Organization of a bee colony

The queen
The drone
The worker

The tropical honeybee, Apis mellifera adansonii (scute-lata), lives a unique, sophisticated social life similar to that of its counterparts in Europe and elsewhere. There are two sexes, the female and the male, but the former is subdivided into two castes. In the average colony, there are -

a) one fertile queen, whose main activity is egg- laying,
b) from 20 000 to 80 000 sterile female worker bees, which do almost everything that needs to be done in the colony, and
c) from 300 to 800 fertile males, generally called drones.

In addition, there are about 5 000 eggs and 25-30 000 immature bees in various stages of their development, called the brood. Of these, some 10 000, newly hatched, are the larvae, which have to be fed by the workers, while the remainder, after the larval stage, are pupae, sealed into their cells by the workers to mature. They are called the sealed brood.

The honeybee nest

The nest of a bee colony consists of a number of vertical combs which hang parallel to each other at a distance of about 10 mm. The combs, about 25 mm wide, are composed of hexagonal cells. There are two types of comb cells: the smaller, called worker cells, and the larger, called drone cells. In the worker cells in the lower part of the comb, the bees rear worker brood; in the upper part of the comb, they store pollen and honey. In the drone cells, the bees rear drones. Occasionally they build a third type of cell, the queen cells, in which queens are reared.

Development of the honeybee

The bees develop from fertilized or unfertilized eggs laid by the queen at the bottom of the cells. Fertilized eggs are laid into worker cells and queen cells, and the unfertilized into drone cells. The egg develops in three days. After that time, the female queen and worker larvae hatch from fertilized eggs, and male larvae hatch from unfertilized eggs.

All the larvae are fed during their first three days of life with "bee milk", or "royal jelly", produced by the nurse bees, which are young worker bees not yet ready to leave the hive. After that time, worker and drone larvae are fed on a mixed food composed of honey and pollen, while larvae destined to develop into queens are

fed on royal jelly during their whole larval life of five days. Thus, queens can be reared from any worker larvae younger than three days.

When a queen disappears accidentally from a colony, the workers reconstruct a few worker cells, containing larvae younger than three days, into queen cells and continue to feed the larvae with royal Jelly. Queen larvae are sealed in their cells by the workers five days after being hatched, worker larvae after six days and drone larvae after seven days.

In the sealed cells, metamorphosis of the larvae creates the pupae. The adult queen emerges from the cell 16 days after deposition of an egg, the worker bee after 21 days and the drone after 24 days.

The queen

There is always one queen in a hive. She is half again as large as a worker and longer than a drone. Her wings are much shorter than her body and cannot cover the whole of her abdomen. Her long, tapering abdomen makes her resemble a wasp. She has sparkling gold hairs on her shiny body. The queen has a sting but, unlike the aggressive workers, does not use it to fight hive intruders. Her sting is only used to fight rival queens. She does not go out to collect pollen, nectar, water or propolis, and therefore she has no collecting apparatus like pollen baskets, long proboscis for drawing nectar or wax glands to secrete wax to build comb cells. As a queen, she usually does not feed herself.

Immediately after she emerges, the queen tours the hive to see if there is any rival queen hiding somewhere. If she finds one, the two queens will fight until one is killed.

If the colony is not preparing to swarm, then the newly emerged queen seeks out potential queens hiding in comb cells. The queen pipes to make a special noise and the hidden capped queen responds. Immediately, the emerged queen locates the cell, tears it to pieces and kills the unemerged queen. Sometimes the workers watching as spectators will help the queen to evacuate the contents of every queen cell.

Five days after the queen emerges from her cell, she starts to fly out of the hive, making an orientation flight of about five minutes. Next she makes mating flights which last about 30 minutes. She flies to an area 6-10 m above the ground where drones have congregated. In other places, she is not attractive to the drones. During a successful mating flight, she is mated by about eight drones. If the flight is not successful, she makes another the next day. During the mating flight, the drone's semen is injected into her oviducts. Prom there, the spermatozoa enter

into a special reservoir called the spermatheca. A well-inseminated queen carries about 5000000 spermatozoa stored in her spermatheca.

