA (1988) 14 pp.  
Reprint from *Bee World*.

## PESTICIDES

92. **Pest control safe for bees** by M. Adey, P. Walker and P.T. Walker. London, UK; IBRA (1986) 224 pp.  
A reference book for extension officers who need to tell crop growers about the importance of bees as pollinators and about controlling pests without killing bees. Useful for government departments, colleges, aid agencies, development projects and others concerned with bees, pollination or pesticides. The book was published with financial support from the Tropical Development and Research Institute, UK.
93. **Proceedings of the 6th ICPBR symposium on hazards of pesticides to bees** edited by G. Lewis. (1997) 297 pp. Softcover.  
Report from the meeting held in September 1996 in Braunschweig, Germany.
94. **The conservation of bees** edited by A. Matheson, S.L. Buchmann, C. O'Toole, P. Westrich, I.H. Williams. (1996) 254 pp; UK. Hardcover.  
Bees form a vital part of many natural and farmed landscapes all over the world both as pollinators and as part of the wider insect community. But everywhere bees are under pressure, from the direct impact of pesticides in the environment, as well as indirect effects of habitat alteration and destruction. This book focuses on a number of important topics in bee biology, habitats needed for bees to thrive, interactions between bees and many plant species, and conservation in temperate regions of four continents. Each topic is dealt with by an international cast of authors.

95. **The impact of pest management on bees and pollination** by E. Crane and P. Walker. London, UK; Tropical Development & Research Institute (1983) 232 pp.

A discussion of pollination by bees (and other insects) of important crops grown in the tropics and subtropics, and an assessment of damage to bees by pesticides commonly used. Measures to reduce the killing of bees yet effective in eliminating pests are explained and recommendations made.

96. **Pollinator protection: a bee and pesticide handbook** by C.A. Johansen and D.F. Mayer. Cheshire, CT, USA; Wicwas Press (1990) 212 pp.

This book is aimed at beekeepers, growers and pesticide applicators and is written in a style that makes it easy for the reader to pick out information. The book covers the history of bee poisoning, the types of pesticide involved, other factors involved in poisoning and the symptoms of poisoning. Most of the book concerns honeybees but information on leafcutter bees and alkali bees is also included.

## **REFERENCE WORKS**

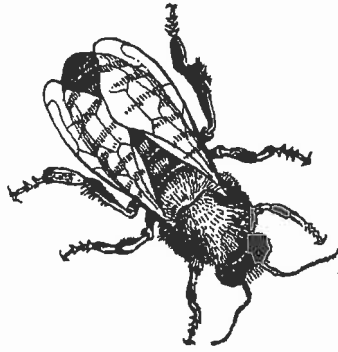
97. **Directory of institutions in developing countries known to be concerned with apiculture.** UK; IBRA (1982) 18 pp.

Names and addresses of 363 institutions, listed under 105 countries. Available as photocopy with cover.

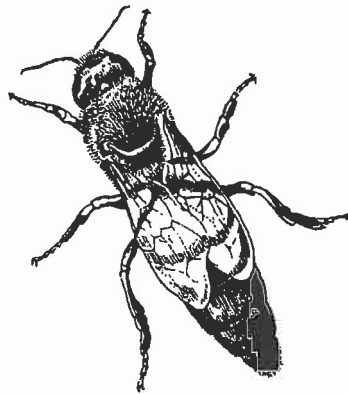
98. **Directory of suppliers of beekeeping equipment world-wide.** UK; IBRA (1982) Available as photocopy with cover.

Lists 265 suppliers of equipment in 40 countries who are believed to export their products. There is a separate classified list of different types of equipment, with names of suppliers who specialize in them.

**Description of references courtesy of:  
International Bee Research Association**



## Appendices





## Appendix 1

### Some Honeybee Forage Plants In the Tropics and Subtropics

Acacia albida	Cola nitida (cola)
Acacia dudgeoni	Combretum L. spp.
Acacia gourmaensis	Combretum paniculatum
Acacia nilotica	Croton L. spp. (croton)
Acacia polyacantha	Cucumis spp.
Acacia senegal	(cucumber, melon)
Acacia tortilis	Cucurbita moschata
Adansonia digitata (baobab)	(pumpkin)
Albizia lebbbeck	Dalbergia sissoo (sissoo)
Allium L. spp.	Dialium elgeranum
(onion, leek, garlic, etc.)	Dichrostachys glomerata
Anacardium excelsum	Diospyros batocana
Anacardium occidentale (cashew)	Durio zibethinus (durian)
Annona senegalensis	Dyschoriste Nees spp.
Anogeissus leiocarpus	Ehretia acuminata
Asparagus officinalis (asparagus)	Elaeis guineensis
Avicennia marina (mangrove)	(African oil palm)
Azadirachta indica (neem)	Eriobotrya japonica (loquat)
	Brachystegia spiciformis
	Carica papaya (papaya)
	Cassia siamea
	Ceiba pentandra
	(silk-cotton tree)
	Citrus aurantium (orange)
	Citrus bergamia (bergamot)
	Citrus deliciosa
	Citrus grandis (grapefruit)
	Citrus limon (lemon)
	Citrus medica (lime, citron)
	Citrus paradisi
	Citrus reticulata (mandarine)
	Citrus sinensis
	Clethra barbinervis
	Cocos nucifera
	(coconut palm)
	Coffea arabica (coffee)

<i>Eucalyptus alba</i>	<i>Gleditsia triacanthos</i>	<i>Khaya senegalensis</i>
<i>Eucalyptus albens</i> (white box)	(honey locust)	(African mahogany)
<i>Eucalyptus cadambae</i>	<i>Glinicidia sepium</i>	<i>Lespedeza</i> spp. (bush clover)
<i>Eucalyptus camaldulensis</i>	<i>Gmelina arvoreae</i>	<i>Ligustrum japonicum</i> (privet)
(red gum)	<i>Gossypium hirsutum</i> (cotton)	<i>Litchi chinensis</i> (litchi)
<i>Eucalyptus citriodora</i>	<i>Grevillea robusta</i> (grevillea)	<i>Maduca longifolia</i>
(lemon gum)	<i>Grewia mollis</i>	<i>Malus pumica</i> (apple)
<i>Eucalyptus cladocalyx</i>	<i>Haematoxylon campechianum</i> L.	<i>Mangifera indica</i> (mango)
(sugar gum)	(campeche, logwood)	<i>Medicago sativa</i> (lucerne, alfalfa)
<i>Eucalyptus maculata</i>	<i>Helianthus annuus</i> L.	<i>Melicocca bijuga</i> (honeyberry)
(spotted gum)	(sunflower)	<i>Melicocca lepidopetala</i>
<i>Eucalyptus melliodora</i>	<i>Hevea brasiliensis</i> (rubber)	<i>Mimusops elengi</i>
(yellow box)	<i>Hibiscus</i> spp.	<i>Moringa oleifera</i> (ben nut tree)
<i>Eucalyptus paniculata</i>	<i>Hymenaea stilbocarpa</i>	<i>Musa</i> L. spp.
(grey ironbark)	<i>Hypoestes Soland</i> spp.	<i>Nepeta</i> L. spp.
<i>Eucalyptus robusta</i>	<i>Impatiens Riv. ex L.</i> spp.	<i>Nephelium lappaceum</i> (rambutan)
(swamp mahogany)	(balsam)	<i>Nephelium litchi</i> (litchi)
<i>Eucalyptus saligna</i>	<i>Impatiens glandulifera</i> Royle	<i>Nyssa ogeche</i> (ogeechee lime)
<i>Eucalyptus torrelliana</i>	(Himalayan balsam)	<i>Ocimum</i> L. spp. (basil)
<i>Eupatorium odoratum</i> (snakeroot)	<i>Ilex pedunculosa</i> (gallberry)	<i>Parkia bicolor</i>
<i>Euphorbia longana</i> (longan)	<i>Ilex rotunda</i>	<i>Parkia biglobosa</i>
<i>Eutyrospernum parkii</i>	<i>Julbernardia globiflora</i>	<i>Parkia clappertoniana</i>

