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BEE-KEEPING



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Publisher's Note

The first three editions of this book were compiled by Sri S. M. Chitre, the then Supervisor of our Apiary of Village Industries section. The fourth edition was revised by the then Supervisor Sri Amrit Rao Ghatge, who drew on his experiments and researches especially on the Rock Bees, Little Bees and the Dammer Bees. These have been incorporated as the last three chapters of this book.

This fifth edition has been thoroughly revised by Sri S. K. Kallapur, B. A., LL. B. organizer for Bee-keeping Industry, Khadi and Gramodyoga Board, Bombay.

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INTRODUCTION

Bee-keeping is nowadays carried on on an extensive and commercial scale in the West, but should we care to trace the history of apiculture or the science of bee-keeping as it developed, we find that these strange little creatures, that lived in a society under rigorous and complicated laws and laboured extensively in darkness, first attracted the attention and notice of talented philosophers and literary men like Cato, Aristotle, Varro, Pliny, Columella and Palladius. Aristomachus is said to have studied the bees for forty years but his vast knowledge and experience are denied to us as his writings on the subject are reported to have been lost. The real history of bee-keeping, however, begins in the seventeenth century when the great Dutch Savant Swammerdam discovered some fine laws such as the sole maternity of the Queen Bee. He founded the true methods of scientific investigation. He contrived injections to prevent decay and he first dissected the bee, discovered the ovary and the oviduct and definitely determined the sex of the queen which was till then looked upon as a "King".

Then came Reaumur who made a vast number of experiments and researches in his garden at Charenton. He understood the formation of swarms and the marvellous architecture of the hive. We owe him the idea of the glass-hive.

Huber was born in Geneva and lost his eye-sight in early childhood. He had a faithful servant by name Francois Burnens. With this servant's help Huber devoted his life to the study of the bee. In the annals of human suffering and human triumph there is no lesson more praiseworthy and admirable than the story of this patiently studious and energetic person who, with his spirit, guided the eyes and hands of the other who had the real earthly vision but who with his own eyes had never seen a comb. His writings have remained a treasure-house into which subsequent writers have delved.

Dzierzon discovered the first hive with moveable combs, but one of the most outstanding improvements was effected by Langstroth who discovered the theory of bee-space. Mehring introduced artificial wax foundation for the combs so that bees might be spared the labour of moulding wax and constructing the tiny

symmetrical cells which cost them so much honey and so much labour. Major de Hruschka invented the honey-extractor by which honey could be extracted without the destruction of combs. During the present century, A. I. Root has devoted forty years to methods of bee-keeping and has given us fuller knowledge on the subject.

The history of bee-keeping in India, according to these improved methods, dates from the second decade of this century when an American missionary, Father Newton, began the rearing of a few colonies at Shembaganur (South India). He used to impart instructions in the science to students attending summer classes conducted by the Y. M. C. A. at their Rural Reconstruction centre at Martandam. Some of the students began to keep bees. From them the knowledge percolated to a few inductive and progressive bee-keepers. Gradually the industry spread in the Travancore-Cochin State. Within a few years of it, the Government of Madras began to take an interest in the matter. Coorg and Mysore followed. Attempts were also made by the Governments of U.P. and M.P. The State of Bombay came last in the field. In Coorg,

Mysore and Madras considerable progress was made in the early parts of the 4th decade of this century. The progress of the work in the State of Coorg was at the instance of Swami Sambhavananda of the Shree Ramkrishna Mission.

Excepting in the State of Bombay no organised attempts seem to have been made by the governments concerned. In the result the industry received a set-back in at least some the States. At the date of the writing of this book, the position of the industry was as follows :—

Names of the States	No. of Bee-keepers	No. of bee-colonies	Honey production in lbs.
1. Bombay	2,320	7,377	73,209
2. Madras	2,062	4,130	40,620
3. U. P.	—	1,284	1,902
4. Punjab	105	295	1,540
5. Bengal	—	—	—
6. Orissa	9	45	—
7. Bihar	18	92	—
8. Assam	—	—	—
9. Mysore	732	1,652	6,185
10. Travancore-Cochin	2,754	10,045	92,185
11. Coorg	646	1,593	5,000
12. Manipur	300	800	2,400
	8,946	27,313	2,23,041

How backward our country is can be understood on a persusal of the following figures for a few other countries collected from the reports published by the governments concerned :—


	No. of Bee-keepers	No. of Bee-colonies	Honey-yield (in pounds)
U. S. A. (1951).	8,00,000 to 10,00,000.	55,08,000	27,27,71,000
England (1944)	× × ×	5,00,000	1,10,00,000
New-Zealand (1950).	6,798	1,40,703	76,16,000

A comparative study of the figures given above will show how negligent we are in developing an industry that can easily provide avocation to a number of persons residing in the rural areas and give additional income to the village people.

At present research in bee-keeping is carried on only at two places : Coimbatore in South India and Katrain in the East Punjab. The schemes are financed by the Indian Council of Agricultural Research. On a small scale, some research work is being done at Mahabaleswar in the Bombay State. Little work worth the

name has been undertaken in the matter of the domestication of wild bees (*Apis dorsata*).

It is heartening to note that the matter is now receiving proper attention and bee-keeping has become one of the village industries taken up for intensive development under the Five Year Plan. The All India Khadi & Village Industries Board, which was formed in February 1953, has been placed in the charge of the work. The regular work in that behalf commenced from the October of 1953.



I

REGIONS SUITABLE FOR BEE-KEEPING

Few have an idea of the vast quantity of flowers that are needed to support a colony of bees. "I have 5 acres of the best garden land. Could you supply me with ten colonies of bees?" is the usual question asked. A single colony of bees may be responsible for the visitation and fertilisation of upto a quarter million blossoms in a single day. One bee working for a life time could never produce one lb. of honey. 37000 loads of nectar are estimated to go into production for so much. Even in regions where flowers abound, a pound of honey represents a combined flight of approximately 50,000 miles equivalent to two circuits round the earth. 40,00,000 flowers are said to be ordinarily required for the production of one pound of honey.

It is estimated that a colony requires about 480 lbs. of honey to maintain itself, 400 lbs. to support the bees, 70 lbs. to support the brood and 10 lbs to produce wax. Any surplus over this should become available to man.

In addition to nectar, bees have to gather from flowers very large quantities of pollen which is absolutely necessary for the rearing of the young ones. The weight of pollen required for this purpose is estimated at being between 40 and 100 lbs. per year.

Hence while a hobbyist can keep bees almost anywhere, a bee-keeper who thinks of depending on the industry for his maintenance or for supplementing his income from other sources appreciably, has got to select the best localities from the point of view of the bees.

Quality of Flowers

Nor can all kinds of flowers be relied on for the purpose of honey production. Highly coloured flowers such as those planted in gardens are not known to secrete nectar in quantities required for profitable bee-keeping ; the cultivated varieties of flowers are of little value to the bees. Certain plants, however, are particularly known for their copious secretion of nectar. It pays to establish apiaries where such plants exist in plenty, and where they yield nectar well ; for, it is not everywhere that such plants secrete it well ; suitable soil and favour-

able climatic conditions influence it. Lastly, bees need not only a large supply of flowers of this type, but a steady supply throughout the year.

Even under the most favourable circumstances, 60 hives are the maximum that can be sustained by a square mile (i. e. 640 acres) of the best of vegetations. If the natural honey resources are not sufficient to maintain the bees quartered in them in full work during the major part of the year, it is doubtful if any income can be derived excepting at prohibitive cost. It is almost impossible to keep the industry going on with the plants reared by human labour. At best they can supplement natural resources.

Bees need water too, particularly in the brood rearing season. They gather it from various sources, leaves, stems, streams, pools etc. Often they go to the dirtiest place for water ; clear flowing water helps them to avail themselves of an adequate supply. They relish such water most. This does not however present any problem.

Climatic Factor

Climate is one of the most important factors

with which the bee-keeper has to deal. Bees find it impossible to move their wings at temperatures below 45° F. At less than 50° F the wings do not lift the bodies. Hence their normal work becomes possible at a higher temperature. Expensive wintering arrangements need to be made for colder regions. Although bees are known to live at a temperature of 120° F, they show restlessness at a temperature higher than 100° F. The wax inside begins to melt, at any rate, to become plastic and sticky at high temperatures. Observations reveal that the hive temperature should not exceed 96° F. The bees do increase or lower the temperature inside the hive. They increase it by clustering and lower it by fanning their wings. Fanning calls for some exertion. The bees which would otherwise be collecting honey and nectar are called upon to stay at home and attend to the work of fanning. Further, there exists a limit by which they can increase or lower it.


Bees have a limited span of life. If the community should live and prosper, new bees should take birth as fast as the older ones die. Egg-laying and brood-rearing are possible within a range of 90° F to 96° F. A few authors

however think that egg-laying can commence even at 85° F. Ordinarily the temperature within the hive exceeds that outside by 7° to 10° as a result of the crowding inside. Hence a range of 75° to 90° F outside can bring about a temperature of 85° to 95° F within to make brood-rearing possible. Bee-keeping presents no difficulties in areas having this climatic range. In them egg-laying and normal work of the hive go on uninterruptedly throughout the year provided, of course, they have a plentiful supply of flowers affording pollen and nectar during the most part of the year. The secretion of nectar also requires a sufficiently high temperature. Usually bees do not suffer from any disease in such areas. They become disease-resistant.

Suitable Area

Many of our countrymen seem to be under an impression that honey begins to flow from a hive as soon as a colony of bees is hived and kept in their house compounds or gardens. A few even think that all that they need to do is to somehow get a queen bee and place her somewhere in their garden. The foregoing lines

would make it clear that not all areas are suitable for the industry. Various conditions have to be considered. A survey should first of all be made to get an idea of the vegetation, and its extent to judge whether a succession of blossoms throughout the year—at any rate during the greater part of the year—can be ensured. The surest test of the suitability of an area is to see if there exist natural bee colonies in it. Their presence in sufficient numbers and the extent of their honey-yield in the combs in their natural homes give a very correct idea. The absence of natural colonies might be an indication that the area is unsuitable. But an experiment might, however, be made if a survey reveals natural advantages. For this purpose about 40 colonies should be quartered in an apiary and the result watched over a period of three years. It is only thereafter that an idea whether bee-keeping could be carried on successfully can be had. Attempts at getting bees from outside to practise the industry in areas where such experiments fail should be discouraged.



II

KINDS OF BEES

In no other parts of the world are come across as many varieties of bees as in India. Broadly, they are classified into : (1) the Giant bee also known as *Apis dorsata* or the wild bee, (2) the Indian bee, *Apis indica*, (3) the flower bee, *Apis florea* and (4) the dammar bee, *Apis mellipona*.

Apis Dorsata

Apis dorsata known to the common man as the giant bee, rock bee and the wild bee is not come across in any other part of the world. It constructs its combs on the face of overhanging rocks, branches of lofty trees and on the ceilings of houses. The combs are single, and remain suspended. From side to side, they may measure upto 5 or 6 feet and upto 4 feet from top to bottom. The brood is reared in its lower portion. The thickness at this part of it is about 2". The honey is stored in the upper part of the comb, which is about 4" in thickness. These bees are rarely found above an elevation of 3000 feet from the sea level.

The importance of this class of bees arises from the fact that it is the biggest and the cheapest source of our honey and wax. These bees are 2 to 3 times as big as the Indian bees, (*Apis indica*). They can tolerate a higher temperature. Their wax has a higher melting point. They are considerably stronger than the Indian bees, *Apis indica*, and hence can fly over longer distances at a higher speed during their foraging trips. It thus becomes possible for them to cross-pollinate the flowers of our tall trees as also of the field crops in the plains. The rich wood-lands of some of our mountains owe their existence to them.

Giant bees possess many good points. No other race of bees, come across anywhere else on earth, is as strong. They are not attacked by any of the common diseases of bees. Excepting the wax-moth, the other pests, at the hands of which the ordinary bees suffer, do not attack them. They collect thrice as much nectar during each of their trips. They rise early in the day, begin work very much earlier, and continue it very much later than the other bees. Their combs give as much as 80 to 100 lbs. of honey, and the annual production of colony

can be estimated at about 250 lbs. under favourable conditions. They are very fond of living in groups. In the Eastern Division of the North Kanara District trees are known which harbour 150 to 200 colonies. Swarms issuing out during the season settle on the same trees, rocks or ceilings as the parent colonies. Hence their hunting pays well. An eminent author calls them 'Nature's apiaries in air'.

But there are some bad points about them. The first and the foremost among them is their ferociousness. They become enraged easily, and when enraged, they pursue their victims over very long distances ; they do not leave them alone even if the victims dive in water. Their stings are extremely painful; in not a few instances the consequences have been fatal. They are of a migratory character. No colony stays at a place for more than 3 months even when allowed to remain unmolested. The wax-moth finds it easy to attack the combs, and the bees desert at the slightest disturbance from it. As the combs are comparatively heavy particularly when replete with honey, and the attachment to the branches or rocks slight or just enough to sustain the weight of the combs under

normal conditions, even an ordinary storm blows them away. They cannot tolerate cold.

A few professionals, however, handle them with an astonishing degree of ease. Their flesh does not swell much when stung. This immunity is also acquired as a result of repeated stings. This circumstance together with the fact that the bees which construct their combs on the ceilings of residential buildings tolerate the presence of man and permit skilful handling of them on certain occasions began to interest the Western bee-keepers and entomologists. Many attempts were made to transport a few colonies to Europe. Dathe, a German scientist was the only person who succeeded in getting living giant bees to Germany (1883). But all his attempts at acclimatising them failed. Benton, an American bee-keeper made two attempts in 1880 and 1905 to transport a few colonies to U. S. A. The second trip was at the instance of their Department of Agriculture. But both the attempts failed. The giant bee has remained a free insect to this day.

Apis Mellifica

The *Apis mellifica* of which species the

Indian bee is a member, constructs its combs in the hollows of trunks of trees, in the hollows of walls, rocks, burrows in the ground and in similar well-protected places with a small hole just sufficient to allow egress and ingress to the bees. A few species are in the habit of pasting the resins of trees as a protection against ants and other enemies of theirs.

Unlike the giant bee and the little bee, the combs are 7 to 13 in number, all of them arranged parallelly in two rows, one row above the other. The lower row is intended by them to store honey for day to day use and pollen ; and to enable the queen to lay her eggs. The brood is reared in these lower combs. The queen resides in them. She rarely trespasses into the upper row of combs which are exclusively meant for the storing of honey during the season of plenty. Thus it becomes possible to remove them for the extraction of honey without molesting the bees working in the lower combs. The queen is thereby enabled to carry on her egg-laying work. In spite of the removal of the upper row of combs from time to time colonies have continued for genera-

tions in the same hives, whether pots or logs or any others.

The Indian bees tolerate the smell of human beings. When handled carefully in the proper season, they do not sting. Their stings are not as painful as those of the giant bee. Repeated stings give immunity from swelling and paining.

In favourable localities colonies give even in natural hives 8 to 10 lbs. of honey for a single extraction. Yields of 20 to 30 lbs. are also reported.

Repeated extractions by the removal of only the upper row of honey combs leaving untouched the lower row, has enabled the forest dwellers in this country to harvest a much higher yield.

Rearing of the Bees

In India the progressive among forest dwellers have been rearing them in pots, logs and walls from over a thousand years. They coat the interior of the pots or the logs as the case may be with wax and deposit them in out-of-the-way places a month or so ahead of the swarming season. Straying swarms enter them

in a few instances and begin to reside in them. The pots or the logs are removed within a few days to the houses of the owners and deposited on suitable stands. In certain parts of our country—particularly in parts of Mysore and Coorg States—apiaries of 50 and more of such hives with colonies are not rare. In Europe these bees were studied at closer quarters. They were provided with hives of straw and latterly of wood wherein they were enabled to live a life of the same kind they live in nature. The bees accepted them and resided in them.