Sometimes nuptial flights can be delayed as the result of a long rainy season or pronounced bad weather. When a young queen bee has been unable to mate for about a month, she will start to lay unfertilized eggs in worker cells. From these eggs, only drones will develop. In this case, the colony will perish within a few weeks unless the beekeeper observes what is happening and reacts immediately by giving the colony a new queen (requeening) or by inserting a new brood comb with very young larvae and eggs, from which the colony will develop a new queen, after having killed the old unfertilized one.

Three days after her last mating flight, the queen starts to lay her eggs, which are produced in her ovaries. A good queen lays 1 500-2 000 eggs per day. She lives three to five years, but after two years she lays fewer eggs. When her spermatozoa become exhausted, the she also lays unfertilized eggs in worker cells, where drones now develop. Such a queen in called a dronelayer.

Each queen produces a queen substance, called a pheromone, by which many activities of a colony are controlled. In the absence of a queen or a pheromone, the workers transform some worker cells containing young larvae into queen cells and start to rear new queens.

When there are no larvae younger than three days in the colony, the bees have no way of rearing new queens. In this case, ovaries of some workers develop, and they start to lay eggs. However, as worker bees cannot be inseminated, they lay only unfertilized eggs. Such workers are called laying workers.

The drone

The drone is popularly known for exhibiting a high degree of laziness. His presence in the hive seems to be of little importance to the beekeeper. He is stout and larger than the worker. He has no suitable proboscis for gathering nectar and has no sting to defend himself or the colony. Like the queen, he possesses no baskets for collecting pollen grains and no glands to secrete wax for comb construction. He does no work in the hive but is fed, eating large quantities of food, and moves about in sunshine and on warm days making loud, frightening noises everywhere he goes. This is why he is considered useless, but he has a very important function to play, which only a few of his kind ever fulfil. This function is to inseminate the queen, and for this he is well prepared.

The compound eyes of the drone are twice as large as those of the queens and workers, and both eyes meet at the top of his head, which is not true of workers and queens. This enables him to see the queen during the mating flight. The

drones also have the largest wings, which help them to reach the queen during the flight.

The spermatozoa are produced in the drone's testes during the pupal stage. After the drone emerges from the comb cell, the spermatozoa pass into seminal vesicles, where they remain until mating. During mating, they pass into the copulatory apparatus.

The colony begins to rear drones in late spring and early summer. They reach sexual maturity nine days after emerging, and fly out of the hive (mostly between 1 and 3 p.m.) searching for the queens over a distance of 8 km or more. Hating occurs in the open air, in the drones' congregation areas. During mating, the drone everts his copulatory apparatus, injecting the semen into the queen's oviducts and leaving part of the apparatus in the tip of the queen's abdomen. That part, visible in the queen returning from the mating flight, is called the mating sign. The drone dies during mating.

Toward the end of the nectar flow, when fresh nectar becomes scarce, the workers prevent the drones from feeding. At first they push the drones from the brood combs to the side combs and eventually drag them half-starved from the hive.

In unfavourable periods, drones are tolerated only in queenless colonies or those containing unmated queens. Thus the presence of drones in a colony during such periods shows that something is wrong with the queen and that action by the beekeeper is needed.

The worker

Workers are the smallest and most numerous of the bees, constituting over 98% of the colony's population. One colony, as has been seen, may have as many as 80 000 workers, but 50 000 is a more common maximum.

Although they never mate, the workers possess organs necessary for carrying out the many duties essential to the wellbeing of the colony. They have a longer tongue than the queen and drones, and thus are well fitted for sucking nectar from flowers. They have large honey stomachs to carry the nectar from the field to the hive; they have pollen baskets on their third pair of legs to transport the pollen to the hive. Glands in their head produce royal jelly as food for the larvae and glands in their thorax secrete enzymes necessary for ripening honey. Four sets of wax glands, situated inside the last four ventral segments of the abdomen, produce wax for comb construction. A well-developed sting permits them to defend the colony very efficiently.