Parkinsonia aculeata (Jerusalem thorn)	Rhus spp. (sumac)	Terminalia superba (limba)
Persea americana (avocado)	Ricinus communis L. (castor)	Tilia japonica (linden)
Phaseolus L. spp. (bean)	Robinia pseudacacia (black locust)	Tilia maximowicziana
Pistacia vera L. (pistachio)	Roystonea regia (royal palm)	Tithonia tagetifolia (Mexican sunflower)
Pithecolobium dulce	Sabal palmetto	Toona ciliata
Polygonum L. spp. (bistort)	Salix L. spp. (willow)	(toon, Indian mahogany)
Pongamia pinnata	Schinus terebinthifolius	Tridax procumbens
Prosopis cineraria	Sclerocarya caffra	Trifolium spp. (clover)
Prosopis glandulosa (mesquite, honey mesquite)	Sesamum indicum (sesame)	Vaccinium L. spp.
Prosopis juliflora	Spathodia campanulata	(bilberry, blueberry, etc.)
Prosopis pallida	Spondias mombin	Vitex agnus-castus (chaste tree)
Prosopis pubescens (screw bean)	Styrax japonica (snowball)	Vitex doniana
Protea L. spp. (honey flower, etc.)	Syzygium aromaticum (clove)	Zizyphus jujuba (Chinese jujube)
Prunus spp. (cherry, apricot, peach)	Syzygium cordatum	Zizyphus maritania
Psidium guajava (guava)	Syzygium cumini	Zizyphus mucronata
Pterocarya trinacea	Syzygium jambos (rose apple)	Zizyphus spina-christi (Christ's thorn)
Pyrus pyrifolia (pear)	Tamarindus indica (tamarind)	
Rhamnidium glabrum	Terminalia ivorensis (framiré)	

## Appendix 2

### Making A Wax Foundation Press

(Courtesy, Dr. Diana Sammataro, Bee Expert, USA)

To do some operations in the bee yard, it may be necessary to have a sheet of wax foundation. But buying sheets of wax with the embossed hexagonal design is expensive and too difficult to obtain for some. So here is a way to make your own with some plaster of Paris, nails, scraps of wood and screening. Note: the screening is essential to prevent the plaster of Paris (P of P) from cracking.

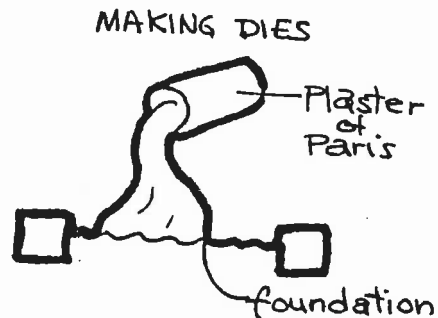
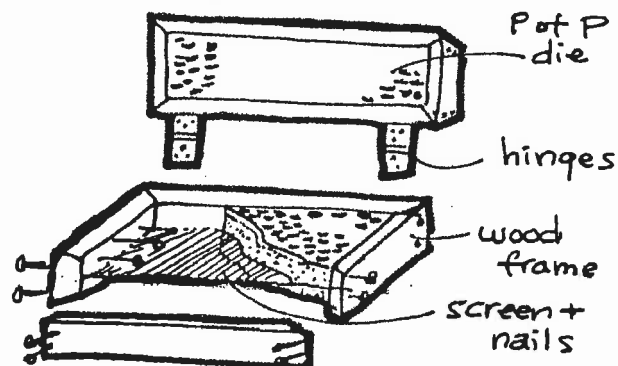


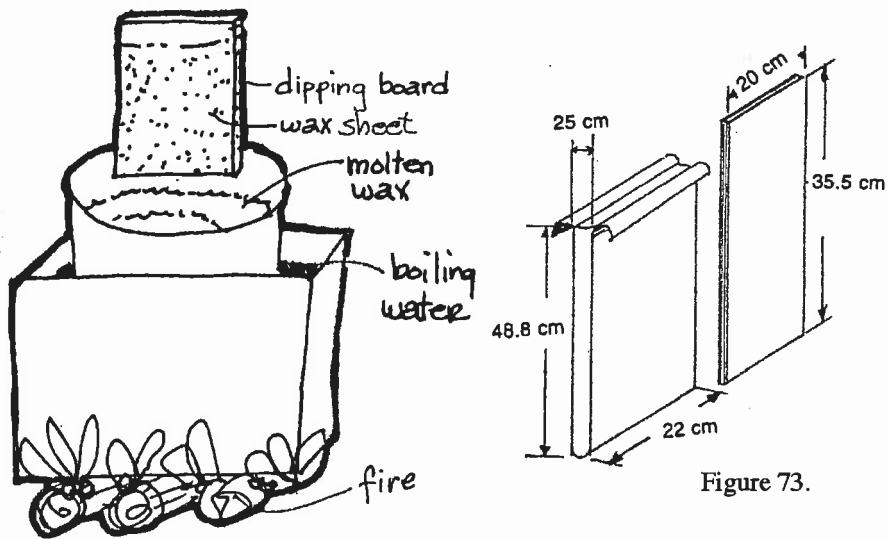
Figure 71. Wax foundation press.



The press consists of a pair of heavy wooden blocks, larger than the sheet of foundation you wish to make. It is framed in wood and has hinges on one of the long sides, so the halves close together like a book. Inside, where the halves meet, are a pair of dies,

castings of plaster of Paris taken from a sheet of wax foundation. Note: a sheet of plastic foundation works very well for this operation. You can make the impression from a flat sheet of foundation (or comb with the sides cut down, leaving only the midrib of wax) on a board. Coat the foundation with vegetable oil and pour over it the plaster of Paris. Allow it to harden, then make another one, the same size.

Once hardened, set the plaster dies into the wooden framework (Figure 71), screw in the hinges and you are ready. To make a sheet of foundation, brush the mold with the wetting liquid (see recipe), in order to facilitate the removal of the finished sheet. Pour melted wax in the center of the mold, close the lid, wait for the wax to harden, remove and rinse with cool water. Trim it to size and store, or set it in a frame. To make this go faster, make two presses.