These circumstances endeared them to scientists. They became the subject matter of study very early. Probably no other living creature has been the object of so much study (except of course the man) as they. The word bee-keeping is now used to denote the keeping of these species of bees in homes. The account which is given in the following pages is of this class of bees.

Among the Indian bees themselves here are numerous varieties. The most important among them seem to be : (i) the hill variety, and (ii) the plain variety.

The hill variety resides in the hilly regions.

It is slightly bigger in size ; it is blacker, more vicious and more nervous. But it is a better gatherer of honey. While the plain variety constructs its combs in a direction parallel to the entrance, a hill variety is known often to construct them in a direction at right angles to the entrance.

Apis florea

This species of bees is also peculiar to India. There are several varieties of it. They partake many of the characteristics of the giant bees but are very much smaller. They are of a migratory nature. They build single combs usually in bushes, hedges, hung down from branches of trees, eaves of huts, corners of buildings and in house chimneys. They also make their combs in stacks of cotton stalks, in empty boxes, etc. Shady places in the neighbourhood of brooks and nallas are their favourites. They shun captivity and love open life and generally make their combs at high and well-lighted places. They are usually noticed in the summer. They can tolerate climates as hot as 120° F. Their stings are very small. They

are not prone to sting ; and the stings are not painful. They are gentle.

The combs vary from 6" to 1½' in breadth and 6" to 1' from top to bottom. As in the case of the giant bees the top portion of the combs is used for the storage of honey and the brood is reared in the lowest part. The middle portion is used for the storing of pollen. As the colony and the availability of nectar increase, additions are made to the original combs by constructing cells on either side. There does not exist any uniformity either in the size or in the shape of different cells forming the honey portion. The facing or the direction of the cells too does not show any uniformity. A kind of regularity and uniformity is however noticeable in the brood-cells.

The wax is very weak. Often the comb gives way with the weight of the honey and the brood. It begins to turn dark and decays very soon. It is attacked easily by the wax moth.

The drones of this species of bees are about 3 times the size of the female or the worker bees. The drone-cells too are 3 times as big as the worker cells. The queen bee is

about twice the size of the worker. While the worker bees are smaller than the workers of the Indian bees, the queen bee is of the same size and the drones are bigger.

The hoarding instinct does not seem to have developed so much among this species of bees as with the giant and the Indian bees. The swarming takes place more often. This might be a result of the weakness of the wax.

The yield of honey is extremely small. A comb in the height of the season does not contain even half a pound. This coupled with the circumstances that the bees are of a migratory character has not interested either the scientists or the bee-keepers. But the honey is reputed to possess higher chemical properties and is more in demand in certain parts of India.

Apis Mellipona

This is the only variety of honey bees which is stingless. It is extremely small in point of size, about $1/10$ of an inch. It is mostly a tropical insect. It possesses domesticable habits and is known to remain in the same place for generations together. It does not possess wax

secreting glands and is therefore unable to construct combs. The honey and pollen are stored in spherical cells made out of an admixture of propolis and earth. The broods too are reared in such cells themselves. The eggs are laid by the queen in the store of honey and pollen and then covered up. They hatch inside the vessels, or cells, pass through the larval stage and finally emerge as bees from them when once the eggs are deposited within and the cells are sealed from without.

These bees reside in the crevices of the walls inside houses or in the hollows of trees and inside bamboos. The honey is said to possess great medicinal properties ; the bees are therefore reared in some areas in homes specially constructed for them—tubular trunks of trees or bamboos, or sometimes narrow boxes with a small hole to afford egress and ingress to the bees. They prefer darkness like the Indian bees and hence close down all the crevices, leaving only a very small opening. They line all the route by a kind of gum collected from the barks of trees. The eggs are laid and the honey and pollen are stored at some distance from the opening, a tubular zig zag route leading thereto.

This affords them protection from enemies and in addition keeps the brood extremely warm in the cold weather and extremely cool in the hot weather.

The dammar bees do not have bands which the other three types of bees possess. Their wings are proportionately larger and are attached horizontally to the main body. This enables them to carry a proportionately heavy load of nectar and pollen.

Downward work

While in the case of the other three kinds of bees the combs hang down from a support and they work downward, the dammar bees merely deposit the cells on some solid surface and the addition is made by piling the cells one over the other. The brood is laid in the centre. The honey is stored in cells about six times the size of the brood-cells on either side of them. The pollen is stored next to the honey-cells. The pollen chamber is the biggest in point of capacity. The cells too are the biggest being about 8 times the size of the brood-cells. The additions as in the case of the brood-cells are made by piling the cells one over the other. Noteworthy

is the habit of these bees of the storing of gums which are deposited away from the brood and the other chambers. This is probably because gums ooze out from the barks of trees only during a certain season.

There is practically little difference between the sizes of the drones and the workers among this species of bees. But the queen is about 3 times the size of the workers. She has very small wings.

The bees, when emerge, are white in colour and gradually darken with age. The abdomens become larger and brighter as they advance in age. The hind portion is very strong and is curved. This is probably to fit them for the purpose of the carrying of the gum, which is comparatively a very difficult task.

The work these bees are called upon to do inside the hive is both light and little. Hence most of the work of the bees lies outside the hive in the transporting of pollen, nectar, resin and water.

Stings undeveloped

The sting in the case of these bees does not seem to have developed for the reason that they

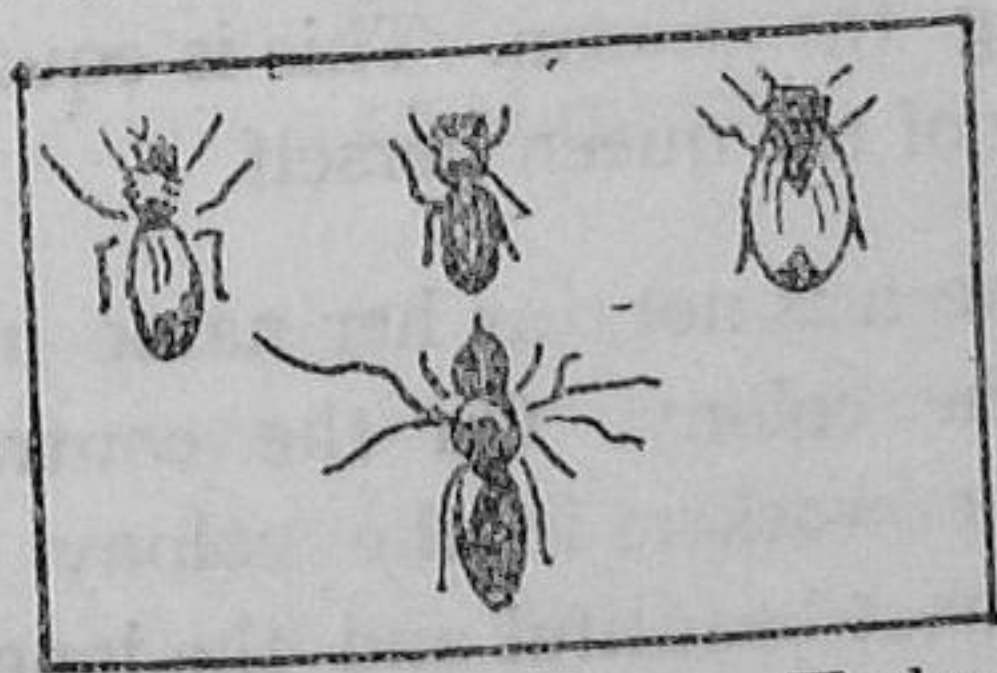
have few enemies, firstly because of the small size of the entrance to the hive, secondly because of the scanty store they collect and lay by. When molested, they crowd on the intruders eyes and nose and thus scare them away. They also make attempts to piece them with their legs. But on the whole they are harmless and can be attacked with impunity.

The honey collected by the bees is very small in quantity. A hive can provide but a few spoons. Hence like the flower bee, this species too has not interested the scientists and the honey gatherers.

III

RESIDENTS OF A COLONY

A normal colony at the height of the summer season of the activity is composed of three kinds of individuals : (1) the queen of which there is only one *normally*, who is the mother of all the other bees of the colony (excepting just after a new queen has been reared), (2) thousands of workers or sexually undeveloped



Top row-Indian Bees, (Queen, Worker, Drone)

Bottom-Rock Bee Worker

females which *normally* do not lay eggs, but do all other work and (3) many drones. There are also during the active season all stages of developing bees known collectively as the brood. *

* E. F. Phillips—Bee-keeping.

The Queen

The queen is the largest individual in the colony. Her sole duty consists in the laying of eggs. Normally only one egg is laid by her in each cell of the brood hive. The eggs are fastened to the cell base by a posterior end by means of a secretion of the queen. The number of eggs the queen lays depends on climate conditions, the available food supply and space. Under European and American conditions a queen is said to lay as many as 3000 eggs in a day during the season. This is equal to thrice the weight of the queen herself.

The queen is not, as her name implies, the ruler of the colony. On the contrary she is ruled by the workers in the colony. She possesses the most beautiful and the longest body ; her gait is queenly ; she is the only fully-developed female ; she alone possesses ovaries and can mate with a male bee. The whole life of the hive centres round her. She is the pivot of the community and without her the whole colony would perish. Upon her safety and fertility depends everything.* She is always

* E. C. Kelsey—*Spell of the Honey Bee.*

surrounded by attendants. The food that she takes is the richest ; it is gathered and prepared by the workers. She does no work whatever.

Compared to her body her wings are short. Nature seems to have willed so for the reason that she is not required to go out of the hive except on a mating flight on the 5th day, or so, of her emerging from her cell and on the occasions of swarming. For the rest, her life is spent inside the hive.

She possesses a sting, but it is not meant as a weapon against man. It is meant as weapon of offence against a rival queen.

Egg-laying

Mating takes place only once in her life when she is 5 to 8 days old. But when weather conditions do not permit it, the mating is said to be delayed by another 3 or even 5 days. If it does not take place within this time limit, she has to spend her entire life as a virgin. Some are of the opinion that mating takes place more often but before she commences laying eggs. Mating cannot occur except when she is on the wing because until the tracheae of the drone are distended with air (which is possible only when he is in full flight) his sexual organs

cannot be used.* During the act his reproductive organs are completely torn away from his body and he drops to the ground dead. But before death overtakes, he supplies her with the means of fertilising millions of eggs. This one act of copulation gives her sufficient spermatozoa to last to the end of her life. She begins to lay within 24 to 48 hours of the mating and continues to do so till she becomes incapacitated due to old age or from other causes.

The duration of her life is 3 to 4 years. But the prime of her youth is said to last for only one year commencing from her second year. Ordinarily there is only one queen in a hive. But a mother and daughter are noticed to live together after the former becomes incapacitated from laying eggs on account of old age. This is known as an act of supercession. As long as she is capable of laying, she does not tolerate the presence of another queen. Any queen cell constructed in the hive is torn upon by her if she is to continue at all in the hive.

The Drones

“Drones” has become another word for a

*E. C. Kelsey—*Spell of the Honey Bee*.

lazy being. They do none of the work in the hive. They are heavy consumers of the stores gathered by worker bees. They are not in favour with bee-keepers who restrict their birth by providing special combs to the queen or by trapping them after they emerge as adults. Nevertheless they are as necessary to the race as the queen or the workers. They are perfect males and before the queen can lay eggs, she must mate with a drone.

They are strong and burly ; in girth they are bigger than the queen. They possess very powerful eyes. They do not have pollen baskets on their legs, nor the wax glands, nor the stings. Their presence in the hive is tolerated by the bees as long as nectar flows freely. When the season of scarcity commences, they are starved to death and when they become extremely weak due to starvation they are expelled from the hive or bodily carried away and dropped at some distance from the hive.

Drones begin to fly at the age of one week, and become potent for the purpose of the sole duty for which they take birth at the end of the second week. The duration of their life is

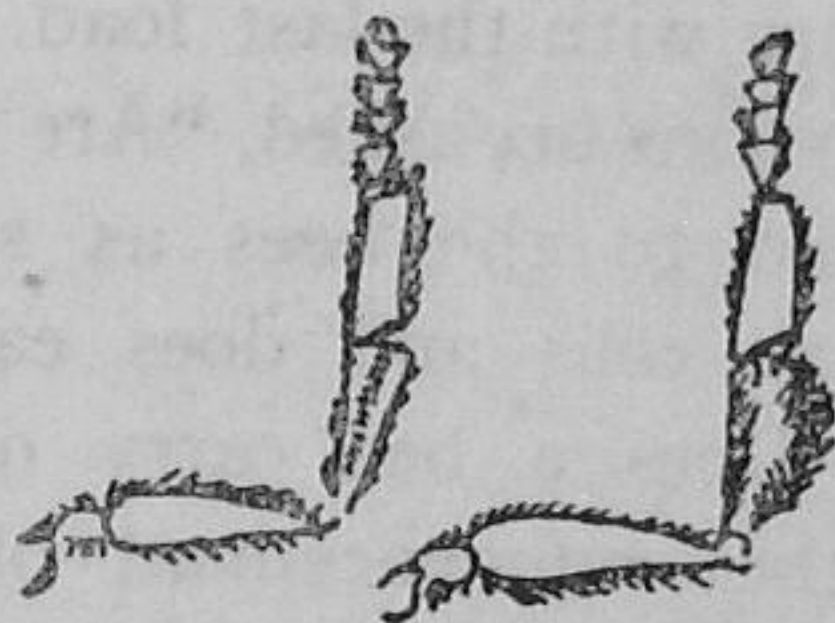
6 months, but they are rarely allowed to live to an old age or to die a natural death.

Workers

The largest number of bees in the colony are females who are also known as workers. Sexually they are undeveloped. These bees feed the growing larvae, clean, guard and ventilate the hive, build the combs out of wax, gather nectar, pollen, water and propolis and in fact do all the work of the hive except that they lay eggs only under abnormal conditions, namely when a colony becomes queenless and remains so for sometime. Under conditions such as this some of the workers begin to lay eggs in profuse quantities ; but all such eggs are unfertilised and only drones are born out of them.

They control the temperature of the hive, incubate the eggs and feed the drones and the queen. The preparation of the food is done by them. They produce the wax. They convert the nectar into honey. The legs in the case of the workers are variously modified, the third pair being modified for the carrying of pollen. The ventral plates of the last four visible segments of the abdomen are modified on the

anterior edge to form wax glands from which the wax in comb-building is secreted. The sting

*a**b*

(a) *Worker's leg*

(b) *Worker's leg showing how pollen is collected*

is straight and barbed. The tongue is longer than in the queen or drones. The honey stomach is well developed for the carrying of nectar to the hive. Workers never mate with the drones.


Span of Life

Speaking in general terms the length of the life of the worker bees is measured not so much by days or weeks as by the amount of the work they do. During the period when nectar is being gathered abundantly, they literally work themselves to death. The average length of their life is barely six weeks while in periods when less work is done the life is leng-

thened. During the active season, the larger part of the worker bees die outside the hive failing to return with the last load.

Often questions are asked, "Are the different duties assigned to the bees as soon as they emerge from the cells and does each specialise in its work? Does a bee carry on the same work from the commencement of her life till her death?" The activities of the workers vary with their age and development. The first two weeks are spent by them in the performance of hive duties. The duties of the nurse and the guard come first, then the manufacturing of wax and the construction of combs, then follow pollen and water gathering, lastly, nectar gathering. A few authors are of the opinion that the guard duties are assigned to old bees which are no more able to forage.