The kind of work performed by the worker depends largely upon her age. The first three weeks of her adult life, during which she is referred to as a house bee, are devoted to activities within the hive, while the remainder are devoted to field work, so that she is called a field bee.

Duties of the house bee

The duties of a house bee are -

a) cleaning the hive and the comb
b) feeding the brood
c) caring for the queen
d) making orientation flights
e) comb building
f) ventilating the hive
g) packing pollen, water, nectar or honey into the combs
h) executions
i) guard duty

Cleaning

The first activity of the worker bee on reaching maturity is to clean herself. She removes all unnecessary particles, grooms herself immediately and then crawls out of her cell. She takes in food and then starts cleaning the brood cells, employing both tongue and mandibles. The comb cells are cleaned to receive eggs laid by the queen who, before laying, examines the comb cell to satisfy herself that it has been properly cleaned. If she finds a cell that is not properly cleaned, she quickly rejects it. Other duties which may occasionally be necessary include removing dead intruders or dead bees from the hive, and removing debris and other objectionable material. Anything that is too large to carry is often dragged along and pushed outside, while dead snakes, wax moths or other carcasses too heavy to transport are encased with propolis brought in by field bees.

Feeding the brood

After three to five days, the worker bee starts to feed the brood. At this stage she is called a nurse bee. At first she feeds larvae more than three days old with a mixture of honey or nectar, pollen, small quantities of bee milk and some water. After a few days, she starts to feed the younger larvae (1-3 days old) exclusively on bee milk, which she produces in brood-food glands, also called milk glands or hypopharyngeal glands, located in her head.

Caring for the queen

The next work undertaken by the young worker is to provide for the needs of the queen bee. Whenever the queen needs food, she calls for it by stretching out her proboscis towards the mandible or mouth of the nearest worker. The workers are always anxious to satisfy her needs and make a circle or semi-circle around her. The queen contacts the nearest worker, and if she does not get as much as she needs, she approaches the next. This continues until all her demands are met. It is also the duty of the nurse bees to bathe her with their tongues and mandibles and to carry away her faeces.

Orientation flight

The orientation flight is not so much a house duty as an exercise for the young worker. She must learn how to fly, and she must know the vicinity, especially the location of the hive. She therefore first makes some short flights in front of the hive and in the immediate vicinity to acquaint herself with the environment, so that when in the near future she goes out to forage, she will be able to find her way back home.

Comb building

Comb building provides the needed "rooms" in the hive, in the form of hexagonal cells, for two main purposes: storing food and rearing brood. Beeswax, the material for the construction of comb, is secreted by the worker's wax glands, which are best developed and productive when she is 12-18 days old. The wax, which emerges from the glands as a liquid, hardens quickly and appears in the form of oval flakes similar to small fish scales, protruding from between the last four overlapping abdominal segments on the under-side of the worker's body. As we have already seen, the bee must consume large amounts of food (honey and nectar) to produce these wax flakes.

Bees engaged in building combs usually hang themselves in festoons at or near the site of the building operation. There they hang quietly while their digestive organs transform the contents of their honey sacs into energy and beeswax. The wax is removed with the spines of the hind legs and is then manipulated with the mandibles to build the comb cells. Capping of comb cells is also the duty of comb builders.

Ventilating the hive

Temperature control is one of the important duties of the house bee. When the temperature is low, bees cluster to generate heat for themselves, but when it is high, some of them have to fan their wings to circulate air throughout the hive. The right temperature required is between 33° and 36°C, while the brood chamber requires a constant heat of 35°. Honey has to be cured in order to ripen, and this also requires the help of circulating air. According to Crane, 12 fanning bees positioned across a hive entrance 25 cm wide can produce an air flow

amounting to 50-60 litres per minute. This fanning can go on day and night during the honey-flow season. The phenomenon is always at its peak in October in the high savannah and forest zones of Vest Africa.