**MAKING PLAIN WAX SHEETS**

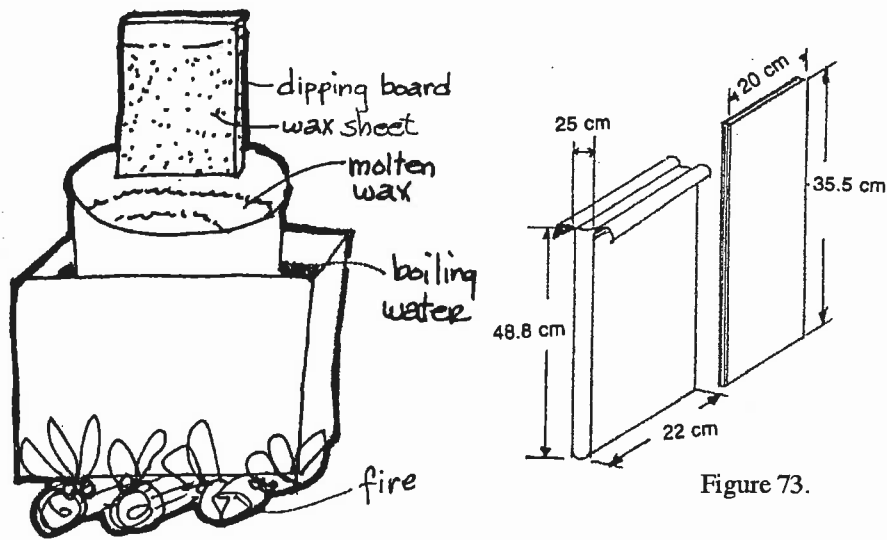
Figure 72.

Figure 73.

Sometimes, only sheets of thin wax are required. Such a sheet can be cut into thin strips to use for starters. Use a smooth hardboard, wet it with the wetting solution and dip the board in hot wax (Figure 72). For a thicker sheet, dip it several times. When the wax is hard, peel it from the board and you are ready to cut it into

castings of plaster of Paris taken from a sheet of wax foundation. Note: a sheet of plastic foundation works very well for this operation. You can make the impression from a flat sheet of foundation (or comb with the sides cut down, leaving only the midrib of wax) on a board. Coat the foundation with vegetable oil and pour over it the plaster of Paris. Allow it to harden, then make another one, the same size.

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**MAKING PLAIN WAX SHEETS**

Figure 72.

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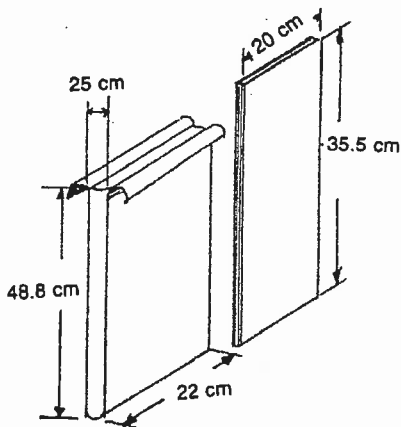


Figure 73.

2cm strips. A smaller wax container, submerged in hot water, can be used if just a few sheets of wax are needed (Figure 73).

*(Source: Agroforestry Technology Information Kit, IIRI (et. al.), Philippines).*

### **Wetting Solution:**

4 liters rain water or distilled water

60 ml of liquid detergent

150 ml honey

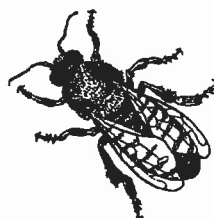
60 ml alcohol

The mixture should not be sudsy. Minerals in hard water will make the wax stick and therefore difficult to remove from the molds.

### **Sources Of Foundation And Foundation Making Equipment:**

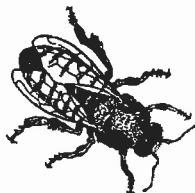
#### **Beeswax Foundation (African):**

John Rau and Co. Ltd.  
P.O. Box CH 621  
Chisipite  
Harare, Zimbabwe  
Fax 495012



#### **Beeswax Foundation (Asian):**

Rawat Apiaries  
Ranikhet S.B. (Kumaon Hills)  
Almora (U.P.) India

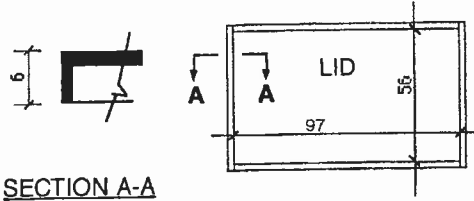
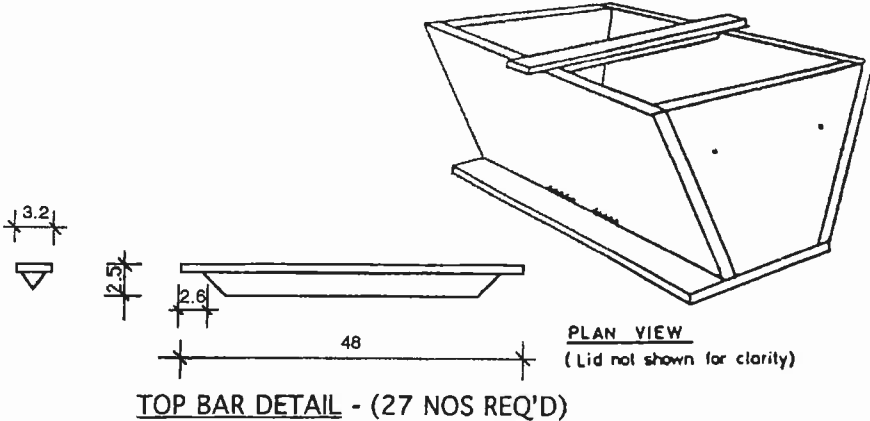


#### **Foundation Rollers (European,African, Asian):**

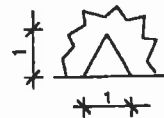
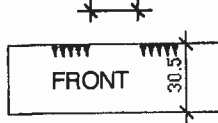
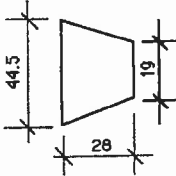
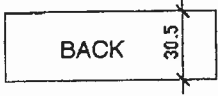
Tom Industries  
P.O. Box 800  
El Cajon, CA 92022 USA