In the height of the season they are worn out in 6 or 8 weeks. It is difficult to list the duties which the worker bees perform in a few words. An account of their work by F. S. Stuart, which reads more like a poem than one of a scientist and which would interest the layman reader, is set out in an appendix.



IV

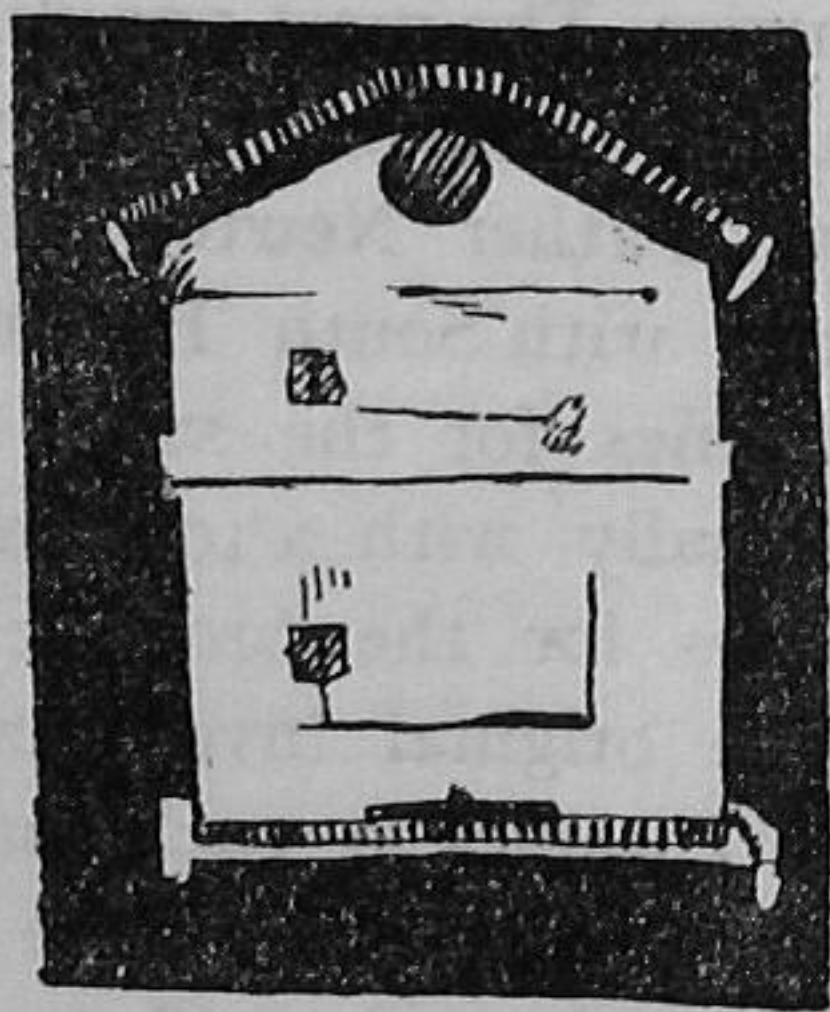
APIARY EQUIPMENTS

The most important among the apiary equipments is the hive. Numerous types of hives costing anywhere between Rs. 40/- and Rs. 80/- are advertised by the manufacturers in foreign countries. The most popular hive among the Indian bee-keepers is the one devised by the Rev. Father Newton after a series of experiments with South Indian bees. The size of the frames for the super chambers is $8\frac{1}{4}'' \times 2\frac{1}{2}''$ internally with a top bar-breadth of $\frac{7}{8}''$. The frames for the brood chambers are $8\frac{1}{4}'' \times 5\frac{3}{4}''$. The original hive was devised to accommodate 7 frames in each chamber. But in many areas, the chambers have been broadened to accommodate 8 to 13 frames keeping their original dimensions. These hives are known throughout India as Newton hives. In certain areas attempts are being made to introduce Langstroth hives.

Better Hives Needed

No standardisation of hives has been

attempted thus far in India. In some areas the hives are made from extremely cheap materials without any regard to their strength. Even deal wood is used; no heed is paid to the jointing of the planks; very often they are fixed with nails. In some areas the planks are only $\frac{1}{2}$ " in thickness; in some $\frac{3}{4}$ " and in others 1". In some areas, particularly where the



Bee Hive

rainfall is heavy, roofs are made to slope; in others the roofs are flat. In some areas the bottom-boards project 2" to 6" in front of the hive for enabling the bees to alight. In others the bottom-board does not project at all, but a separate alighting board is provided. In

areas where the industry has made some headway e. g. in South India and particularly in the Travancore-Cochin State, hives are made with very cheap material in the most haphazard way. They do not afford any shelter to the bees from wind, rains and enemies. Yet the bees stick on in them on account of the suitable climate, pasturage and other natural conditions. The hives are usually manufactured by the bee-keepers themselves at a cost of Rs. 4/- to Rs. 8/-. The unsuitability of the equipment is reflected in the very low yield from the colonies—about 7 lbs. a year. There does not seem to be any doubt that the bee-keepers would earn a higher income by the use of better hives.

In some areas, where the strength of the colonies is comparatively big e. g. in Coorg, attempts are being made to introduce Langstroth hives on the ground that on account of the smallness of the size of the frames in the Newton hives, their inspection takes a long time.

Duty of the Scientists

The last word about hives cannot be said

at present. The industry is still in the commencing stages. Hardly any scientist has given any thought to the subject thus far. The hive should have some relation to the needs of the bees. It should also be a convenient tool for the bee-keeper. As such, the purchasing power of the average Indian should be taken into consideration while devising it. Cheapness and simplicity combined with strength and efficiency should be taken into account too. The country is a vast one. Bees differ in some way from region to region. Different dimensions might be required for the hives in different regions.

Protection from Enemies

The hive requires a stool or a pedestal for being kept clear of the herbage which grow on the land, and also as a protection from ants and other enemies. The legs of the pedestal or the stool, as the case may be, require to be kept in water cups or otherwise surrounded by water. The height of 2' to 2½' from the ground for the supports to enable the bee-keeper to stand by while manipulating is preferred by a majority of the bee-keepers. A few supports are shorter. The simplest of the supports

consist of ordinary pegs driven into the earth with a small plank to support hives. At the base on the ground is an improvised basin to hold water. They cost about 8 annas each, and give very efficient service.

Queen excluders made from wires or perforated zinc sheets are the next necessity. They are available in sufficient quantities at a very small cost.

Comb Foundation

Comb foundation is another important item in the equipment. It is not possible nor is it necessary for every bee-keeper to own a mill for the manufacture of foundation sheets. There are at the present day 5 comb foundation mills in India. They would be able to supply all the sheets necessary for the purpose of our bee-keepers for sometime to come. A mill costs about Rs. 4000/-. Sufficient sheets for about 10,000 hives can be manufactured in the course of the year by each mill. Our bee-keepers are not in the habit of supplying full foundation sheets to the brood-frames at any rate. Only starters $\frac{1}{2}$ " in breadth are provided. $\frac{1}{2}$ lb. of sheets costing about Rs. 2/8 suffice for

a normal colony for a year. The sheets are made out of pure wax, some are in 3 plies and some in 5 plies.

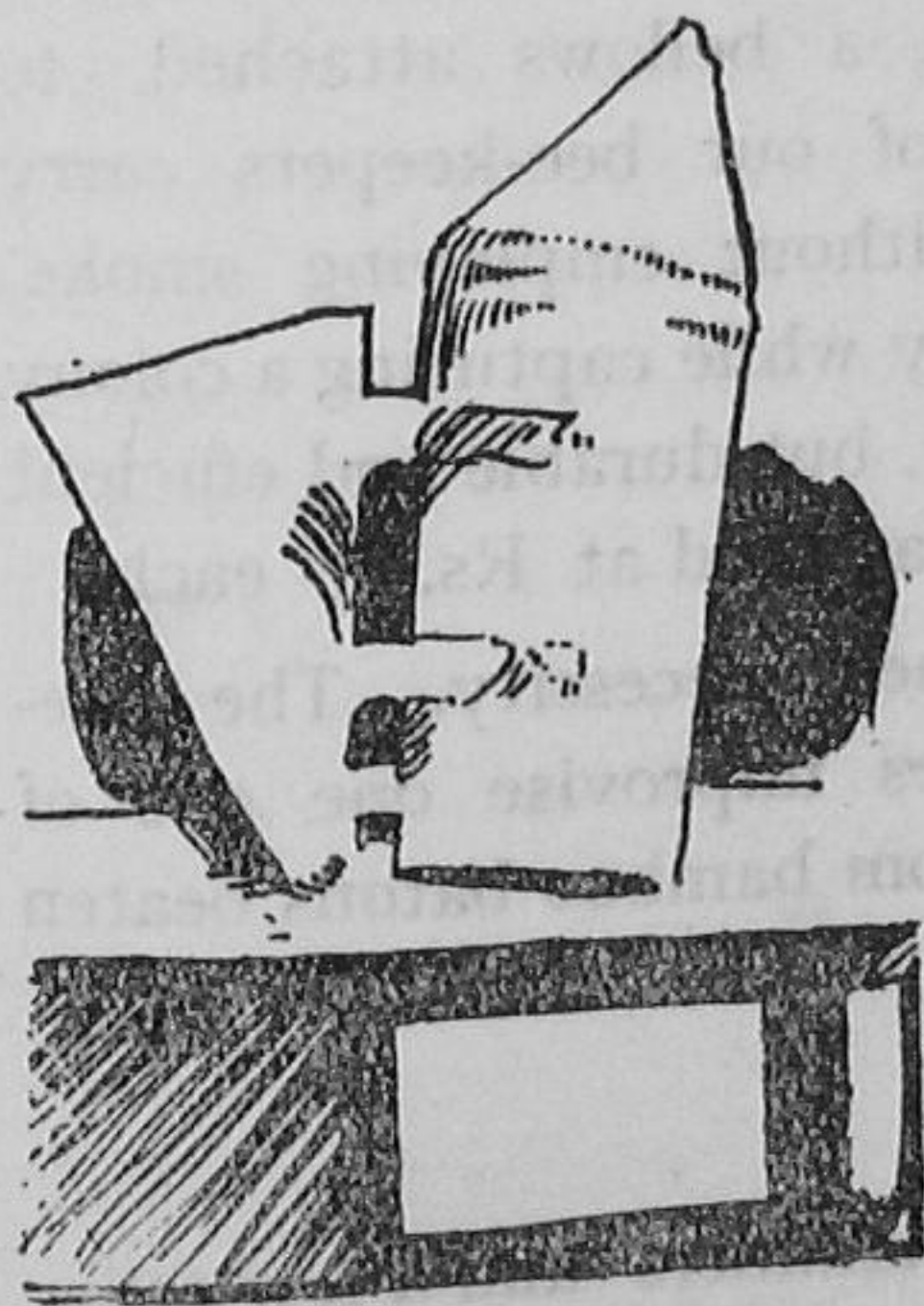
The sheets are required to be fitted to the frames. A wax embedder costing about Rs. 2/- is necessary for the purpose. A reinforcement of wire lengthwise and breadthwise to prevent the sagging of the sheet or its breaking away during the extraction of honey is also necessary.

A feeder is the next necessity. Three types of feeders are advertised: (1) lever lid tins with holes punched in the covers, (2) dummy feeders with floats and (3) top feeders. Ordinary cigarette tins or glass tumblers serve the purpose well enough. With a good covering of the correct thickness these tins and tumblers have given very good work. They cost very little. The beginner at any rate need not spend any money over costly feeders.

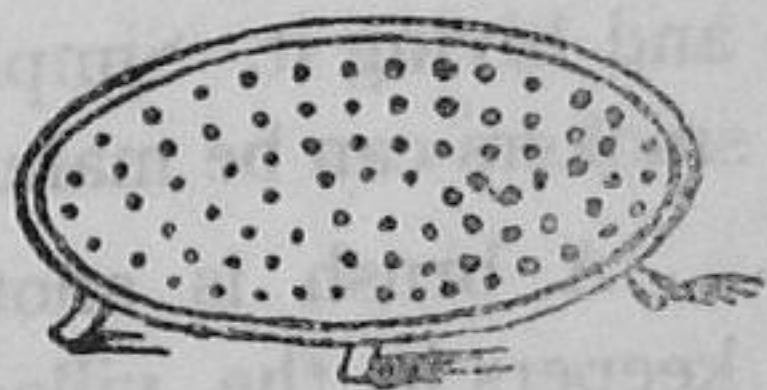
Veils & Smokers

Veils, smokers and gloves are the other equipment which the bee-keeper needs to carry with him while working among his bees. A black net suspended over a panama hat with elastic bands around their bottoms to allow

themselves to be fastened round the waist of the operator are popular. Indian bee-keepers do not generally use veils. Nor do they use gloves. But the beginner should not take risks. The bees usually strike the tender parts of the eyes and lips. Veils give ample pro-



Smoker



Inner stand of the smoker

tection to them. When provided with one, the beginner ventures near the bees with greater confidence and manipulates efficiently. The fundamental idea behind all manipulation is to frighten the bees. When they are scared, they gorge themselves with honey and then

when their bodies are full they cannot easily bend them, to sting. Smoke terrifies them without causing any further injury. But too much of it stupefies the bees. A tolerably good smoker can be made out of a tin or copper receptacle in which to burn rotten wood or other materials with a bellows attached, to force a draft. Most of our bee-keepers carry on manipulations without employing smoke. They use smokers only while capturing a colony and hiving it. Simple, but durable and efficient smokers can be manufactured at Rs. 5/- each.

A brush is another necessity. The bee-keepers in the villages improvise one out of waste coir fibres or from bamboo batons beaten at one end.

Minor Tools

Hatchets, chisels, hammers and a few other simple carpentry tools finish the equipment in a village apiary in our country. Special bee dresses are recommended by some authors. They are in use only in some Governmental apiaries in our country. But the bee-keeper does not use any. He approaches his bees in the same manner in which he approaches his children or

his cows. Does this imply that Indian bees are more tame than foreign bees ?

An apiary of 12 bee colonies which an average agriculturist can keep as a subsidiary industry while looking to his principal occupation of agriculture requires an investment of Rs. 400/- at the most in South India. It lasts for about 10 years at any rate. Renewals cost about Rs. 20/- per year. Out of so much an intelligent and industrious bee-keeper earns a net income of Rs. 250/-.

V

STARTING WITH THE BEES.

Bee-keeping means :

1. The provision of a home to the bees sheltered from winds, sun, rain, cold and enemies.
2. The selection of a suitable locality for keeping them.
3. The planting of fruit, vegetable and flower trees, plants, creepers, shrubs etc. blossoming by turn in seasons of scarcity to supplement what nature provides to the bees.
4. The extraction of only surplus honey during the peak season, leaving sufficient food for them to pull through during the period of scarcity.
5. The knowledge of the science of bee-keeping.
6. The caring for the bees in the same way in which man cares for his wife and children and other dear ones.

How to succeed

Success in bee-keeping depends on :

1. The health and the vigour of the bees.
2. Honey and pollen resources in any locality throughout the year.
3. Skill in the management of bees ; the industry of the bee-keeper and the understanding of bees by him.

Skill does not come by reading books alone. It comes by experience. A period of apprenticeship under a successful bee-keeper is necessary for the aquisition of it, in addition to the reading and the understanding of the books on the subject. Bee-keeping is not meant for persons who do not have the mind or the patience for this.