Honey conversion and packing

It takes several bees to produce honey. No single honeybee completes the whole process. The forager brings a load of nectar to the hive and transfers it to a house bee, who proceeds to the empty or uncrowded part of the hive, where she rests and exposes the nectar to the air being fanned by the fanning bees. The air circulation helps reduce the moisture content of the nectar and thus aids sugar concentration. The house bee may load the nectar into the upper section of an empty cell or add it to the honey or nectar of a cell incompletely filled. The speed with which she manipulates the nectar depends on the intensity of the nectar flow. If nectar is abundant, the house bee may deposit her load quickly into a comb cell for later processing.

The time required for the nectar to mature into honey depends for the most part on its original moisture content. For example, if the sugar content is high, as in the nectar of Combretum paniculatum, which is usually over 65%, ripening takes about two hours. On the other hand, if palm wine (which bees enjoy very much) is sent into the hive, more time will be required, since its sugar content is as low as 4.5%. Matured honey usually has over 80% sugar concentration. Ripening time is also determined by the quantity of the nectar: combs completely filled with nectar, even if strongly ventilated, may take as much as 36 days to mature.

Packing water, pollen and propolis

Other essential commodities which are brought in by the foragers and need the attention of the house bee are water, pollen and propolis. Water is required for cooling the hive, especially during the harmattan season, when the atmosphere is very dry and temperatures are too warm for the bees' comfort. Water is mixed with honey and pollen and then fed to the older larvae, between 3-6 days old. Pollen is also packed to about three-quarters full in comb cells in the brood chamber, sometimes side by side with brood cells. Cells are never completely packed with pollen.

Propolis is a resinous material collected from trees. It is difficult to unload, because it is gummy in consistency, and the house bees have to help the foragers to unload. The carrier holds firmly onto the walls of the hive, and the house bee removes the sticky gum from the hairy corbicula or pollen basket. Sometimes it takes more than three days to off-load a forager. The propolis is either stored or used immediately for the purpose required: to block holes and cracks in the hive, to repair combs, to strengthen the thin edges of the comb, or to make the entrance of the hive watertight or easier to defend. As already mentioned, propolis is also used to cover objectionable material in the hive and

to embalm dead intruders such as wax moths, snakes, etc., too large to be removed.

It is interesting to note that house bees are always eager to help unload the field bee that brings in material which the hive requires immediately. For example, when the weather is too warm and water is required to cool the hive, they will pay no attention to foragers bringing in nectar or propolis, who will have to wait until the heat situation is brought under control before they are offloaded.

Executions

Executions are a means of protecting the colony from hunger, disease and any catastrophic event. They may be performed to eliminate strange bees, to kill or drive away old and sick bees, to discourage other hive predators from entering the hive, to remove sick or unwanted unemerged brood, to eliminate useless drones, and to kill unwanted or strange queens.

Guard duty

Guard duty is the final activity of the house bee before she leaves the hive. By this time she has reached peak strength, is very energetic, and is best fit to defend the entrance of the hive, which is also the point of entry of the colony's enemies.

The guard bee has the duty of inspecting all incoming foragers by smelling their odour. When satisfied, the guard allows the incoming bee to enter unmolested with her load. In most ·cases, foragers with loads to discharge are not intercepted unless the hive is greatly disturbed. After staying at the entrance for a while, the guard may fly out on patrol for some time before returning to the entrance. The guard bee is also responsible for watching any crack through which a robber bee or any other intruder might enter the hive. In an alerted hive, guard bees stand on four legs, their forelegs lifted and they antennae held straight, searching here and there. Any intruder, robber or other enemy first receives a frightening audible warning, followed by a sting; if he persists, the application of the alarm pheromone on the spot where the bee stings quickly summons more defenders. The scent helps other attackers to find the target and follow without delay.