# Kenya Top-Bar Hive



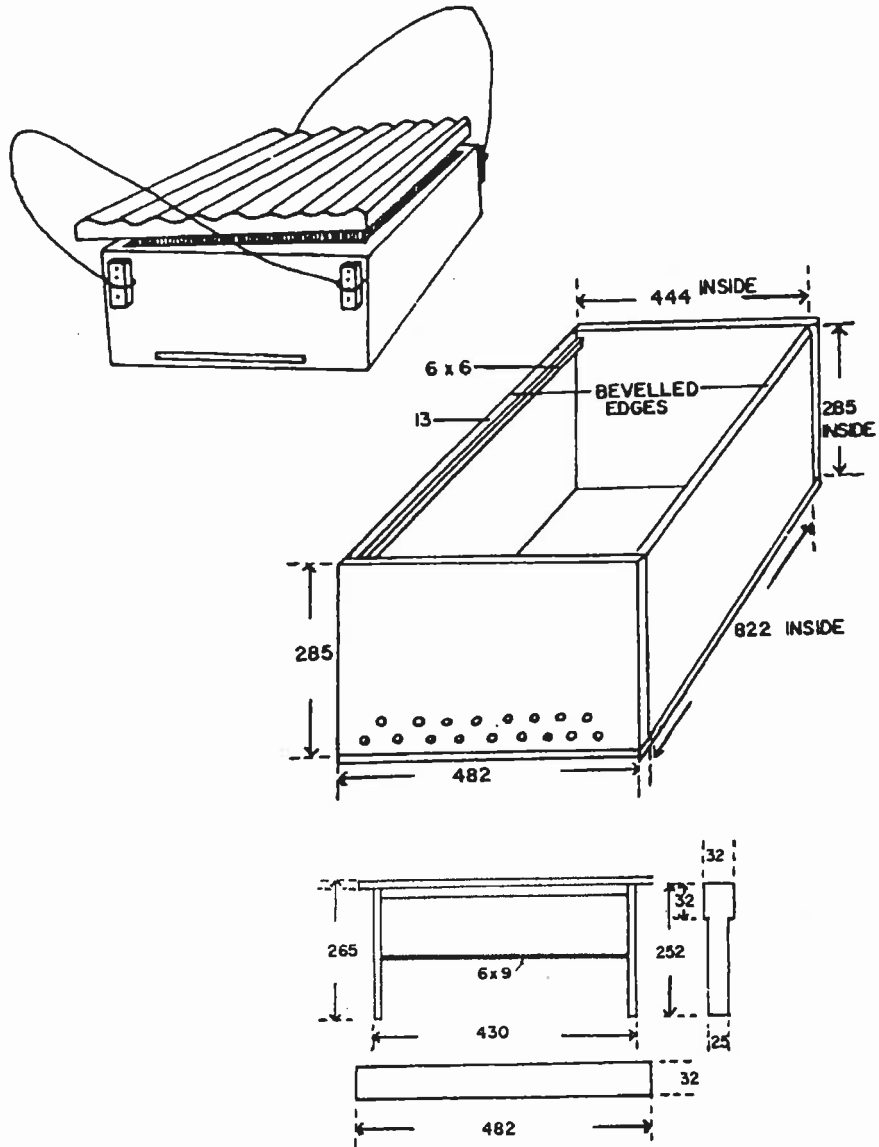
Notes: Hive is a Ghana version, Kumasi. There are many variations of this hive. Lumber 1.9cm (3/4") émiré or odom. 3.2cm width of top-bars is critical. All dimensions in centimeters.



Illustrations courtesy, Food and Agriculture Organization of the United Nations and S. Adjare, Beekeeping in Africa.

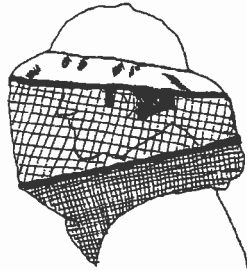


# Long Hive

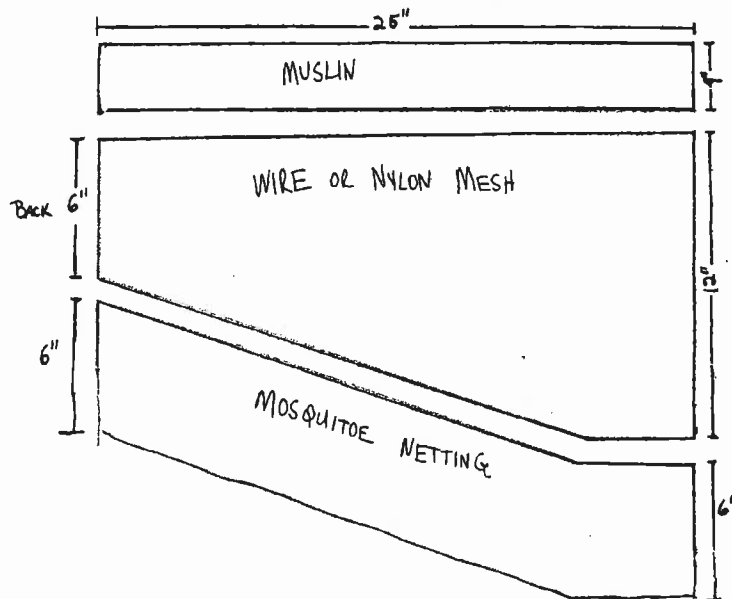


*Courtesy, Food and Agriculture Organization of the United Nations, Tropical and Sub-tropical Apiculture, FAO, Rome, Italy. Illustrations by S. Townsend.*

## Appendix 4



### ROUND WIRE VEIL



#### Materials:

1. Wire or Nylon Mesh: 132cm (52") wide by 30cm (12") long.
2. Black Elastic: 6mm (1/4") wide by 58cm (23") long.
3. Muslin, cloth, or "flour sack:" 10cm (4") wide by 127cm (50") long.
4. Mosquitoe netting: 15cm (6") wide by 135cm (53") long.
5. Twill tape: 13mm (1/2") wide by 23cm (9") long.
6. Nylon cord: 2.44m (8').

*Courtesy, Henry Mulzac and John Zago.*

## Relative Toxicity of Pesticides To The Common Honeybee

### Group 1 - Highly Toxic

The application of these pesticides to foraging areas when bees are active may cause severe damage. Beekeepers must know in advance when they are to be used and take special precautions; moving colonies out of the area temporarily is perhaps the safest approach.

aldrin	heptachlor
arsenicals	Imidan
Azodrin	Lannate (methomyl)
Raygon	lindane
RHC	malathion
Bidrin	methyl parathion
Chlothion	Methyl Trithion
dimethoate	Mobam
fensulfothion	Monitor
DDVP (dichlophos)	parathion
diazinon	Phosdrin
Dibrom	(Mevinphos)
dieldrin	Sevin (carbaryl)
Dimecron (phosphamidon)	Sumithion
Ethyl Guthion (azinphosethyl)	Temik (aldacarb)
Famothos (famphor)	TEPP
Furadan	Zectran
Guthion	Zinophos

## Group 2 - Moderately Toxic

These products should not be applied directly on fields when bees are actively foraging or when hives are exposed. Dose, timing and application methods are among factors determining whether the pesticides can be used with minimum risk to bees.

Abate	MetaSystox (methyl demeton)
Agritox	MetaSystox R (oxy-demeton-methyl)
Banol	mirex
Carzol (formetanate)	Perthane
chlordane	Phosalone
DDT	Phosvel, Abor
Di-Syston (disulfoton)	Pyramat
endothion	Systox (demeton)
endrin	Thinet (phorate)
Korian (ronnel)	Thiodan (endosulfan)
	Trithion (carbophenothion)

## Group 3 - Relatively Non-Toxic

These products can be used on fields or near hives with minimal damage to bees; in fact, a few of the listed acaricides can be used to control bee mites within the hive.

### A. Insecticides and Acaricides

acaraben (chlorobenzilate)	Dilan
Allethrin	Dylox (trichlorfon)
Aramite	Eradex
Bacillus thuringiensis	Ethodan
cryolite	Fundal
Delnav (dioxathion)	Galecron (chlorophenamidine) <sub>96</sub>

Dessin  
Kelthane (dicofol)  
Kepone  
methoxychlor  
Mitrox (chlorbenside)  
Morestan  
Nemagon  
Neotran  
nicotine  
Omite  
OMPA (schradan)

Heliothis Virus  
Ovostran (ovey)  
Phostex  
phrethrin  
Rhothane (TDC)  
rotenone  
ryania  
sabdilla  
Sulphenone  
Tedion (tetradifotoxaphene)

## **B. Fungicides**

Arasan (Thiram  
Benlate (benomyl)  
bordeaux mixture  
copper oxychloride sulfate  
copper sulfate (monohydrate)  
cuprous oxide  
Cyprex (dodine)  
Dexon  
dichlone  
Difolatan  
Dithane M-45 (folcid)