Start in the industry should be made after reading and understanding some simple books on the life and history of bees, and thereafter by acquiring a colony of bees. This can be done by :

1. Purchasing a colony from a nursery or from someone.
2. Hiving a swarm.

3. Spotting and hiving of a colony from its natural home in the tree trunks etc.

4. By the principle of increase.

Owning a Colony

1. The simplest and the surest method of owning a colony is to purchase or otherwise get it from a nursery or from someone who is in a position to part with one. Unfortunately there are no nurseries in India at present. Attempts are being made to start five such nurseries by the All India Khadi & Village Industries Board. But this is a small number compared with the expanse and the needs of the country. In the localities where the industry is going on a few of the bee-keepers are in the habit of selling colonies. But it does not become possible to satisfy the requirements of the population even in those areas. A scheme for the registration of private nurseries and to subsidise them as a means of supplying the needs of persons desirous of taking to the industry is before the Board.

2. On a few occasions a person desirous of keeping bees chances to see a swarm perched on a tree. The hiving of a straying or perching swarm is an extremely simple affair. The bees

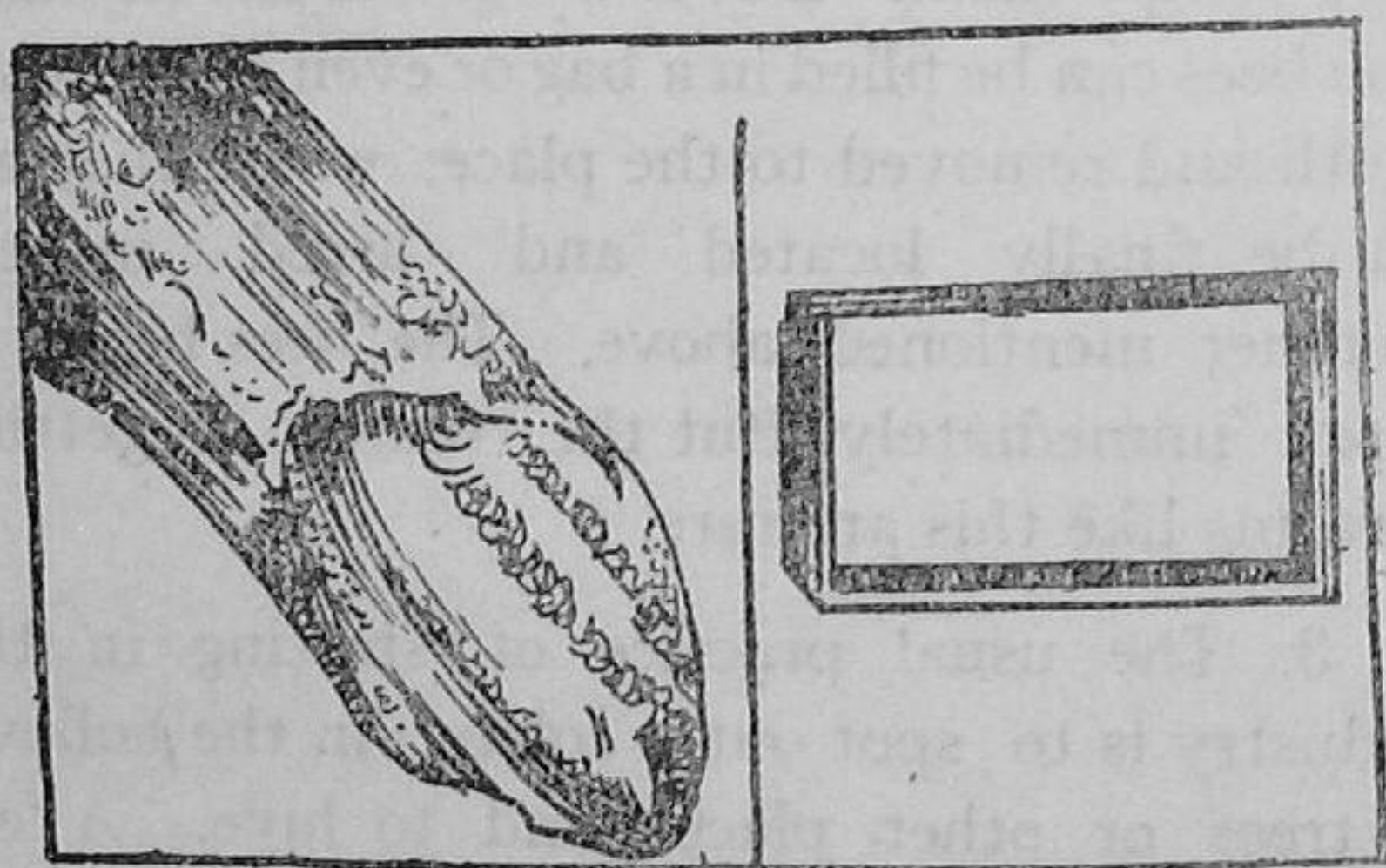
are extremely docile then since they are usually full. They are in search for a home. In many instances, the hive in which it is to be finally quartered can be taken to the site and the bees made to enter it. A frame with a young brood easily tempts them. In the same way frames with properly fixed comb foundation sheets also tempt them. But if a hive is not at hand, the bees can be filled in a bag or even an ordinary cloth and removed to the place, where they are to be finally located and hived in the manner mentioned above. The bees begin to work immediately. But the chances of getting swarms like this are rare.

3. The usual practice of starting in the industry is to spot out a colony in the hollows of trees or other places and to hive. A few spot out the homes of bees by following their track from the flowers which they visit for the sake of nectar and pollen. A few make out the presence of the natural home by the peculiar noise which the bees make while entering and going out from the entrance of the hive.

How to Effect Transfers

A person desirous of transferring the bees

into a modern hive from the natural home has to equip himself with a modern hive, a chisel, hammer, hatchet, a smoker, a spare box, ropes etc., if the natural hive happens to be at some height from the ground. As stated elsewhere, the entrance to the home inside the hollow is through a hole. It has got to be widened so



1. *Natural combs in
the hollow of a tree*

2. *Comb built in
a wooden frame*

as to allow the hand to be thrust in for the purpose of taking out the combs and bees. Experts straightaway thrust their hands inside and remove the combs after the entrance is enlarged. The combs are then deposited into a small wooden box. When all the combs are

removed and deposited, the bees are also taken out in handfuls and put inside the box ; it is then lowered to ground. The combs are tied to frames of the brood chamber by means of banana string or strings made of some other fibres that can be gnawed easily by the bees. The bees are then made to enter the hive whereupon it is taken to the apiary and quartered on a hive stand.

Two persons are usually required for this operation. But the removal of the combs from the natural hive has got to be made by the person sitting on the tree. Often the heights are inaccessible. Very often the bees sting when he is perched on the height. On occasions he gets a branch to sit upon. Often he does not get such quarters and has to improvise one. Often he has to make use of the smoker and send out whiffs of smoke inside to stupefy and subdue the bees. Often if the tree happens to have a big hollow, the bees mount up into it and do not come anywhere near the entrance for the person to catch them. If the trunk of the tree is hollow bellow the entrance, the combs may fall down during the operation. The queen bee may be lost or injured.

The bees might after escaping from the entrance perch on inaccessible heights on other trees outside. Often, even after all the bees or a major part of them are hived, they do not begin to work at all.

It is impossible to lay down the 'dos and donts' for this operation. It is an expert's job. Experience alone should teach what to do when.

Other Methods

The case of transferring from walls of houses and rocks presents even greater difficulty. The walls cannot be broken open. But in some parts of the country the transference is not made directly. One month or so ahead of the swarming season, earthen pots or hollowed logs of wood are tied in the forests abounding with bees. The inside of the pots or the trunks are coated with bee's wax to tempt the swarms into them and to afford them a start to commence construction of combs. In some instances swarms enter them and begin to work normally. They are left undisturbed for some time. After a month or so, the pots or the logs are taken to the site of the apiary and deposited on a stand in the exact place where

the bee-keeper intends to quarter the bees after transferring them into a modern hive. The crude hive is allowed to remain there for a few days. During one evening when all the bees return home after foraging, and after it becomes dark enough for the bees to see, the combs are taken out one by one and tied to the frames of a modern hive with plantain strings etc. No smoke needs to be employed for the purpose. The operation is done sitting on firm ground. No bee is injured during it. While hardly one colony can be transferred from the natural homes in the trees in the course of a day any number can be transferred from pots and logs in the course of a day. The bees stick on to the new home and begin to work from the very next day.

Patience Necessary

When the colonies are transferred directly from tree trunks, the colony should be fed on artificial feed for a few days till the bees become accustomed to the new site and commence working normally. The bringing out of the bits of plantain fibres and pollen from

outside is an indication that they have a mind to stick on. Sometimes this does not happen for a week. The bee-keeper should have patience. Often the bees desert the new home repeatedly, and the bee-keeper has to follow their course and hive them repeatedly. Often they are lost. The bee-keeper should be prepared for all kinds of disappointments.

A few foreign authors suggest the placing of an empty hive next to the entrance with or without drawn combs and the fixing of a cone or a plate to the hole so as to allow the bees egress from it but to prevent ingress. The bees are then said to enter the modern hive set by the side of the entrance and to commence working. This method does not seem to have been tried anywhere in India.

Increase by dividing

4. More would be stated on this subject in the chapters on Swarming and Uniting, Dividing, Dequeening and Requeening. The building up of an apiary by this process is possible only in areas where the bee-keeping industry is going on on some scale already.

While preventing the damage to honey

production by the tendency of the bees to divide, often there becomes available a brood comb. It can be used for increase. Combs with a few bees adhering to them can be removed from the main colony and made into nuclei to be allowed to build up with the help of other combs becoming available similarly from other colonies. This method of building up colonies should be attempted in the right season so that the colony grows up to a full stature to take advantage of the main honey flow.

VI

MANIPULATION OF BEES

The work which a bee-keeper does in his apiary with the object of getting from his bees as high a yield as possible is called 'manipulation'. Instinctively bees collect nectar, manufacture it into honey and store it into cells. Instinctively they manufacture wax and construct combs out of it. Man need not help them in this. In areas well suited for the industry with very little care a bee-keeper is able to get some honey from his bees. But by 'manipulation' an intelligent bee-keeper is able to get from his bees more honey than one who is indifferent towards them. He is able to get a tolerably good yield in lean years while an indifferent bee-keeper harvests little or nothing. He is able to save his bees from total destruction when diseases and pests attack them while his counterpart loses them.

Two Essentials

There are two essentials which ought to

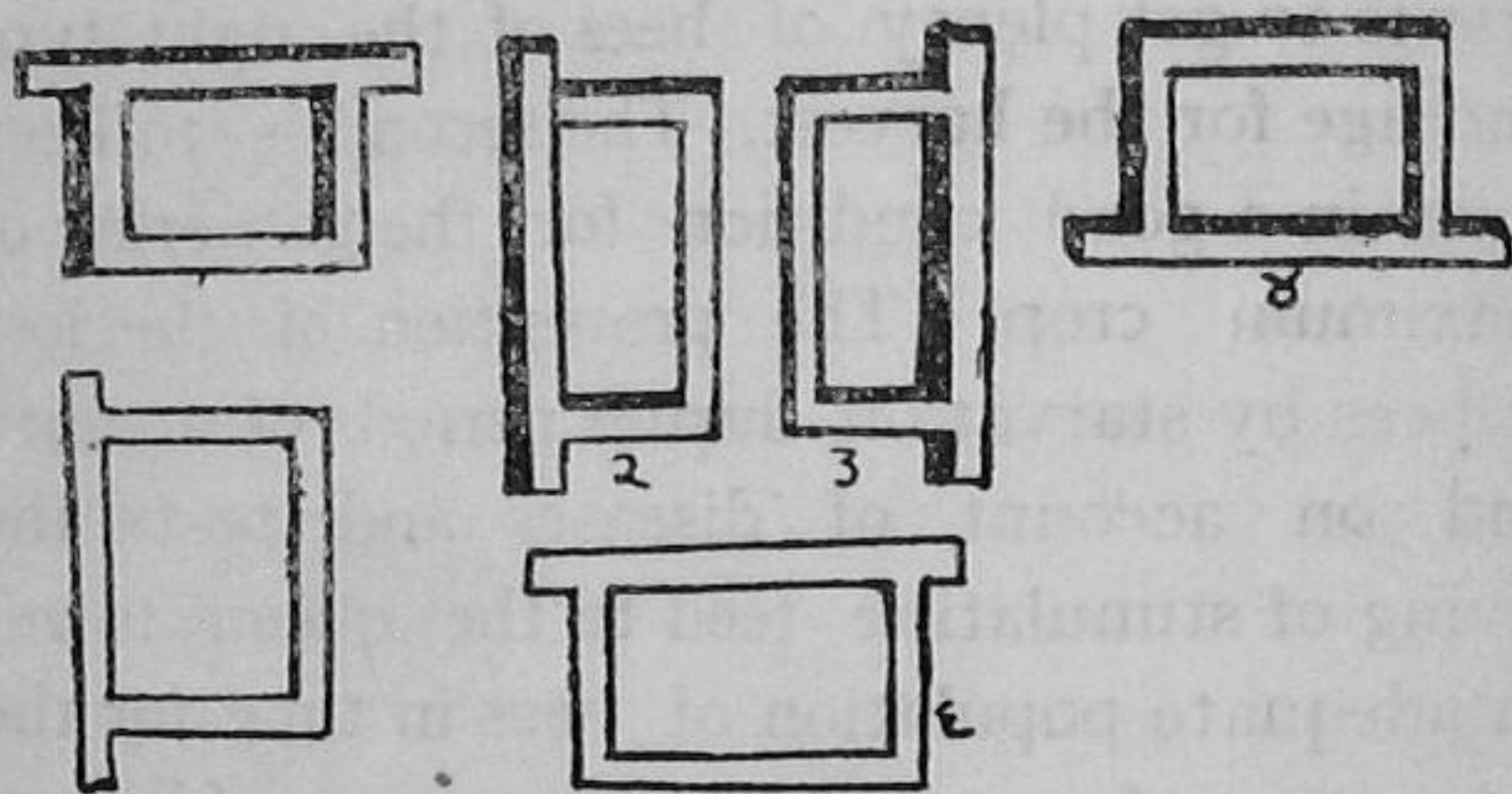
engage the attention of an intelligent bee-keeper desirous of prospering in the business : The first is to get plenty of bees of the right type and age for the harvest. The second is to keep them in a good condition for the gathering of maximum crop. The prevention of the loss of bees by starvation during periods of scarcity and on account of diseases and pests, the giving of stimulating feed to the queen to get an adequate population of bees in time for the harvesting of nectar during the season of honey-flow are among the duties of the bee-keeper in connection with the first essential. The prevention of swarming forms part of his duties so far as the second essential is concerned.

At the end of this book are set out in a separate chapter rules for the guidance of the bee-keeper under the title 'Dos and Donts'. A few of them would be discussed in this chapter since the knowledge of the theory connected with them is felt necessary.

Unnecessary Disturbance Bad

The amateur is given to handling bees more often than is necessary. This disturbs the work

of the bees. Each time the roof of the hive is lifted, and the frames are taken out, ventilation



Different positions of a frame while handling

is altered. Exposing of the frames to sunlight hinders the work of the bees. Places sealed by them with a purpose are broken open. Parts constructed by them are smashed. All this disruption means several days' work to them. Honey which was intended to be stored is consumed by them. Fresh honey does not come in the course of the day. Hence the first rule is that the bees should not be disturbed unnecessarily. The homing of bees laden with pollen, nectar and water and brisk work on the threshold of the hive are good signs. The bee-keeper needs to do nothing in relation to the hive when he sees them.