It has been observed that during the brood-rearing season, more guards are stationed at the hive entrance than during the peak of the honey flow.

The field bees

Activities involving flight may start from the third day after emergence from the brood cell, but the young worker begins her actual foraging activity later. Between the 18th and the 21st day, her hypopharyngeal and wax glands have

become too weak to function, so that she cannot produce royal jelly to feed the queen and the young larvae, nor wax to build comb cells. But by this time she is in perfect condition to fly and knows the geography of the locality. She therefore starts field work, fetching nectar, pollen, propolis or water, but always concentrating her activity on the immediate needs of the colony.

Observations conducted in several places in Ghana showed that foragers begin to be active as early as 5:15 a.m. and that by 6:30 p.m. almost all have returned to the hive. In the latter part of July, August and September, most foragers brought pollen. By 5:20 a.m. the first consignment of pollen had arrived. More heavy loads of pollen continued to come, and traffic at the entrance was heavy until 7:30 a.m. This phenomenon was repeated between 10:00 and 11:30 a.m., when the sunshine was intense.

Nectar gathering

Nectar, the sweet liquid secreted by plant nectaries, is collected by foragers, taken to the hive and turned over to the house bees for processing. The forager then returns to the flowers and collects more. The number of trips she makes in a day cannot be assessed precisely. It may vary from time to time for a number of reasons: the availability and accessibility of the nectar source, the quantity of nectar present, and the nectar requirement of the colony for the day.

Sight and smell enable the bee to locate sources. She lands on the part of the plant that will support her and dips her stretched proboscis into the corolla of the flower. If there is nectar, she sucks it into her honey stomach. If there is none, she wastes no time before moving to the next flower. Some flowers have more nectar than others. Sometimes the bee can load enough by visiting one, two or three, but in plants with tiny flowers she can only get a full load by visiting hundreds. A fully loaded bee can carry 85% of her own weight.

The time taken to complete a trip varies, but can reach 2 hours. In the savannah, foragers visit certain plants at specific times of the day. The dawadawa plant (Parkia clappertoniana), for example, produces large quantities of nectar and sweet Juice which flows on parts of the stem and branches, but the dry harmattan drains the moisture in the liquid, and the juice becomes so sticky that the bee cannot load it easily. Probably for this reason, bees visit the plant as early as 5:15 a.m. and as late as 6:15 p.m. On each occasion, only one trip is made. By 6:30 p.m., no bees can be found on the tree.

Water collection

Bees consider water-carrying as one of their most important duties. They execute it regardless of what may be involved. If they need Water for the hive, they will resort to drastic methods to acquire it. In water-scarce areas, desperate bees sometimes attack farmers for their sweat, and clothes cannot be washed

outdoors in the daytime for fear of molestation by desperate bees searching for water. Thirsty bees visit kitchens, bathrooms, toilets and all obscure humid places. They will land on any moist area, dip their proboscis and suck in water. Loading of water takes only a few seconds. The bee carries it to the hive and returns in a few minutes to reload if water is still present.

The scout bee

Foragers can take on scout duties as well. The scout bee locates food sources and passes on the information to other bees by a series of dance-like movements. She circles around and around, stamping her legs and wagging her abdomen; sometimes she stretches her proboscis, possibly to show the type of food she has found. The onlooking workers watch her dance, interpret it and act accordingly. It is believed that different dances show different types of information to be passed on.

Another most important duty of the scout bee in a new swarm is to search for a suitable accommodation, while the rest of the swarm waits on a tree branch or in a small enclosure. On finding a suitable hollow or hive, she returns to the swarm and performs a characteristic dance to inform them about the find. When two or more bees make different finds, each scout dances especially vigourously in an attempt to win the support of the swarm.