Glyoxide (glyodin)  
Karathane (dinocap)  
Manzate (maneb)  
Mylone  
Parzate (nabam)  
Phaltan (folpet)  
Polyram  
sulfur  
Thynon  
Zerlate (ziram)

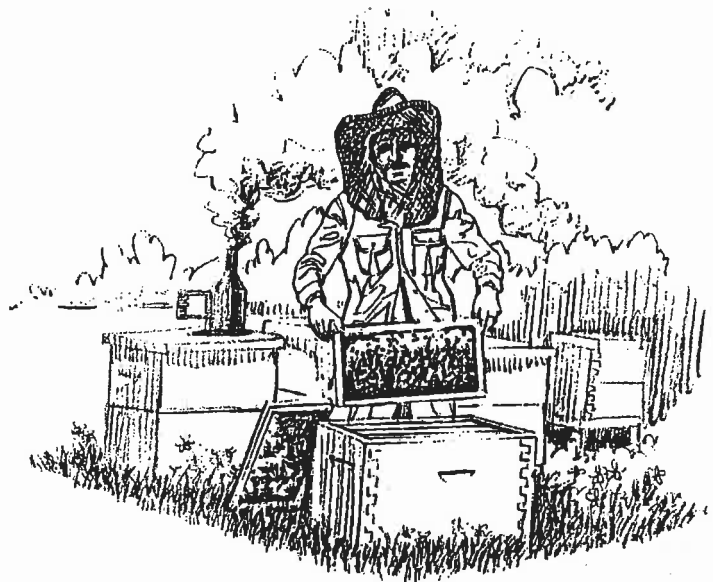
## **C. Herbicides**

amitrol  
Ammate (ammonium sulfamate)  
Atrazine  
Banvel (dicamba)

Betanal (phenmedipham)  
Caparol (promytryne)  
Casoron (dichlobenil)  
delapon

### C. Herbicides (cont)

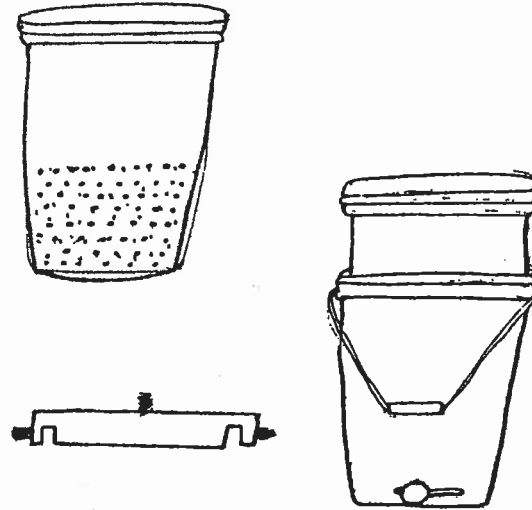
DEF	paraquat
diquat	picloram
Eptam (EPTC)	Planavin
Folex (merphos)	Princep (simazine)
Herbisan (EXD)	Radox (CDAA)
Hyvar (bromacil)	Sinbar (terbacil)
Igran (bromacil)	Stem F-34 (propanil)
IPC	TOK (nitrofen)
Karmex (diuron)	Trysben (2,3,6-TRA)
MCPA	Vegedex (CDEX)
Milogard (propazine)	2,4-D
monuron	2,4-DB
NPA	2,4,5-T



## Appendix 6

### Simple Uncapping Can

*(Courtesy, J.C. Johnson, Spanish Town, Jamaica)*



#### Materials:

1. Two 5-gallon plastic pails (damaged containers can be used), one fitted with a 1-1/4" honey gate.
2. One 2.54 X 2.54 X 41cm (1 X 1 X 16") piece of wood (or to fit).
3. Three 2.54cm (1") screws.

#### Method:

Perforate one pail with 3-4mm (1/8") size holes; a piece of wire heated over a flame can be used to melt the holes in the plastic.

The pail is perforated to about half-way up.

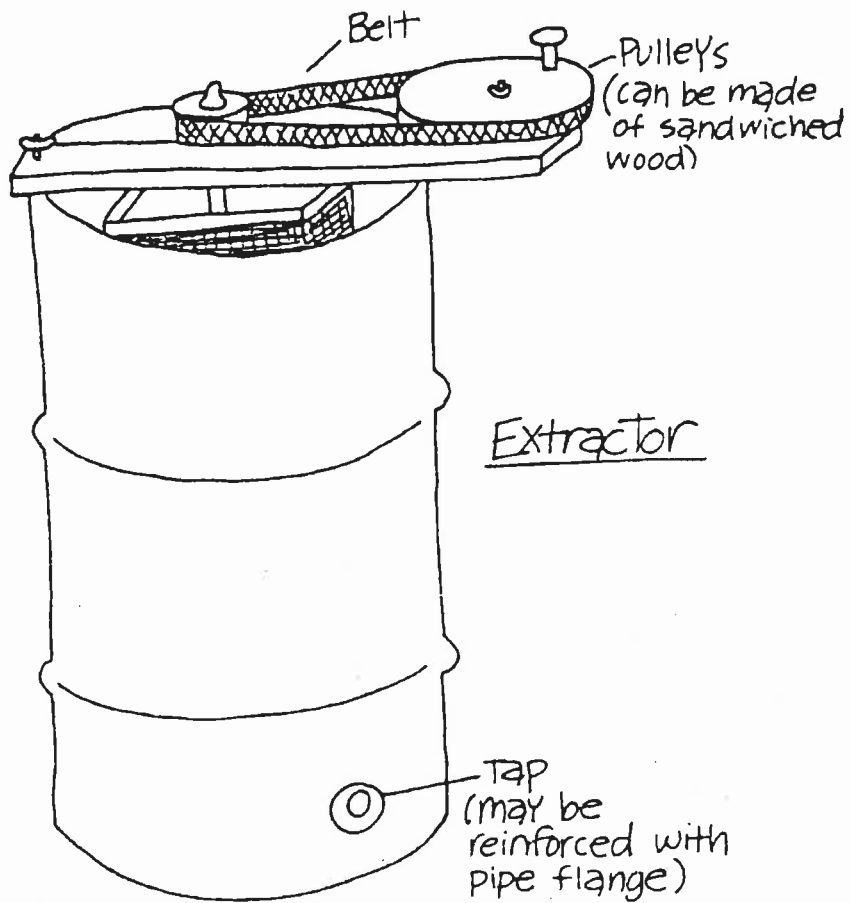
Notch the wood at either end so it fits over the top of the second pail.

One screw is counter-sunk into the wood, mid-way between the notches to rest your frame as you uncap. The other two screws are placed into the ends so they can be tightened to hold the wood firmly to the rim.