Bees clustering on the outside idly, the darkening of the colour of the bees and the loitering of drones in large numbers are signs of queenlessness in the hive. The hive would need to be opened in such a case for further inspection. The absence of newly laid eggs and larvae are further indications that the hive is queenless. Hence a detailed search for the queen needs to be made. The presence of workers eggs confirms that the colony is queenless. If the hive is found to be queenless, it calls for requeening. The absence of eggs and larvae might also be due to the circumstance that the combs have become dark and brittle in which case fresh and new comb foundation needs to be provided after the removal of the old ones. The presence of queen cells in the midst of the combs, known as supercedure cells indicate that the queen has become incapacitated for the laying of eggs either from old age or from some other cause. The bee-keeper might either wait for the emergence of the new queen and her mating, or requeen the hive with a new laying queen. The presence of queen-cells at the bottom of the brood-combs indicate that the bees are intent on swarming. The precautions mentioned

in the chapter on 'Swarming' might then be taken.

Some Precautions to be Taken

If comb building is not progressing satisfactorily the indications are that the hive is lacking sufficient strength of young bees. It might also indicate the absence of food or its shortage. If the bee-keeper notices absence of food provisions in the hive, artificial feeding should be given. If he notices absence of sufficient space for the laying of eggs or for the residence of the bees, additional supers, ventilation, brood chambers etc. might have to be provided. If bee strength is diminishing, requeening or the providing of stimulating feed to the queen might be necessary. If the honey is ripe for extraction, either it should be extracted or fresh and additional supers should be provided.

Bees sting; and the stings are painful and cause swelling to the skin. Hence a large number of our bee-keepers fear to approach the hive or to handle the bees. They depend on experts to attend to the manipulation. In a large number of cases proper attention

is not paid by them to their bees. This results in a low yield of honey. The average yield per hive is about 7 lbs. in this country. It ranges between 20 and 30 lbs. in different parts of the United Kingdom. In America the average exceeds 40 lbs. Australia records the highest yields from individual colonies of bees. The record yield is said to be 830 lbs. from a single hive, while several apiaries record yields of over 600 lbs. from some of their individual hives.

Advice to the Beginner

Bees need not be feared much. When handled properly at the proper time, they do not sting. They have every reason not to sting, for it is fatal to them to sting. Undisturbed they are invariably nonviolent. A sting or two does not cause much pain and is not harmful to the human system. Most people can take a sting without feeling much inconvenience. Bee-stings have been valued for the relief and even cure of rheumatism. Repeated injections of bee-venom into the flesh give it a kind of immunity and as the bee-keeper progresses in the industry they

neither cause pain nor swelling. Stings can be avoided even by the beginner when provided with hand-gloves, veils and smokers. Authorities on the subject warn the beginners not to approach their bees without these provisions. Smoke employed in the right quantities causes bees little harm except for temporary stupefaction. It subdues them. The veil protects the eyes and the other parts of the face which are the main targets of the bees. The hand-gloves protect the fingers and the other tender parts of the hand. Few make use of gloves as they cause great inconvenience while operating. It is remarkable that none of this equipment is employed by the bee-keepers of our country. They work among the bees without them. There is however no denying the fact that they afford protection and the beginner ought not to venture among his bees without them.

When Do Bees Sting

Bees are known to sting only under the following circumstances : Handling of them in cold, damp and windy weather because it impedes them in their work of nectar gathering. The

smell of their own venom, as it is emitted when the bees are crushed or injured, and of human perspiration and human breath when directed at them exasperate them. Sudden movements, jars and jerks as when a hive is opened violently, obstruction of their flight as when the manipulator stands in front of the hives or approaches them from the front, or much disturbance upset their temper. The hive should be opened in the middle of a warm day, if it is necessary at all, with great gentleness when most of the worker bees are away foraging. Nurse bees do not as a rule sting. Bees are also known to sting when food becomes scarcer or when sudden climatic changes occur.

Easy Cure

And if a sting results it should be removed by pressing along the skin with the thumb nail or a knife blade, i.e. by scraping it off. Any attempt to pluck it out or to squeeze it would drive more poison into the skin. The scent of the poison should be masked as soon as possible by the rubbing of some leaf, preferably a leaf having some smell of its own or by emitting some smoke from the smoker if one be at hand.

Any disinfectant, tincture, or iodine or some such substance would also work; otherwise other bees attack the manipulator. It is difficult to list his duties or to prepare the time-table for his programme of work. Each colony of bees has its own peculiarities and individualities. The best teacher of the science of bee-keeping is experience, which is to be gained by observing the bees at work in the apiary. There are however certain rules which guide the conduct of bees and the variations are within these rules.

ARTIFICIAL FEEDING

Bees require to be fed artificially on the following occasions :

- i. When the hive does not have any provisions.
- ii. When the season of scarcity is approaching.
- iii. When the season of plenty is approaching and the bee-keeper thinks of having a full force of worker bees to take advantage of the nectar to come in.

Bees collect surplus honey during the season for the bad days that are to follow. A season

of plenty is nearly always followed by the season of scarcity. But man in his greed deprives them of the stores laid by them. It therefore becomes his duty to see that they are not starved. This is his self interest too. For, if the bees desert, he would be losing a colony and the prospect of the income next year.

Bees desert the hive when they do not have adequate provisions for their daily needs. They also desert when they find that the season of scarcity is approaching and do not possess sufficient provisions to pull through. A bee-keeper who desires to retain the colony should therefore give it sufficient provisions. There is no feed for the bees that can equal honey. Combs with honey is therefore fed to them by intelligent bee-keepers. But honey costs more than sugar which is the next substitute for honey. A syrup made out of two parts of water and one of granulated sugar by volume by gently heating the mixture has been regarded as the best substitute. Usually a small quantity of tartaric acid is added to the mixture. The syrup is put in feeders and placed inside the hive in the super.

Feeding the Queen

Feeding is also given to the queen bee to stimulate egg-laying. The intelligent bee-keeper who anticipates an impending honey flow thinks of having a full force of worker bees to take advantage of it. For this purpose, he feeds the queen bee and urges her into laying more and more eggs, ahead of the season.

A few give profuse artificial feeding for the production of comb honey in seasons of scarcity, under the belief that what the bees deposit in the cells as a result of the feed is honey. What the bees store as a result of artificial feeding is not honey at all. It does not possess any of the properties of the product which they manufacture out of the netar of flowers. The best course for the bee-keeper is to allow sufficient honey to remain in the hive for the bees to pull through during the periods of scarcity.

VII

SWARMING AND ITS PREVENTION

The term swarming is applied to the act of a family of bees leaving their home to establish a new one elsewhere. A varying proportion of the adult bees together with the old queen fly from the hive leaving behind some adult worker bees and several unemerged young queens including queen cells and stores to last for some time. Before leaving, the bees provide themselves with sufficient food for a few days.

Many theories have been advanced to explain why bees swarm. The most logical assumption is that swarming takes place due to the urge of a natural impulse developed in the bees through the thousands of years of unbroken existence and ingrained in them at birth. The continuation of the race depends on this act of the bees. But for it, the specie would become extinct. It is an impulse of propagation or colonisation called into action when conditions favourable to its outcome present themselves.

To repress such an impulse completely is hardly possible and not altogether desirable.

Swarming Planned Beforehand

The bees do not swarm without making preparations. The impulse is felt relatively early in the season to enable both the original (known as the parent colony) and the swarming colony to gather sufficient provisions for the rainy days. Drones are raised well in time to become sufficiently virile for mating the virgin queens to emerge from their cells at the appointed hour. Sufficient provisions are also in the hive, while swarming, to enable the parent colony to carry through till its work gets into full swing.

It has been found that the natural impulse to swarm manifests itself only under certain circumstances. The following are a few of them :—

1. Lack of sufficient room in the brood-chambers to lay worker-eggs.
2. Lack of ventilation in the hive.
3. Overheating of the hive due to the lack of shade.

4. Queens which are poor layers of eggs : resulting in the super flow of larval food.

5. Dislocation of the brood-chamber by inadvisable manipulation.

6. Weather conditions resulting in a light or heavy flow of nectar.

Honey Production Affected

Success in honey production depends upon (1) getting a sufficient strength of bees in time for the harvest and (2) keeping them in proper condition for the harvesting of honey. Swarming takes away a very large proportion of the working population of bees in the season of honey collection itself. Particularly when it is a too frequent occurrence, as when after-swarms issue or when the colonies are too feeble, all calculations at getting a remunerative income from the industry are upset. Hence controlling of swarming has begun to occupy a very prominent place in the science of bee-keeping. On a bee farm the greater part of the work in the season of honey-flow consists of operations connected with swarm control. The bee-keeper is called upon to anticipate the bees' actions and by taking proper precautions to minimise the losses due to swarming.

(7) Colonies which are weak often store nectar in the brood-chamber itself. This restricts the space for the laying of the eggs and results in the swarming of the colony. The employing of the Demaree Plan controls the swarming.

(8) The provision of additional supers as the workers go on needing them.

(9) The removal of one or two brood combs from time to time and putting in their place new foundation combs in order to give more room, and at the same time more work, to the queen. This plan works best in apiaries having some weak colonies. The brood from the strong colony when provided to weak colonies strengthens the latter ; and the bee-keeper profits from both the giver and the taker.

(10) The removal or the casing of the queen to prevent swarming. This plan which was once very popular has gone out of use now. It was found from experience that bees do not work properly when they do not find any queen in the hive.

(11) Destruction of the queen cells. This

practice does pay sometimes. But it calls for heavy work from the bee-keeper who should examine the hive fully for finding out and destroying the cells at least once in 5 days. And if by some mischance a queen cell escapes his notice, as it happens very often, the colony becomes lost. Further, colonies bent on swarming are known to do so in some cases even before cells are sealed.

Remedies Suggested

The following remedies are suggested by some other authors :

- (1) The requeening of the hive by new queens of the current year ; preferably of a colony of known non-swarming heredity.
- (2) The clipping of the wings of the queen in advance of the season. This prevents the queen from flying with the swarm. Even if she escapes from the hive, she falls down at some distance from it. When the swarm finds no queen in its midst, it returns to the hive. The bee-keeper can find the queen by a careful search within a few yards of the hive. Even if

she is lost the colony is saved by this practice. It gets a new queen when one of the virgins emerges from the cells and mates successfully.

In spite of the best preparations to prevent swarming, the bee-keeper is caught unawares many a times. As stated at the commencement of this chapter, swarming is a natural impulse of the bees. By swarming the bee-colony satisfies an instinct of life and is invigorated. Theoretically speaking, the harvest of honey which depends for its quantity on the number of the working population of bees ought to suffer when a part of the workers is removed from the combined strength of the colony. But in actual practice it has been found in many cases, that the swarming colony fares very well in its new home. Bee-keepers who have been able to capture and hive it successfully have earned a very good income within the course of the year, a much better income than what they would have probably earned by artificially controlling the bees. So too have bee-keepers, who by adopting one or the other of the following methods saved for themselves both the parent and the swarming colonies.

Artificial Swarming

The process has been described by R. O. B. Manley in the following words : 'A well ventilated empty hive, or better still a travelling box, is set down by the colony to be treated. A cover of the receptacle is held by one person while another does the shaking. First of all the queen must be found and the comb she is on held down in travelling box or hive and shaken while the cover is moved aside. Having thus made sure of the queen the bees are rapidly shaken from several combs until we have what is judged to be a moderately large swarm. The swarm is then removed to the place where it is to be quartered. No artificially made swarm can be released within bee-light of its original home. When taking away the swarm, it is important that one comb with a queen cell on it shall not be shaken. All other cells are carefully removed and the hive closed up and left until the next visit when the virgin may be expected to have emerged from the cell left. At the second visit all the queen cells are destroyed after ascertaining that a virgin has in fact emerged from the cell left.'

The virgins in this case usually mate satisfactorily and do not often get off with the mating swarms.

Division of the Colonies

The second plan, which in principle is the same, is to divide the colonies into two parts. This is widely practised in the North Kanara District with great success. The queen bee with a few brood combs and a sufficient strength of worker bees is separated from the parent colony and removed to a place beyond the range of bee-flight during one evening and quartered there. It commences work in the new environment vigorously from the next day onwards, being completely rid of the swarming fever. As stated earlier, such colonies have yielded well. The parent colony with its virgin queen inside the cell starts working too. The queen emerges in course of time, mates, and commences laying. Any extra cells are cut away and destroyed. Such colonies too are known to prosper well. The first i. e. the divided colony is brought back to the apiary after some time.

The success of the parent colony depends on

how soon the virgin queen attached to it begins to lay. A few bee-keepers therefore supply it with a virgin or mated queen as soon as the division is effected in order to avoid the delay consequent on the emergence of its own queen from the cell and the mating. The practice of supplying mated queens is not popular as it often results in the issue of a new swarm. Even the providing of outside virgins often creates disturbance in the parent colony. Many of the bee-keepers think that it is safer to allow nature to have its own way and leave the bees with the unemerged queens to manage as they desire.

The success in getting a good yield of honey by the dividing process depends on the strength of the combined colony and the egg-laying capacity of the queen. The dividing of weak colonies is discouraged by all.

Swarming and Harvest Season

In a vast country like ours with the climate, rainfall, soil and vegetation varying from region to region, it is natural that the seasons of honey-flow and swarming should be different. In most of the regions, the season of swarming

commences in February and continues till the end of March and the honey harvest comes in the three months of March, April and May. In some regions, particularly in the extremely northern and cold regions, the season starts one or even two months later. In some parts there occur two honey-flows, the first one known as the minor honey-flow in October and November and the second or the major, in March, April and May. Yet in other parts there are as many as three honey-flows.

Temperature.

An idea of when the swarming should be anticipated would be had if the following simple facts would be borne in mind. In bee-keeping temperature is one of the most important factors with which the bee-keeper has to deal. Whatever the outer temperature, that inside the hive should not go below 46°F or higher than 97°F . Egg-laying becomes possible within the range of 90° to 96°F inside the cluster of bees. Bees are able to maintain inside a hive higher or lower temperature than the air surrounding it. When the temperature is higher outside, they cause a drop inside by fanning. The maximum temperature they are said to tolerate

outside the hive is ascertained to be 120°F , although in temperature above 110°F they find it difficult to carry on their work. They cause a rise in the temperature inside the hive by clustering and by muscular activity. But for the movement of the muscle they require a temperature of at least 45°F . The wing muscles fail to lift the body at a temperature of less than 50°F . Thus although they find it possible to move outside the hive between the ranges of 50° and 105° or even 120° , there is a limit to which they can raise or lower the temperature within the hive; about $10\text{--}15^{\circ}\text{F}$ on either side. This is one of the reasons why the queen does not lay eggs during the cold season.

Pollen

Pollen is the next requirement. Hence egg-laying and brood-rearing can become possible only when the bees can raise the temperature to about 90° inside the cluster and pollen is available outside. Swarming occurs when a condition such as this can be maintained for some length of time with a honey-flow following it.

In certain parts of India cold is never severe. So bees find it possible to carry on their activities during the greater part of the year. On the sea coast particularly to the south of Bombay on the west coast and on the east coast extensive plantations of coconut trees exist. The flowers of these trees give plenty of pollen. They flower throughout the year. Hence egg-laying continues all the year round. At times it slows down when bees find it difficult to essay out of the hive during heavy rains. So the swarming season in such areas is a prolonged one. Bee-keeping becomes comparatively simple in such areas.

Symptoms of Swarming

About the symptoms of swarming, E. R. Root writes :

“In their natural state and when neglected or poorly managed, the bees usually slow down in their work after queen-cells have been started in preparation for swarming especially during a few days just previous to the time the swarm issues. The field workers in increasing numbers stay in the hive instead of working in the fields, bringing about a crowded condition sometimes

resulting in a great cluster of bees hanging on the outside. The clustering on the outside was formerly considered a symptom of swarming provided it occurred during a honey-flow, but it is by no means a reliable symptom. Clustering out during hot weather when there is a dearth of nectar is quite another thing and has nothing to do with swarming."