Robber bees

All worker or foraging bees are thieves. They claim anything they like as their own property. They snatch honey away from honey harvesters from other swarms during the daytime, especially when the weather is sunny and bright. In the rich savannah bee-zones where water is scarce, bees easily steal water from villagers. Robber bees visit other colonies' hives and try to take honey in order to store it in their own hive. The problem of hive robbing is not as serious in tropical Africa as in America and elsewhere. Only very weak colonies are sometimes robbed; usually it is abandoned hives that other colonies invade to take advantage of the honey stored in the comb cells.

It is strange that bees often fail to take advantage of water or any sweet juice located close to the hive, but when it is placed further away (about 20 metres or more) they take it. This shows that the beekeeper should always watch his hives to avoid leakages of honey, for the leak will not be recovered by his own bees but by other bees from elsewhere, thus encouraging robbing.

The annual biological cycle op the bee colony

1) The colony in the period before the honey season

A period occurs in the tropics as well as in the temperate zones during which environmental conditions are unfavourable for the bees, and as a result the activity of the colony diminishes.

In temperate zones, the winter temperature falls so low that the worker bees cannot fly out of the hive. The queen stops laying, so that the bees do not rear brood in winter at all.

In tropical zones, unfavourable conditions for honeybees may occur in different periods and may be caused by different factors:

a) In some areas, the temperature falls so low that the activity of the colony is reduced. Few or no plants are flowering. Only a few bees fly out of the hives, and as a result, very little, if any, nectar is collected.

b) In other areas, drought occurs, and the number of flowers, and therefore the amount of nectar available, is reduced considerably.

c) Still elsewhere, the rainy season sets in and the bees cannot collect nectar.

In all these circumstances, temperatures are higher than during temperate-zone winters, and the bee colony's activity never completely stops. The queen generally does not stop laying as long as stores are available within the hive, although the amount of brood present reflects a much slower rhythm of laying. Thus, bees in unfavourable environmental conditions in the tropics require more food than bees during temperate-zone winters.

When the colony's stores are exhausted, the bees stop rearing brood and start to eat it. The population of the colony diminishes, and the colony may die or migrate in search of better living conditions. Migration is very common in African A. mellifera as well as in the Asiatic bees A. cerana and A. dorsata; European A. mellifera very often do not migrate but die off.

In any case, the population of a bee colony at the end of the unfavourable period is very much reduced.

2) The colony during the development period

When more plants start to bloom, the unfavourable period is over. The bees can collect more nectar and pollen, and the young workers eating more pollen, can produce more bee milk. As a result, the queen can lay more eggs, and the nurse bees can feed and rear more brood. During the unfavourable period, sometimes only 100 cm^2 of brood, or even less, is present in one comb, but now the amount of brood increases gradually to cover 10 or 12 entire combs, and sometimes even more. The number of comb cells occupied by brood may reach 30 000.

Swarming

As the availability of pollen and nectar increases, the population of the colony thus increases with it. But when, at the same time, the honey flow is not heavy, some disorder occurs.

Each nurse bee can secrete more bee milk than one larva can eat, and when 2 000 workers emerge per day, they are able to feed 4 000 larvae. but the queen can only lay 2 000 eggs per day at best. Thus there is over-production of bee milk in the hive, and some nurse bees have no larvae to feed.

Since drone larvae consume four times as much bee milk as the worker larvae, the bees probably now rear drone brood. Nevertheless, some workers cannot pass through the stage of nurse bees. They start to eat the bee milk themselves and to feed other adult bees on it. Their ovaries develop. The colony is now crowded with such bees, and they will provoke swarming of the bee colony.

Under these conditions, the workers start to build several queen cells, or "cups", in which the queen lays her eggs over several days; when the larvae hatch, the nurse bees supply them with large quantities of royal jelly, neglecting to feed the queen with it. As a result, the ovaries of the queen shrink and she is now able to fly.

The bees swarm the day after the first queen cell is sealed; about half of the population leaves the hive together with the old queen. The swarm clusters, usually on a limb of a tree, before it decides to fly to a new home found by the scouts.