## Appendix 7

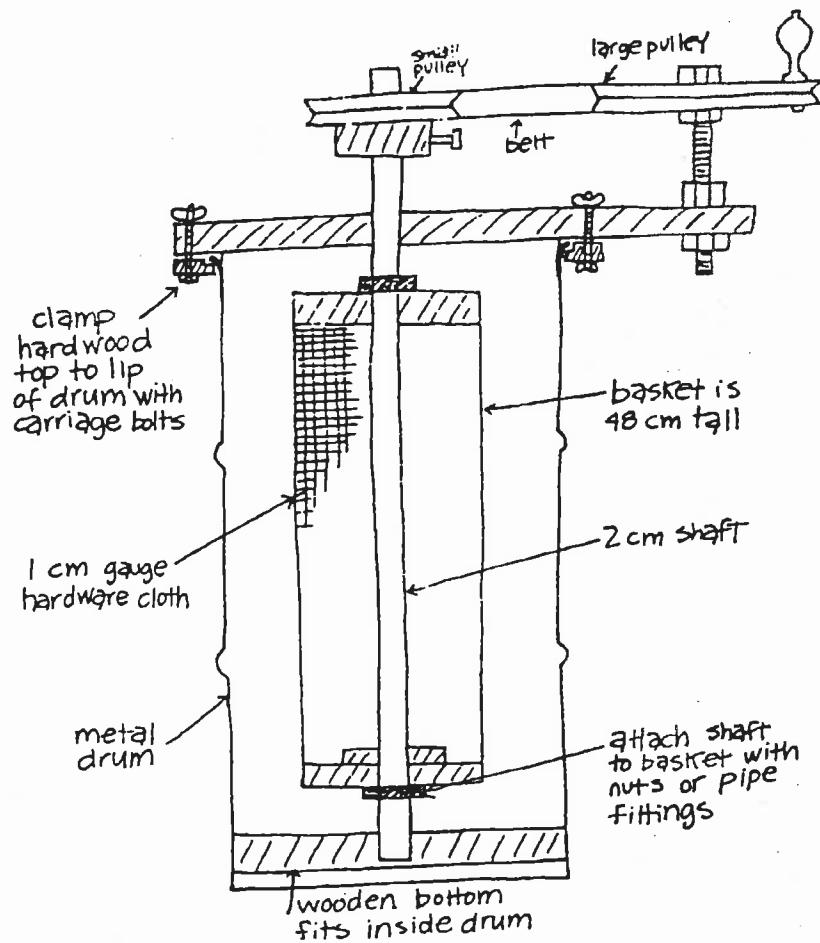
### Belt-Driven Honey Extractor

(Courtesy, Henry Mulzac and Rob Kingsolver, USA.)



A honey gate can be affixed here.



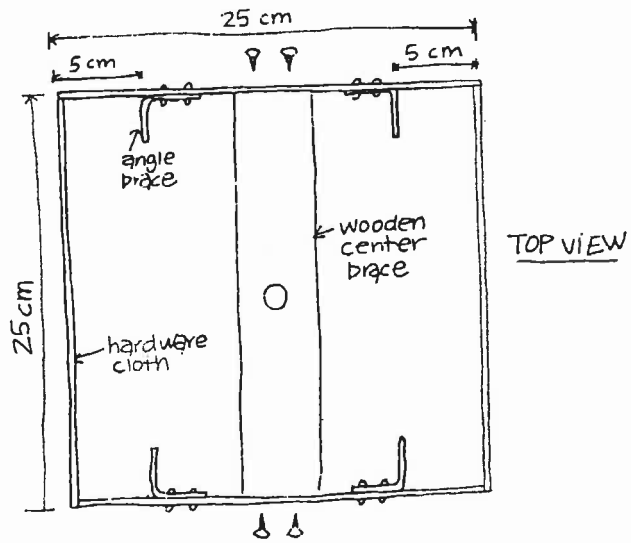
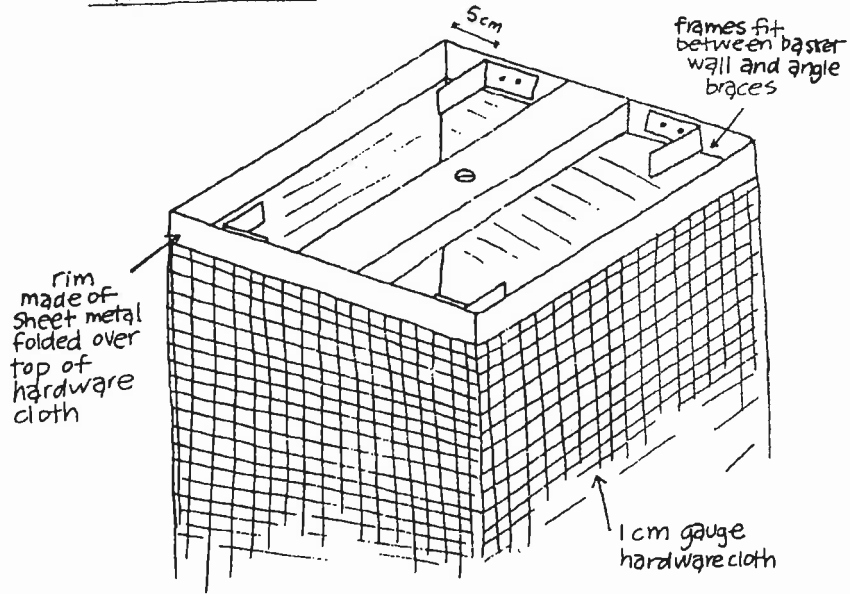


### How to Use:

Cut off the cell cappings before extracting the frame of honey.

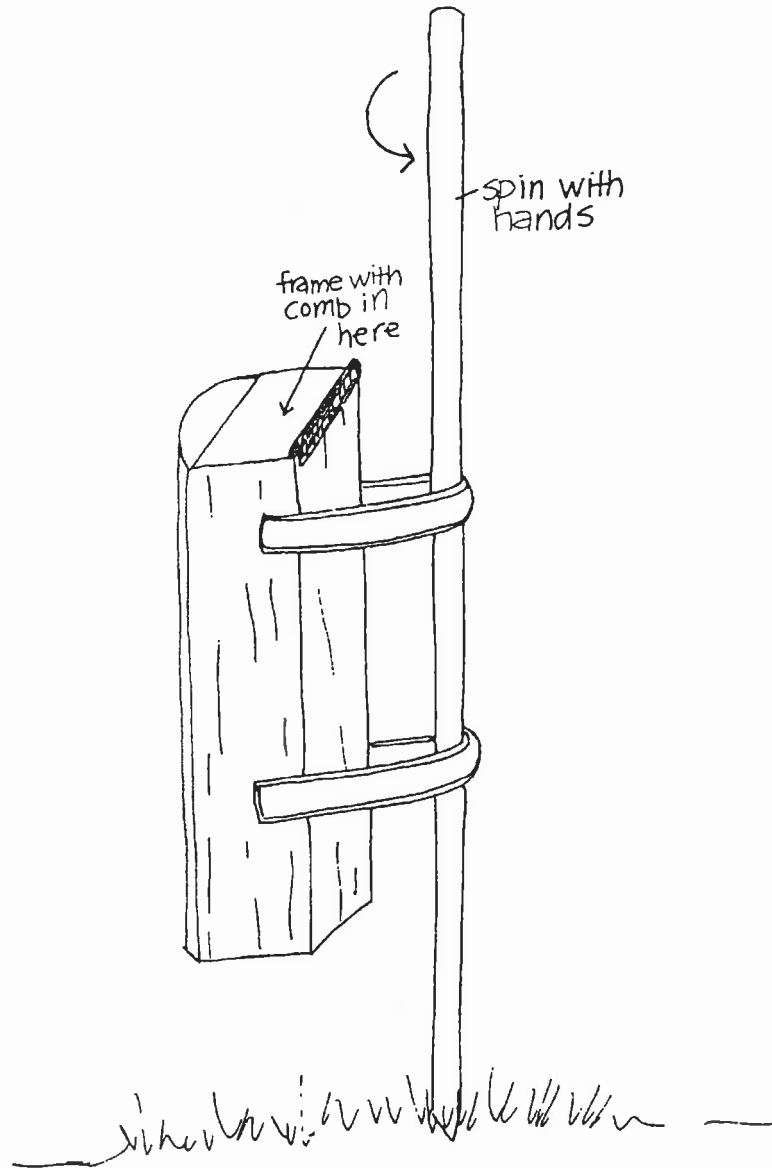
Partially extract the honey from one side of the comb; then turn the frame around and completely extract the other side. Turn the frame around again and finish extracting the comb. This minimizes comb breakage since it prevents the weight of the full side of the frame of honey from pressing against the empty side.