Slowing Down of Work

A more reliable symptom that the colony is preparing to swarm is the lack of usual flight at the entrance, due to many of the field bees staying at home. When this is noticeable by looking into the supers it will be noted that they are crowded with bees, sometimes wedged into every nook and corner, this being quite unlike the normal condition in the supers. These idle bees are usually filled with honey, which makes them appear unusually large because of their distended abdomens. These conditions, when present during a honey-flow are practically a sure indication that the colony is preparing to swarm. However, in well-managed colonies this slowing down of field work does not always occur, but little if any difference in

the work being noticeable even on the day the swarm issues.

Surest Sign

The only certain indication of swarming is the presence of queen-cells containing eggs or larvae during the swarming season. By noting the advancement of the queen-cells it is often possible to predict on what day the swarm will issue. Queen-cells built under the swarming impulse are sometimes called 'swarming cells' to distinguish them from queen-cells built at other times to supersede the old queen.

VIII

UNITING, DIVIDING, DEQUEENING AND REQUEENING OF COLONIES.

The combining of two weak colonies of bees to form a strong one or the combining of one weak colony with a tolerably strong one to form a stronger one is called uniting. Uniting is done under the following circumstances :

(i) When a weaker colony has little chances of survival through a season of scarcity immediately ahead.

(ii) When a honey-flow is impending and a colony is found to be unable to take advantage of it.

(iii) When a colony not sufficiently strong is queenless and the bee-keeper thinks that he stands to gain more by uniting it with another than by providing it with a new one and to wait till it begins to lay.

A colony of bees requires a sufficient numerical strength to provide warmth inside the hive for brood rearing and to collect

provisions for the colony. In the absence of the number, chances of survival in a season of scarcity or a cold weather are almost nil. The bee-keeper stands to gain on the whole by uniting such colonies.

If a colony is weak at the commencement of a season of honey-flow, the flow would be over by the time the colony gets strong enough to collect surplus honey for the bee-keeper. By uniting such a colony with a strong one or with another weak one to form a sufficiently strong one his chances of getting some profit from the industry are more.

The uniting of bees is not altogether an easy matter. The reason is that every colony has a distinctive odour by which bees recognise individuals of their own group. The entrance of bees from other colonies is resented. Often a fight between the two groups ensues resulting in the destruction of one or both of the colonies. Hence this part of the work can be managed well only by experienced bee-keepers.

How to Unite

Uniting of bees is done in one or other of the following ways :—

(i) Uniting colonies in pairs : The two colonies to be united are kept within a small distance of each other to start with, and are gradually brought nearer and nearer day by day. Within a day or so of the two hives being extremely near, one of them is removed altogether and the other is put exactly in the middle position.

Newspaper Plan

(ii) A safer and surer method of uniting is known as the 'newspaper plan'. The stronger of the two colonies to be united is kept below ; over the top of the frames of it is placed a newspaper. Over this is placed the weaker colony with its bottom board removed. It is then covered in the usual way. In a short time the bees begin to gnaw through the paper so that they can crawl through and slowly mix without fighting, gradually tearing away more and more of the paper. In this manner, a strong colony with little honey and a weak colony with plenty of honey may be united to form a good hive of bees. When the newspaper plan is used on a hot day, a hole is poked in it to prevent suffocation.

This plan combined with the first one has given the best results.

(iii) The colonies to be united are smoked vigorously. When they become stupefied as a result of it, they lose all memory of their former locations. They may then be united and placed wherever desired. They also lose memory of the hive odour.

(iv) Colonies are also united after sprinkling sugar water scented with peppermint or any other strong odour which would make all smell alike.

In all these four cases, if both the colonies have queens, the poorer of the two is killed and the better one is kept.

(v) But if the uniting is to be done in the midst of honey-flow, when honey is freely coming, bees of the two colonies to be united are allowed to enter without being molested.

It pays to cage the queen to be saved for a day or two to overcome the danger of the bees from the stranger colony killing her.

Dividing

Dividing of colonies is an opposite process.

Strong colonies are divided into two and thereby an increase is obtained. Dividing is done with two objectives : (1) to prevent swarming and (2) to build up an apiary by increasing the number of hives. Selection of the right time and the proper colonies for the purpose is important. An account of how division should be made is given in the chapter on 'Swarming.'

Dequeening and Requeening

The queen is the soul of the colony. For the harvesting of the maximum crop the bee-keeper should have in his colonies queens known for their prolificness and the vigour of their offspring. Queens as they grow old become less prolific. The gentleness of the off-springs, a nature in them not given to swarming, are also essential. Progressive bee-keepers all over the world therefore give maximum attention to provide their colonies with quality queens. And the rearing of quality queens for sale has become a profession as important as that of bee-keeping

The removal of the old queen with the object of providing a colony with a new one is

called dequeening. The introduction of a new one is called requeening.

Dequeening is done under the following circumstances :

(1) When the queen in a colony becomes old and her pace of egg-laying slows down. In the colder regions the pace does not slow down till after she completes her second year. In the tropics, in many instances, it slows down after her first year. Since the harvest depends upon the number of worker bees in a colony, the bee-keeper has to see that his colonies always have a young and vigorous queen. The average bee-keeper in India does not give proper attention to this but carries on till the queen becomes incapable of laying eggs and is superseded naturally. This is one of the reasons why he does not harvest the crop which the bee-keepers in foreign countries harvest.

(ii) The ability in a queen to lay eggs is an inherited character. While a few queens lay profusely, others of the same age lay a comparatively smaller number of eggs. Under such circumstances the progressive bee-keeper goes in for a pedigree queen that can be relied on for a numerous colony.

(iii) While a few colonies gather big quantities of honey and pollen, a few gather poor stores. This is due to the fact that they are not so vigorous as others ; it is also possible that the bee-limbs—that contribute for a bigger collection—are not so well equipped. A queen known for the motherhood of good gatherers is therefore essential for success in bee-keeping.

(iv) Colonies given to swarming frequently ruin the chances of a good collection as has been noticed in the chapter on 'Swarming.' This property in a colony is attributed to the pedigree of the queen. While a few colonies swarm profusely, others swarm less.

(v) A few colonies are extremely vicious and are prone to sting even without any provocation. A few are comparatively tame. A few colonies are extremely nervous in temperament. They suspend work and begin to gorge themselves with honey as soon as the hive is opened by the bee-keeper, while a few continue their work in an unconcerned manner.

In all these cases, the old queen should be removed before the new one is sought to be

introduced excepting, of course, when the bee-keeper thinks of requeening without dequeening. If the colony is already queenless, care should be taken so that there are no virgins and all queen cells are destroyed.

Introduction of New Queens.

The introduction of new queens is an art. While on some occasions, particularly when colonies are weak, bees accept new queens with rapture, in a majority of cases outside queens are not tolerated at all on account of prejudices about hive odour. She is stung to death and torn to pieces. The amalgamation of the odour of the queen to be inserted with that of the colony should take place gradually exactly as in the case of the union of colonies.

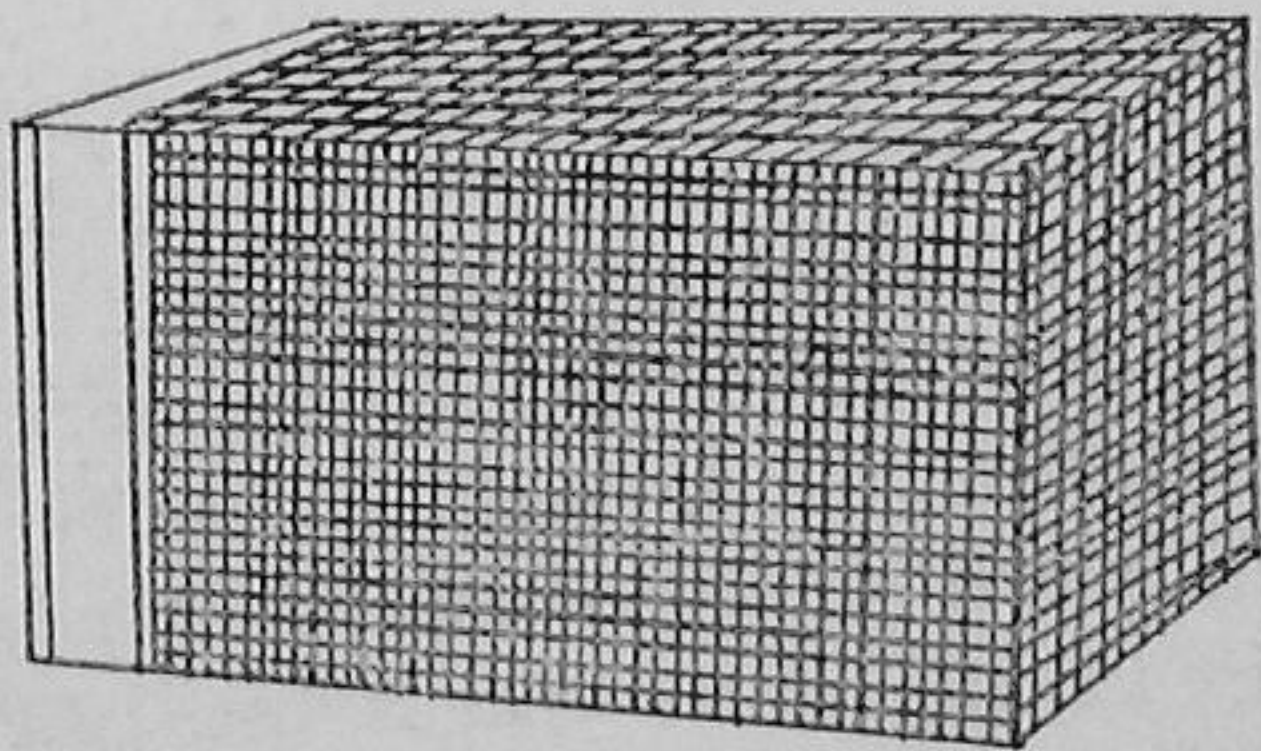
Requeening after dequeening is done in one of the following ways :—

(i) The queen to be introduced is put in a glass tube with its mouth closed by a loose textured cloth and the tube is inserted in the hive. By the time the workers gnaw the cloth, the queen will have acquired the hive odour. The glass tube might be deposited either in the brood or in the super chamber.

(ii) The caging might also be done in an empty match box to be left in the super chamber till the queen gets the hive odour.

(iii) The queen should be dipped in honey and released among the worker bees inside brood-chamber. The bees begin to lick the body of the queen for the sake of honey ; and by the time the honey is sucked completely by the bees from the body of the queen, she acquires the odour of the hive and the bees accept her.

(iv) By means of special introducing cages. Cages are so constructed that the queen is



Queen Cage

separated from the workers in the hive by soft candy. By the time the workers finish eating the candy, the queen acquires the odour of the

hive and walks out unconcernedly and is accepted by the bees.

Replacement of the Queen

The industry is still in an infant stage in this country. The bee-keepers are contented to carry on with such queens as they are having in their colonies. They are satisfied with such harvest as they can get. The idea that a queen should be replaced does not occur to them at all. Once in a way an occasion to queen a colony comes about when a colony becomes queenless. The bees rear a queen out of the brood inside the hive. If for any reason no suitable brood combs exist in it, one from a tolerably good and reliable colony is supplied to it. The adult bees raise a queen which mates in course of time and the colony starts working normally. This process delays the working by 3 weeks to a month. If such a calamity comes up in the midst of the season of honey-flow, the entire income of the year is lost. At times if the queen becomes available, the bee-keeper introduces it in one or the other ways mentioned earlier.

At times an attempt is made by some of the progressive bee-keepers to select brood or

queen cells of high yielding colonies, and try to improve their stock. The education of the bee-keeper in the science of raising pedigree queens and the advisability to requeen his colonies however is an urgent necessity.

The Rearing of Queens

The necessity to supply the loss of a queen in a colony that has not the means of raising another, or to supersede a queen whose fertility is impaired or is getting too old, and secondly to breed a superior race of bees or improve the present stock, and thirdly to provide for the artificial increase of colonies calls for the springing up of this subsidiary industry allied to bee-keeping. In foreign countries, particularly in America, numerous bee-keepers devote almost their entire energies to rearing queens of various races for sale. The advancement of the industry in that country is in a large measure due to them. But in a country like India this part of the work which should be undertaken sooner or later, would have to be shouldered by an official agency.

IX

CARE OF BEES DURING THE RAINY SEASON AND WINTER

The wintering of bees does not present a serious problem to the bee-keepers of India except to some extent in Kashmir and in some of the Himalayan regions. The care of bees during the rainy season does present some difficulties. In some of the most important of the bee-keeping areas, particularly on the west coast and in the hilly regions in the Western Ghats (Malanad, Coorg, etc.) rains commence in June and continue for nearly four months except for occasional breaks. Sometimes rain falls incessantly for weeks. Bees find it impossible to leave their hives. The nectar and the pollen in the flowers are washed away. Strong winds make it extremely difficult to make foraging flights. Even during the occasional breaks bees do not make up their minds to venture out over long distances on account of the uncertainty of weather. The incessant tapping on the roofs of the

hives makes life unpleasant for the bees. Wax-moth rains supreme. Large numbers of colonies desert or die or become extremely weak. When the rains abate a little and fair weather follows, a large number of the remaining colonies also desert. While careful bee-keepers find it possible to retain about 90% of the colonies, others lose as many as 50%. Many of the rest become so weak that the bee-keepers do not find it possible to take advantage of the season of honey-flow which starts early in October.

How to Stem Disaster

With a little care and precaution, intelligent and industrious bee-keepers have been able to stem the disaster. The following are some of the precautions which might be taken :—

1. The colonies should be sheltered inside a roofed shed. In the alternative temporary roofs of betel-nut sheathes or the leaves of coconut, betel-nut or palm or any other leaves or even straw should be constructed over them so that the rain water does not fall directly on the top of the the hives. The covers might also wrap the entire hives excepting for the

entrance. This gives the hives and the bees complete protection.

2. The hives should be strong ones with as few joints as possible. Cracks in the walls and joints of hives afford space to the wax-moth to lay eggs. The moisture too attacks the bees.

3. The bees should be enabled to enter the rainy season with plenty of stores, namely the honey itself.

Removal of Extra Supers

4. Extra supers and combs should be removed from the hives and kept securely away, and thus as much warmth as possible should be made available to the bees inside the hives. If necessary, the space should be reduced from time to time with the warmth of the hive.

5. Vegetable and other plants and creepers should be reared for the purpose of providing the bees with nectar and pollen, particularly the latter within a very near distance of the hives to tempt the bees out for an occasional flight and to make available natural food to them whenever the break of rain permits it.

6. The bottom boards and the joints should

be examined once in eight days or so for the purpose.

Examination of the Hive

7. The hive should be examined periodically to see if a sufficient provision exists for the bees and to give them artificial feeding in case of need. Artificial feeding should be given particularly when a fair weather, which makes it possible for the bees to desert the hive, is ahead.

8. Weak colonies that cannot be expected to survive the rainy season or colonies that have not for any explainable reason yielded properly should either be united with others or let off.

Elimination of Losses

Bee-keepers who have taken these precautions have been able to carry their colonies through without any losses. They can rest assured that the more insulation they give to their bees either outdoors or indoors the better will they repay them in the honey crop of the following year. There can be no development of the industry in the area till

the losses in the rainy season are eliminated totally. As matters stand, the losses are so many that there has been scarcely any increase in the number of colonies. Bees do get flowers of some kind or other during this season in sufficient quantities to maintain them, although the storing of honey becomes impossible. Brood-rearing does not stop completely, although it slows down.