The original parent colony is now queenless. The new queen will emerge from the queen cell 16 days after the egg was laid, or seven days after the swarm left the hive. When the environmental conditions are good, the bees protect the rest of the queen cells so that they will not be destroyed. Thus, two days later (nine days after the first swarm left the hive), a second swarm leaves, but it now has a virgin queen. The next day, a third swarm may leave, and the next a fourth one. When conditions are poor or the population has decreased considerably, the bees will accept the first young queen which emerges but will destroy all the other queen cells with pupae inside them.

After the swarm finds a new home, the workers start to build combs for a new nest. Virgin queens from the swarms and from the parent colony will mate in the near future, and after a few days will start to lay eggs.

Factors provoking and limiting swarming

Certain factors stimulate, and others retard, the swarming of bees. Swarming will be encouraged when the hive is small, for the queen will be restricted earlier in

her egg laying, and disorder caused by the problem of having to feed large numbers of larvae will occur sooner. The same holds true when the queen is old and lays fewer eggs. When the hive is located in the sun, many workers cannot work inside it and have to cluster outside. This also provokes swarming. All the opposite factors limit it. Thus, it is limited when there is ample space in the hive, when the queen is young, when the hive is placed in the shade, and when young bees are supplied with comb foundation (see p. 40). Swarming is also controlled by a heavy honey flow.

3) The colony during the main honey flow

During the main honey flow, scout workers inform the bees of the colony, by means of energetic dances, about the rich nectar sources they have found. Many young workers start to collect large amounts of nectar earlier (at the age of 14 days) than usual (21 days). The other hive bees are fully occupied with evaporation, ripening honey and sealing combs. Consequently, the swarming tendency disappears completely.

At that time, the bees require many empty comb cells to store the nectar they collect. The nectar contains 80% of water and only 20% of sugar. Later it will be transformed into honey, which contains 80% of sugar and only 20% of water. This is why more empty cells must be available in the hive during the main honey flow than are necessary for storing honey. Normally, about 50% of the water from nectar collected during the day is evaporated during the night. During evaporation, the bees also add enzymes which are necessary to mature the honey. The honey is stored in comb cells above the brood and in combs near the walls of the hive. When the honey is ripe and the cells are filled up, the bees seal (cap) them with wax cappings. Such combs are ready to be harvested by the beekeeper.

When the heavy honey flow ends but a lighter flow of nectar and pollen continues, a second swarming period may occur, because the numerous workers which continue to emerge are underworked.

4) The colony during the period after the honey flow

After the main honey-flow season ends, the nectar sources diminish and later stop completely. This causes the queen to lay fewer eggs; eventually she may stop completely. The old worker bees die off and the population of the colony decreases.

The scarcity of nectar and pollen induces the worker bees to dismiss all the drones, which remain only in queenless colonies, in those with laying workers or in those with an unfertilized queen. The presence of drones in colonies during the unfavourable season is a sure sign to the beekeeper that something is wrong with the queen.

Lack of nectar in flowers causes the bees to start searching for honey in other bee colonies. When the hives have fissures or when the colonies are weak, bees from other colonies will rob the honey from them and kill many workers. Therefore, the guard bees carefully protect hive entrances and attack any approaching foreign bee or any creature moving near the hive.

During this period, the bees also arrange proper placement of honey stores. The honey is located in the upper part of the hive, on both sides and to the rear. Space near the entrance is reserved for the brood, and when no brood is present, this area remains empty. Sufficient stores in the colony during the unfavourable period are essential for the survival of the colony. When the stores are exhausted, the colony will die or migrate in search of better environmental conditions. In some areas, massive migration of bee colonies can be observed. However, this phenomenon should be distinguished from swarming. Swarming

occurs in favourable development conditions: the colonies divide; one part leaves the nest, but the other part of the colony remains together with brood and stores. Migration occurs in unfavourable conditions: the whole colony leaves the nest, which contains mostly empty combs.

http://www.fao.org/docrep/t0104e/t0104e05.htm