# BASKET DETAILS



# Hand-Held Honey Extractor

(Courtesy, Henry Mulzac and Rob Kingsolver, USA.)



## Hot Water And Steam Wax Melters

*(Courtesy, Dr. Diana Sammataro, Bee Expert, USA.)*

Hot water and steam will melt dark combs. The liquid wax can then be filtered and allowed to harden. Combs can be put in a burlap sack and immersed in hot rainwater. If your water is hard and full of dissolved minerals, add some vinegar to it. The molten wax, which floats, can be skimmed off and filtered. This is a crude and wasteful method as not all the wax is extracted (Figure 82).

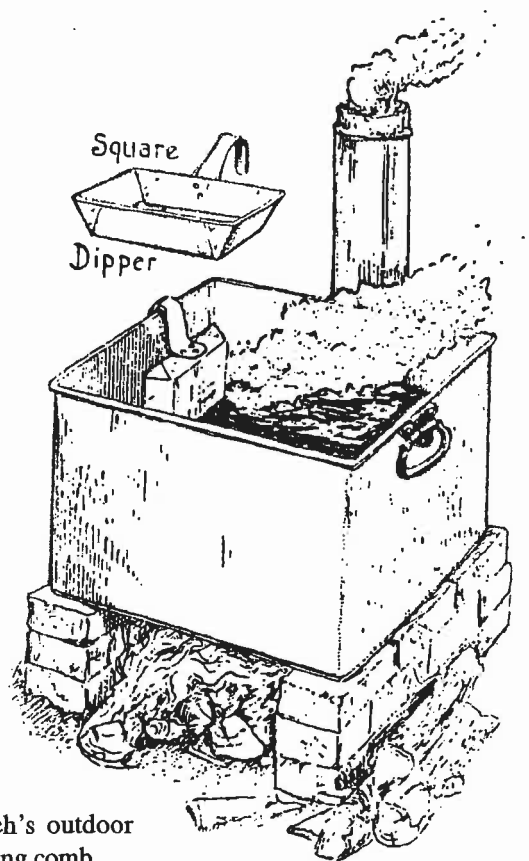


Figure 82. Hatch's outdoor furnace for melting comb.

A better way is to press the melted wax in a steam or hot water press. Whether using a screw or lever press, (Figures 83 and 84) presses are much more efficient for large quantities of wax. Combs are wrapped in cloth bags and placed in the press; they are either pressed cold or are heated with steam or hot water.

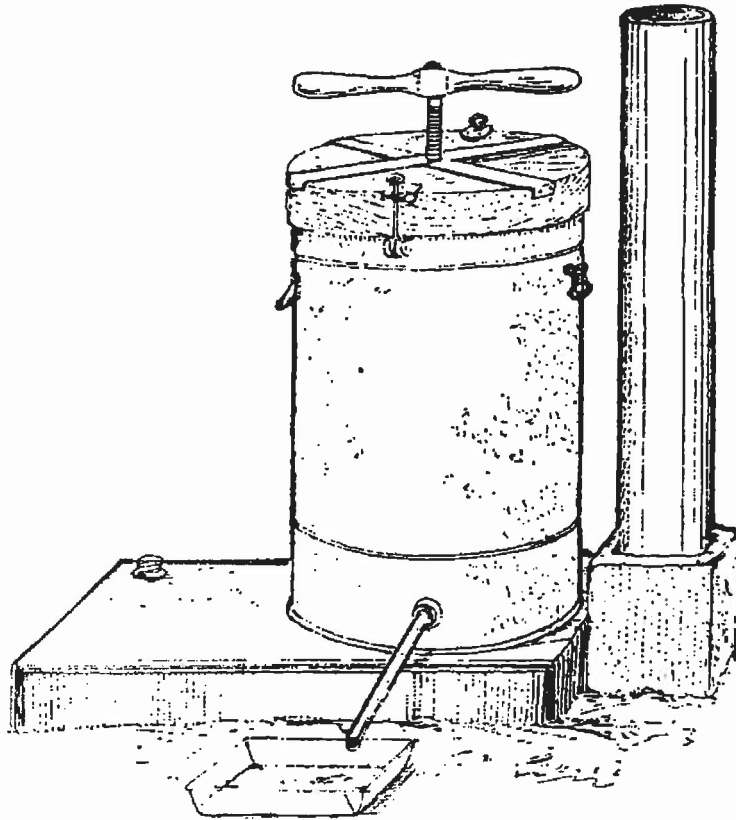


Figure 83. Wax-press melter.

Once the wax has been separated, it can now be made into cakes. Remelt the wax in clean rainwater (equal proportions) over slow heat until it is just melted. Over-heating wax will darken it and destroy its structure. Once it is melted, strain the wax-through a clean cloth (to trap pollen, honey and bee glue or propolis) into a

clean container. Lightly soap the container lightly to facilitate removing the wax cake. Remove the covered container to a draft-free room to cool slowly. Dust must **not** get into it. When completely hard, in 24 hrs, shake out the cake and scrape off any dark particles from the bottom. Do not mix melted light and dark colored waxes.

The remaining waste product, called slum-gum, has been used as a soil builder. Compost, or rot it first, with dirt, manure and green leaves. Once softened, it can be worked into your garden, especially where the soil is hard or too sandy.

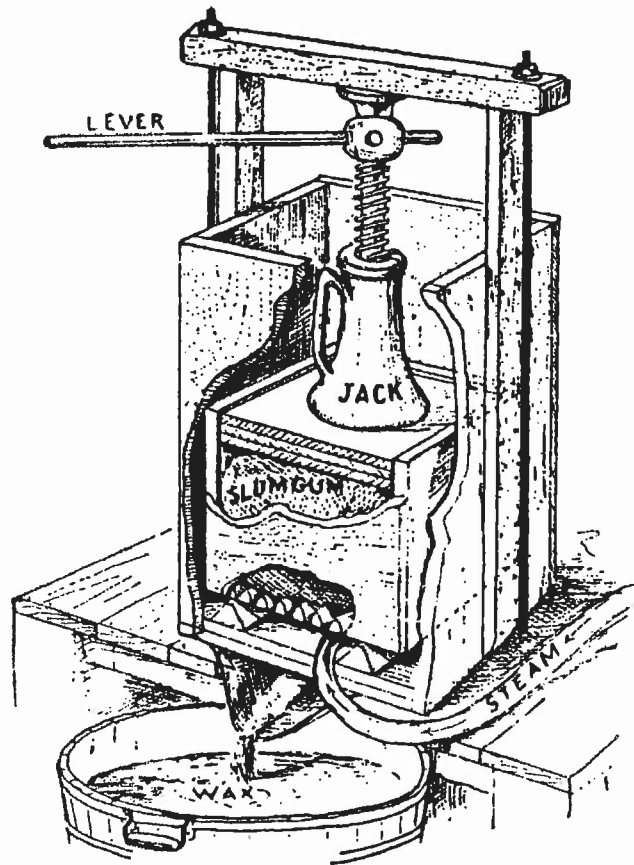


Figure 84. Wax-press using an ordinary jack-screw; cross-beam and supports should be heavier and stronger than those shown.