Cold is not so severe anywhere in India as it is in some of the foreign bee-keeping countries. At any rate it is not so prolonged as in them. Bee-keeping is not practised on any scale in our cold regions. A few colonies are kept by a few institutions. The colonies which are usually quartered in the open during the fair season are removed inside a sheltered place. The cold season which is also a season of scarcity starts from December and continues till the end of February in the worst part of the country.

Wintering of Colonies

Losses of colonies due to death and the losses of colonies caused by the numerical weakness of the colonies surviving the winter

are estimated at crores of rupees in America. Utmost precautions have therefore to be taken by the bee-keepers to winter their colonies successfully. With the generation of sufficient heat by the bees when the outer temperature goes below 57°F colonies can hope to survive the winter. This becomes possible only when the colonies are provided with sufficient food. The other requirements for successful wintering are :—

1. The colony should be large enough so that maximum heat should be generated by clustering.

2. The colony should have a very big strength of young bees ; the adults do not have chances of surviving on account of age. Hence attempts at breeding just before the setting of winter should be made.

3. The colony should have a good queen that would continue to lay eggs as long as possible even after the season of honey-flow is over.

Fortunately the trouble due to wax-moth does not exist in such places.



X

DISEASES AND PESTS

Foreign bees suffer from two kinds of diseases—diseases of the brood, and diseases of the adults. But the Indian bees are immune from them. One of the reasons for this might be the circumstances that they are on the wings for the most part of the year and live on natural food. But scientists are discouraging the importing of foreign bees out of fear that along with the bees the diseases too might be imported.

But the Indian bees are having many enemies ; while the Italian and some other species can successfully withstand attacks of a few of the most important of them, our bees find it difficult to protect themselves.

Common Enemies

The common enemies noticed in this country are : the black ant, the yellow-banded hornet, the death's-head moth, different species of small ants, some kinds of birds, toads, lizards, cockroaches, spiders and certain kinds of lice.

Some kinds of animals particularly the bear attack the hives.

The Worst Enemy

But its greatest enemy is the greater and the lesser wax-moth. Certain kinds of remedies are employed against the ants ; the most important is to place the hives on stands set in vessels containing water. The nests of hornets, death's-head-moths etc. are sought out and destroyed. The damages done by them are not big although some lives are lost as a result of the depredations. The enemy that counts is the wax-moth which destroys colonies after colonies. It attacks all the three kinds of bees which construct combs for rearing brood and storing honey. It has been known from very ancient times, but its worst effects are felt in the warmer climates. In cold regions and at high altitudes the moth does not seem to thrive. The worst season are the four months of July, August, September and October. The bees in South India seem to suffer most from them.

These insects are seldom known to be on wings. But during certain evenings the female

is noticed endeavouring to gain entrance into the hives. They remain hovering till the bees begin to rest and when it becomes difficult for them to see after the night fall, they enter through the door and lay eggs within the hive. Such of them as are prevented from entering lay their eggs in the crevices and cracks on the outside. The egg laying proceeds for 2 or 3 days.

Havoc Wrought by Wax-moth

The eggs are extremely small, about $\frac{1}{2}$ m. m. in length. They hatch within 8-10 days. The larvae are about 1 m. m. in length and of a dirty white colour with a yellowish head covered with a kind of helmet which is proof against the stings of the bees. The larvae are very active in their movements. They reach the cells very soon and begin to tunnel their way in different directions feeding on the wax throughout their course. A trained eye alone can detect the havoc during the initial period. In course of time, the entire comb is eaten away leaving a tangled mass of webs with traces of old combs here and there. The destruction is complete. Bees desert the hive within a few days of its commencement.

Wax is the chief food of these moths. But larvae fed exclusively on pure wax die. Their development requires a food consisting of cast larval skins of bees, pollen, propolis, etc. They thrive best on old combs lined with plenty of pollen and some quantity of honey. This is also the food which the moth requires for the construction of the webs.

Remedy Against the Moth

A strong colony of bees is said to resist effectively attacks from these moths. The careful bee-keeper examines the hive periodically for the eggs of the moths in the joints and crevices of the hives during the season. The menace has got to be combated in the egg stage itself. The renewal of the combs in the brood chamber to eliminate those lined with the skins rotting pollen propolis etc. seems to be a sure remedy. The removal of diseased combs and the provision of new ones, although this involves in the loss of some brood also, rescues the colony. General cleanliness, and the destruction of waste combs also prevent attacks.

Spare combs taken out from the honey

chambers after the close of the honey season are also liable to be attacked by wax-moths. To preserve them from the attacks, they should be stored in air-tight places in containers. The preservation in mud pots sealing their mouths with cow dungs is recommended by the authorities of the agricultural College at Coimbatore, where some research is being carried on. They recommend the exposition of the combs to the sun before storing them away for the next season. In western countries, the combs are fumigated with chemicals like carbon bisulphide, sulphur etc. This and a few other remedies, though possible for the large scale bee-keepers, are difficult for the bee-keeper who practises the industry with about 15 hives as a subsidiary industry.

XI

CROSS-POLLINATION OF FLOWERS BY BEES


The fertilisation of the flowers of the vegetable kingdom takes place as a result of the mechanical transfer of the pollen in them to their female parts. The seed of the future fruit is in the pollen. But for the transfer and its deposit in the proper place, the flower would never yield any seed or fruit. This mission of transferring the pollen to the female parts of the flowers is effected through the agency of certain classes of insects of which the honey bee is the most important and dependable. This act which is known as pollination takes place, without the insects intending it, during their visits to the flowers in search of their food. Other insects visit them simply to quench their hunger and stop when it is quenched. But the bee possesses a hoarding instinct and continues its visits to them until the nectar and the pollen in them are exhausted.

Insect Visitation and Fruit Growing

It is evident from this that successful fruit growing depends on insect visitation to the plants. The flowers of some fruit trees are fertilised by the pollen in themselves and in the case of others the fertilisation takes place by other flowers of the same trees. But there are a few species which require pollen from the flowers of other trees of the same species. This is known as cross-pollination. Even in the case of plant species which are self-fertilisable, cross-pollination gives a higher yield of a better type of fruits. In the cold countries insects are scarce during the early parts of the flowering season. The fruit-grower has to rely on bees for the servicing. Progressive fruit-growers in foreign countries are realising the importance of bees and many now keep them more for the sake of their fruits than for the sake of honey and wax. A large number of bee-keepers earn more by offering the services of their bees for this purpose to fruit-growers than from the honey harvest. High fees are charged for it.

James Hambleton an authority on insect

pollination writes—"The principal role of the honey-bee is in the pollination of the many agricultural crops in the production of seeds and fruits; honey and wax are merely the by-products of pollination. Without the help of this insect to effect pollination many species of plants will not seed or produce fruits no matter how well they are cultivated, fertilised and protected from diseases and pests." Experiments conducted in our own country have shown that yields increase by at least 15 to 20% when cross-pollinated by bees. Unfortunately our agriculturists are not aware of these facts and we value bees only for the sake of the honey and the wax.



XII

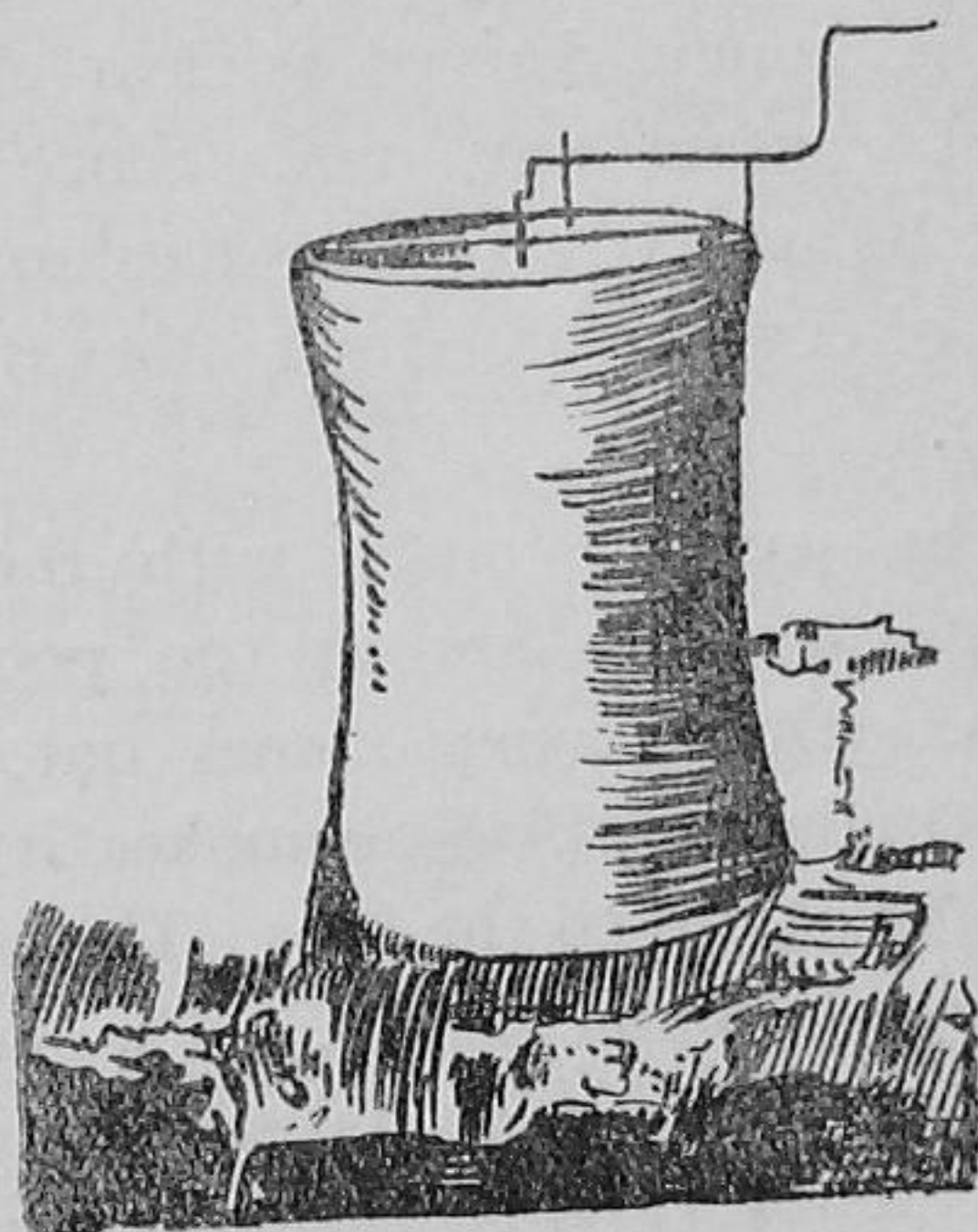
EXTRACTION OF HONEY

The crude method of extraction of honey which obtains in our country at present is to take out the combs from the hives and to crush them. Sometimes the combs are put in a cloth and the cloth is squeezed. A few cut out the parts containing the brood, pollen, etc. and retain only the honey portion in the combs for the honey extraction; others crush the combs together with the brood, young ones of the bees and pollen. The honey thus derived does not possess keeping qualities. A few heat the honey to impart to it keeping qualities. This process is known as ripening.

Honey Extractor

The honey extractor was invented by Major de Hruschka in 1865. There are various types of extractors in the market at present. But the simplest consists of a drum or container with a vertical shaft in the centre of it. To the shaft are attached 2 or 4 pockets to hold

the combs in position. The contrivance turns the shaft, revolving the pockets with the



Honey Extractor

combs in them. Since the combs are held firmly, only the honey is thrown out and collects in the drum. An opening or a tap below, lets it out to be collected in a receptacle. The simplest, yet a very efficient extractor can be manufactured at a cost of Rs. 20/-. This suffices for an apiary of 15 colonies of bees.

Ahimsak Method

Honey thus derived is known in some

areas as 'Ahimsak Honey'. The advantages of this process of extraction are :

(i) The honey derived is clear and pure ; it does not contain any wax. Since only the honey combs are extracted, it does not contain the juices of eggs, or brood nor does it contain any pollen.

(ii) The entire combs with the frames containing them are set in the pockets for extraction. Only honey comes out, leaving the combs undamaged. This makes it possible to return the combs to the bees. The collection of honey starts immediately. The labour of constructing fresh combs is saved to them. Thus more honey results. Secondly a pound of wax requires 6 to 20 lbs. of honey for the raw material. This too is saved. The combs can be used repeatedly.

(iii) The extraction is complete.

Quick Extraction Advised

It has been stated elsewhere that bees store honey in the super chambers. In the season of honey-flow the super becomes filled with honey in two or three days. Usually an additional super is given so that when the combs

in the first super are taken out for the extraction of honey, the bees should begin storing in the new one supplied. The extraction is made as soon as the super becomes filled. But in larger apiaries, instead of extracting immediately, the bee-keepers go on adding supers after supers and extract the honey in them at one time. One advantage in the extraction of honey as fast as it is collected is the prevention of swarming.

Fully Sealed Honey is Superior

The honey as it is deposited in the combs by the bees contains about 60% of water. The water is evaporated by the bees by fanning with their wings till about half contents of the water are removed. Otherwise the honey ferments. It is only when the honey gets keeping qualities that the bees begin to seal the cells in the combs with wax. The commencing of the sealing is a sign that the honey is of the right consistency. A few bee-keepers extract the combs for honey as soon as the sealing commences. Some remove them even before the sealing commences; but honey in that case is then watery and does not have

the flavour of ripened honey. If the honey is not to be given to the bees, the better practice is to remove the combs as soon as the sealing commences. This saves the time and the energy of the bees in the manufacture of wax for the purposes of the sealing. It has however to be noted that honey allowed to stay in the hives for some time after it is fully sealed acquires a richness that honey partially sealed does not possess.

Removal of Bees from Combs

Often bees remain sticking to the combs ripe for extraction. To clean the combs of them some employ smoke. Some use a kind of device known as the bee-escape which is a board with a contrivance which allows the bees egress, but does not allow them to enter. But the average bee-keeper simply shakes the combs or taps them at the entrance of the hive. The bees quietly leave the combs and enter the hive. The combs are then taken to the extracting house.

The extracting outfit consists of a wooden or other box to keep the combs in position during their removal from the hives to the extracting

house and their return after the extraction is over, two uncapping knives and an extractor.

Uncapping

The seal otherwise known as the capping should be removed before the combs are placed in the extractor. This is done by means of a sharp knife. Since wax sticks, the knife is heated in a hot water bath prior to being used. Usually two such knives are required. One gets heated while the other is being used. As soon as it gets cooled, it is put in the bath for being heated again while the one heated is taken up for use. The process is known as uncapping. It consists in scraping away or removing only the surface of the wax. Otherwise the honey inside is liable to be lost. The cappings consist of the best wax that the bees are capable of manufacturing.

The combs thus made ready for extraction are placed inside the pockets and the shaft connected to them is turned. In the beginning it is turned slowly. More speed is imparted as the extraction proceeds. Too much speed destroys the combs. This process removes the honey from only one side of the combs. When

one side is fully extracted, combs are reversed for the extraction of honey in the other side. The combs are then returned to the bees.

The honey at this stage contains bits of wax being the particles of the capping. It is, therefore, strained. When the produce is small the straining is done with the help of a cloth folded four times. This is the usual practice in India. In foreign countries larger producers employ gravity strainers. In them the particles etc. rise to the top and the honey relatively free from foreign matter is led into another vessel.