### Case Studies

#### Nepal

Beekeeping techniques are passed on from generation to generation. Usually beekeepers have between two and five hives which are located within the residential area, although sometimes they have as many as ten. Generally, three types of bee hives are used in the rural areas. Farmers groups all bring their harvested honey to the capital, Kathmandu, for sale.

#### Wall hive

This is a simple hive where the honey is stored in the outer combs while the brood is in the inner combs. The honey can be harvested without disturbing the brood and the hive can then be plastered up again and reused.

#### Log hive

This is a traditional hive made from hollowed out tree bark which is plastered up at either end.

#### Kenyan top bar hive

Honey can be harvested twice each year in the valley regions in March and April, and September and October. In the high mountain areas, harvesting takes place in September and October.

Generally small-scale rural beekeepers have no protective clothing although some wear a veil. They use traditional smokers.

The honey is used to barter for ghee and rice in the remote areas or it is sold to markets at a price of between US\$1.50 and US\$3 per

kilogram depending on the quality of the honey and the availability of buyers. The income generated from the sale of honey is used for school fees, food, clothing and other day to day needs. Usually there are between 3 and 5 children in each family.

### **Problems and constraints**

Bees have a habit of absconding and the loss of one bee colony is about US\$55-70 in cost. This problem can be reduced with good management. For example, by destroying new queen cells, the current queen can be prevented from leaving the hive.

The honey is extracted by hand which is not a good hygiene practice.

Only people who have been trained in pollination will plant trees and flowers for the bees.

Beekeepers report problems with brood diseases and plantations of about 300 trees. Bark hives last for about 5 to 10 years. Solomon would like to plant flowers that are best for honey but there is no water to help them grow.

Solomon is able to pay the school fees with the money he makes from honey and he depends on honey for income generation. Father and son harvest together. Father taught son beekeeping and Nazareth now has 27 traditional log hives.

## **Cajamarca's Highlands in Peru**

### **Saul Villanueva Bardales**

Mr. Bardales has been beekeeping for 63 years. He started beekeeping because there is a great diversity of flora in the area where he lives and he wanted to increase his income. His sons are grown-up and married. Mr. Bardales has 28 hives. They are standard movable



frame hives, which he made himself. The bee hives are located beside his house and he spends an hour each day managing the hives. He has limited beekeeping equipment including a protective veil, a knife which he uses as a crowbar and a honey centrifuge.

The honey is harvested in April and May. It is used at breakfast as a sweetener, and his children consume it directly. Mr. Bardales sells the honey to important families of the region and to middlemen from the coast of Peru. It is sold in bulk and in 1999 the price was US\$4.41 per kilogram. Mr. Bardales extracts the honey with a centrifuge and filters it through a cloth. He is able to reuse his honey combs for many years. The income from the honey has been used to support the family and to help pay for his children's education.

#### **Problems and constraints**

Mr. Bardales works solely on beekeeping and this does not provide sufficient work or income for him.

Some of the bees migrate away from his apiary.

The agro-chemicals used in agriculture decrease the population in his bee colonies.

Complains about a lack of technical support.

#### **William MoisÈs Villanueva**

Mr. Villanueva is single. He lives with his sister who has two children, aged 7 and 5 years old. He has been beekeeping for 3 years. It began when a queen bee and her colony settled on a tree near his house. He captured the swarm and started beekeeping. Mr. Villanueva has 6 beehives which are beside his house. He has a protective mask and a knife. He spends about one day every 2 weeks looking after the bees.

The honey is harvested in April and May. It is sold in bulk to visitors to the City of Cajamarca at US\$2.94 per kilogram. He extracts the honey with a borrowed centrifuge and filters it through a cloth. Children and adults consume the honey directly using a spoon. The income generated from the sale of the honey is used to pay for the basic needs of the family and to buy more material and equipment for apiculture.

### **Problems and constraints**

Cannot purchase all the material or raw matter needed for beekeeping in the region.

No technical support, just orientation/advice from other beekeepers.

Lacks tools to make his beehives and complains of low honey production.

### **Luis Cano Suri**

Mr. Suri has 3 children, aged 7, 5 and 3 years old. He has been beekeeping for a year. A project from the State promoted the activity, but the project never began due to the lack of a budget. However, it inspired Mr. Suri and he decided to start beekeeping by himself. Mr. Suri has 5 beehives, a protective mask, brush and crowbar. The beehives are beside his house and he spends one day per week beekeeping. He harvests honey between February and March. His children consume a large amount of the honey produced as food during breakfast which they spread on bread. The remaining honey is sold in bulk to visitors to the City of Cajamarca at US\$3.48 per kilogram. He extracts the honey with a borrowed centrifuge and filters it through a cloth. The income generated from selling the honey pays for the children's education and medicine.

### **Problems and constraints**

Where to sell, no market.

Lack of land, his property is small.

There is no money credit available to increase his production.

Lack of material and raw matter in the region.

Migration of his queen bees.

His population becomes drones.

Lack of technical support.

### **Bumba Honey Centre**

Farmers from up to 80 kilometers away come to the honey center to sell their honey. The honeycomb is placed into a nylon mesh and the honey takes a few hours to drain; in cold weather the honey drips through more slowly. Once the honey has drained, the honeycomb is placed into a honey centrifuge and squeezed to ensure that all the honey is collected. The remaining honeycomb will then be boiled up and made into wax.

Whiter honeycomb is first grade and sells for Z\$18 per kilo.

Brown honeycomb is second grade and sells for Z\$16 per kilo.

Dark honeycomb is third grade and sells for Z\$14 per kilo.

### **Problems and constraints**

The combs are destroyed and cannot be reused by the bees.

The bees consume large amounts of honey and expend too much energy to produce new combs, thus, reducing honey that can be sold by the beekeeper.

## Appendix 10

### Value-Added Products From Bees

Beekeepers with just a few hives usually make money by selling their honey and wax in local markets. Beekeeper cooperatives, with many members, might wish to extend their profits and markets by turning primary bee products into saleable items. Below is a partial list of possibilities. Some of these products will require added manufacturing technology. However, many can be made with cottage industry knowledge. An excellent reference is: *Value-Added Products from Beekeeping*, by R. Krell. FAO Bulletin #124, Rome, Italy.

**Honey:**

Honey Beer  
Creamed Honey  
Honey Jelly  
Dressings for Wounds  
Honey Gum

**Pollen:**

Nutrition Supplements  
Candy  
Cosmetics

**Wax:**

Candles  
Cosmetics/Soaps  
Furniture Wax  
Varnishes  
Crayons  
Paint

**Propolis:**

Cosmetics  
Ointments  
Shampoo  
Creams  
Nutrition Supplements  
Suntan Lotions

**Royal Jelly:**

Nutrition Supplements  
Cosmetics

**Bee Venom:**

Medical Products

**Adult/Larval Honeybees:**

Fried/Frozen Pupae/Adults  
Dried Larvae and Adults  
Candy Coated Bees