Ripening of the Honey

If the honey is not to be used immediately, it requires to be ripened or processed. The process of the evaporation of excess of moisture to give it preserving qualities is called ripening. The bees attend to this. But as stated already, the honey as it is sealed contains 25 to 30% of water. In hot countries like ours, the contents of moisture should be further reduced if the honey should keep well. This is done in two ways; the first is by keeping the honey in the sun for a few days and thus making the water

evaporate. And the secondly keeping the honey in a water bath at a temperature of 150° to 160°F for a sufficiently long time to bring it to a specific gravity of 1.41 at 30°C . Various types of ripeners are in use. The simplest consists of a container of water with an arrangement to accommodate the receptacle containing honey. Heat is not applied directly to the honey; the water forming the jacket for the honey is heated. The honey is kept stirring to ensure a uniformity of temperature throughout. At higher temperatures than 160° , the flavour of the honey is lost. Certain of the sugars are changed. At lower temperatures than 150°F , the ripening proceeds very slowly, and the enzymes in the honey which are responsible for its fermenting are not destroyed. The process brings about the following results—

(i) The enzymes in the honey are destroyed and thereby the element responsible for the fermenting is removed.

(ii) The sugars in the honey become so concentrated that fermentation cannot occur.

(iii) The air bubbles and the cloudiness in the honey are removed imparting to it a

clear and pleasant colour; any foreign matter floats to the top.

(iv) Often the process prevents granulation.

This process being over, the honey is allowed to settle for sometime and is then led out into bottles or containers from the bottom by means of a tap below. It is then ready for the market.

Extraction of Wax

Apiary keepers have little wax to sell, since all the combs are returned to the bees. But owners of big apiaries do have some wax at times. The cappings give some; the brood combs become unserviceable after a year or so; combs attacked by wax-moth have little other use. But large quantities of wax become available from the giant bee. The extraction of wax from all these sources is done as follows:—

The combs are cut into small pieces and boiled in an adequate quantity of water. When cooled, the wax floats on the surface. Some of the impurities become dissolved in water. Some stick to the bottom of the wax. The latter are shaved off. The process is often

repeated for a second time. The boiling mixture is, on the second occasion, poured over a cloth held in the form of a bag. While yet in the semi-solid form pressure is applied to the mass by means of wooden rollers. Impurities thus pass out of the molten form. It is then heated over a fire by a direct application of heat and cast into the desired forms.

The wax thus manufactured has a yellowish colour. When exposed to sun for 2 or 3 days it becomes bleached. Wax can also be bleached by being treated with sulphuric acid.

XIII

HONEY AND ITS USES

Nectar is not honey. It is only a raw material for honey. Honey is produced by the bee itself. From the moment the worker bee drinks the nectar secreted by the flower and accumulates in its honey-sack, a powerful chemical action takes place within its body, converting the raw sugar into the dextrose and the levulose of honey. Within the hive the forager transfers the sweets to younger bees who process it still further before storing it drop by drop in the open cells. This freshly-made honey is thin and watery. The bees then circulate the currents of air through the honey by fanning with their wings; the excess of water is evaporated and the honey is reduced to a composition and consistency that will keep. It is then given an impervious seal or capping of wax.

The pounds of honey which are thus garnered are the fruits of an infinite number of repetitive actions by the bees. It is mass production in excelsis.

Importance of Honey

For sixty centuries throughout historic ages and even in pre-historic times honey was man's only 'sweetener' and his most favoured food delicacy and medicine. Upon the intrusion of refined sugars, honey declined in use; and now instead of being an important household necessity, it has become an article of luxury, and in some instances an article of medicine.

Honey is the most remarkable of foods we use today. It possesses properties that still baffle modern scientists. The laboratory has revealed many things that were not known earlier, but the more important ones remain a mystery. Two thousand years ago, the Greek athletes stuffed themselves with honey throughout their training period, in preparation for the olympic games. Swiss Alpine climbers have always used great quantities of honey for weeks prior to undertaking dangerous climbs. The long distance swimmers of the nineteen twenties and thirties did likewise before attempting to swim the English Channel or some other body of water that called for endurance. The crew that volunteered in 1937

for the salvaging of the Lusitania lying on the Atlantic Ocean spent six months preparing themselves for the venture. In addition to daily exercise and a diet high in nutritive value, they gradually increased the amount of honey they consumed daily until during the three crucial weeks before they had to go below, they were eating a pound and a half of honey for breakfast every morning. When they came up from the seas they were given nothing to eat except half a tumbler of strained honey with lemon juice and pure water. The work was one of the most dangerous under-sea operations ever attempted; and the men selected were the pick of the under-sea crews of the world. When they emerged from the water their bodily temperature fell down to 85°. Nearer home, Sir Edmund Hillary the conqueror of Mount Everest used to be fed on a diet of honey during the preparatory course as also during the campaign.

Honey and other Sugars

Buy why honey ? It has the following advantages over the other sugars :—

(i) It is non-irritating to the delicate membranes of the digestive tract.

(ii) It is assimilated rapidly and easily.

(iii) It spares the kidney's lessening tissue destruction.

(iv) It provides maximum energy with minimum shock to the digestive tract.

(v) It enables the athlete to recuperate rapidly from severe exertion; and according to medical tests men using honey show less evidence of fatigue.

(vi) It has a natural and gentle laxative effect.

In addition to sugars, honey contains minerals, vitamins and alkalies.

Properties of Honey

Honey is still considered, by physicians the world over, as the perfect sweet for children—the ideal milk supplement in infant feeding; sugar-fed children often become rachitic and prone to acquire certain infections.

Wholesome food preserves health, prevents diseases and aids their cure. The advantages attributed to honey as an ailment apply as well to its medical properties. The rapid assimilation of invert sugars which honey contains makes it a desirable source of quick

energy, a practical food and at the same time an effective heart stimulant.

Unfortunately, honey plays an insignificant part in our modern materia-medica. Something has got to be done to induce the medical profession to look more carefully into the dietic value of honey. On the European Continent where physicians are paid for keeping their clients in good health, honey is freely used. Upto the end of the last century it still held a place of honour in our country. Only with the advent of hundreds of patented and well-advertised domestic and imported preparations, was honey banished as a curative substance. Thanks to the simple country-folk and the primitive races, honey is still in its glory as a dispenser of health. Their laxative medicines, likewise those for coughs, bronchities, tuberculosis and other pulmonary ailments contain honey. For respiratory troubles honey is even mixed by them with pepper, ginger, mustard or garlic. A glassful of warm water is used for bronchities and debilitated conditions.

Cure for Various Ailments

On the continent of Europe, honey is prescribed in pyelitis (inflammation of renal pelvis).

It increases the amount of urine and exerts a decided anticeptic effect. Urine clears and loses its putrid odour. Opera singers in America frequently resort to honey for the treatment of their throat afflictions, with a dose of 3 parts of honey and one of tincture benzoin. It is regarded as an excellent demulcent. A mixture of honey and lemon is a useful gargle. Mixture of honey and alum is valued for sore throat and ulceration of the gums and the mouth. Hot milk and honey makes a remedy for husky throat.

As honey does not ferment in the stomach, is easily absorbed and there is no danger of bacterial invasion, it is regarded as of great value in digestive disturbances. It excites appetite and helps digestion. For anaemics, dyspepsies, convalescents and the aged, honey is an excellent reconstructive and tonic.

In heart weakness, honey has a marked effect in reviving the heart action and keeping the patients alive. Diabetes is the weakness or the exhaustion of a certain gland. Many instances have been reported where honey was well tolerated by the diabetics and supplied them with the required energy.

An Antiseptic

As an antiseptic it has been used in cuts and speeds their healing. It has a distinct bactericidal power which is mainly due to its hygroscopic property. When bacteria come into contact with honey they are deprived of the moisture content so very necessary to keep them alive; and hence they perish. Most micro-organisms which effect the human body are destroyed in honey.

Honey is also used as a skin and hair food. It is also a prized ingredient of a number toilet preparations.

XIV

WHO SHOULD KEEP BEES

An idea of the areas which alone are suitable for the bee-keeping industry has been given in an earlier chapter.

The industry is still in an infant stage. It was introduced in this country only a few decades ago. But even in this short space of time, hundreds attempted to start it and having spent one or more years in it left it. A few left it not being able to earn any profits within the time limit they had set before themselves. A few had selected the wrong area. A few left not being able to collect together even ten colonies for their apiary. And in the case of a few, the 5 or 10 colonies which could be got together did not yield any income of honey. In spite of all this, the impression that bees have only to be kept, and the honey and money would flow by themselves from the hives is gaining further and further ground in the minds of our country-men.

Industry not Suited to All

Is bee-keeping a paying industry? It is a

paying industry in the hands of the right type of persons who select for it the right area. It is not equally well suited for all persons. It is extremely unsuited for persons who are afraid of stings and are unwilling to attend to the bees themselves but think of depending on paid labour.

Dr. E. F. Phillips writes : "To keep bees with interest and profit requires an intimate study of the insects and a detailed knowledge of their needs. It further requires a knowledge of the plants from which they gather nectar so that the necessary steps may be taken to get the colonies in proper conditions for the work required of them. To be a good bee-keeper one must read and re-read the books and the journals pertaining to the subject; for, each reading accompanied by additional experience among the bees brings it some new points which proves important in the practical work. It is necessary for the bee-keeper to know the behaviour of the bees in all phases and in so far as they have been determined, which is not far, the causes of their various activities. Obviously, the successful bee-keeper is a naturalist. Such persons are born and not

made successful. Patience, power of concentration and sympathetic understanding of the bees are essential, and as a result bees become pets rather than beasts of burden for the bee-crank. Person who fail to appreciate bees from this point of view, will probably find it more profitable and pleasant to let them alone."

Proper Attention Necessary

Not only is a knowledge of what to do necessary for success with bees, but it is equally necessary that the right thing be done at the right time. To put on comb honey supers too late, to delay the necessary steps in swarm control or to neglect the preparation of bees for winter, all mean loss in bees, honey and money.

Instead of being an occupation fitted for everyone bee-keeping is fitted well only to the minority.

Only Subsidiary Industry

These lines are not intended to scare away persons desirous of taking to the industry. They are meant simply as a caution. If not thousands, at least dozens are making a living out of the bees in our own country. If not

lakhs of rupees, at least a thousand rupees are earned by them annually from the industry. With a little more of experience, study and application, it might become possible for them to double their income at any rate. There is no reason why others should not do as well. But it is absolutely necessary that the area where bees are intended to be kept should be got surveyed by an expert, and adjudged suitable for the industry before starting the work. No beginning should be made without acquainting oneself with bees. The beginning should be cautious and slow. It might be made with only 5 colonies and the apiary expanded by degrees as the bee-keeper begins to know more and more about bees. To build up an apiary of a hundred colonies within a year or even three years would be an idle dream. In the present state of the industry persons desirous of investing all the money they have in it, or who think of leaving their existing occupation to take to bee-keeping should be strongly discouraged.

Agriculturists Best Suited

Then who should be encouraged to take to it? Agriculturists having some lands and

earning from the agricultural occupation an income just enough to maintain themselves, and having some spare time which they can devote to bees, are the best persons to take to it ; provided, of course, the areas they live in and work is suitable for bee-keeping. No subsidiary industry fits so well into agricultural programmes as bee-keeping. Beginning with about 5 colonies the agriculturist might easily expand his apiary to about 15. They would require of him about an hour which he would be otherwise wasting during about 8 months of the year and about 2 hours at the most in November and April, May and June. The investment would be small. If he earns any income, however small, it would add to his earnings from agriculture. If he does not, there is his earning from agriculture to fall back upon. At any rate he stands to earn a higher income from agriculture as a result of the work of the bees over the flowers of his trees etc. The bees would at any rate give him diversion. As a rule such persons earn and earn well from the industry.

In the same way persons belonging to the leisurely classes having sufficient income from

other sources and plenty of time to spare might be encouraged to take to it as a hobby. If they get some honey, that would be a sufficient reward for the troubles they take. And if they don't get any, they don't starve.

Advantages of Bee-keeping

Bee-keeping on a big scale has its advantages. It does deserve encouragement, but the time for it is not yet. It should come after bees and their keeping are studied better and our scientists become able to advise bee-keepers better. At the present time bee-keeping is more or less a gamble. Some get an undeservedly good income. Some do not get any for no explainable reason.

This discussion classifies our bee-keepers into :

(a) Those having small acreages of agricultural lands, giving to them some small income and having spare time to devote to bees, take to bee-keeping as a subsidiary industry with the object of earning an additional income from it.

(b) Those having sufficient income from other sources and having plenty of spare time at their disposal take to bee-keeping as a hobby

and keep an apiary of one are 2 or 5 colonies, the employment of their time being the chief consideration and the yield of honey being only a secondary consideration.

(c) Those who think of taking to bee-keeping as a commercial proposition with the object of making a living by it.

Benefits Derived

Every one conversant with the conditions of agriculture in India would immediately agree that the first class of persons deserve the foremost attention at the hands of the Government. Bee-keeping benefits this class in more ways than one; the increased earnings from the yield of honey is bound to increase their standard of living. They would have beneficial effect on their health. The increased yield of agricultural crops from the cross-pollinating labours of bees not merely in the holdings of the bee-keeper but in those of others situated within a radius of about 2 miles, which is the range of the flight of bees, and the benefits of bee-keeping to the bee-keepers enumerated already would be reflected in the well being of the country itself.

State Encouragement Desired

Nor should one be blind to the importance of large-scale bee-keeping. It is to them that the progress of the science of bee-keeping is due in a large measure all over the world. While the bee-keeper who takes to bee-keeping as a subsidiary occupation has other means of living, the commercial bee-keeper has to look solely to bee-keeping, if he should live well. The knowledge which he gains ensures to the benefit of the others as well. The supply of honey and the cheap price at which it becomes available in the other parts of the world are due entirely to this class. While those who take to the industry as a hobby or a subsidiary industry at times leave the industry, commercial bee-keepers can be depended upon to continue in it. Often they take others with them either as employees or as apprentices, and thus help in the solution of the problem of unemployment in however small a degree.

Under circumstances such as these, it becomes the duty of the State to encourage them too in some measure.

XV

WORK AMONG THE GIANT BEES

Little attention was paid by our Government and our scientists to the possibility of the domestication of these bees or to the scientific collection and the marketing of the honey produced by them. The massacre of the bees for their honey is the rule. The hunting of the bees is done on dark nights. This is because the bees are unable to see on account of darkness, and hence find it difficult to attack the hunters. Two methods are in vogue. The first is to administer smoke from below. Smoke stupefies bees, and scares them away. In the second method of bee-hunting, the hunters ascend the trees and move on to the branches to which the combs lie suspended and strike the branches with torches made of dry coconut leaves or straw. The process emits sparks which gradually find their way to the ground. Unable to bear the heat and the disturbance, and unable to see anything in the darkness, the bees descend to the ground in the direction of the sparks.

Primitive Method Undesirable

In either case they desert the combs leaving only the baby bees, the dead and the incapacitated ones. The combs are then lowered to the ground, being severed from the place of suspension, and are squeezed for all their contents, the juice or the blood of the baby and dead bees, the eggs, the pupa, the larva, the pollen, the ripe and the unripe honey. Sometimes the extraction is done at the spot ; at times the combs are brought to another place. The squeezing is done by putting the combs in a piece of cloth and twisting it from both ends. Two persons are required for this operation. Little attention is paid to cleanliness. No processing is done. As a result of this, the honey does not possess keeping qualities. It has got to be sold at such price as can be got within about 2 months of its harvesting. The consumer gets it either in this form or adulterated profusely with sugar or 'gur' syrup.

Bees Also Destroyed

What happens to the bees ? Most of them are trampled upon and perish under feet of the labourer. Most of these that fly away out of horror do not find their way back to their

original place of residence, and are lost. The few that return find no traces of the habitation constructed by them with such great industry and skill. Invariably, the queen bee to which alone they can look for the progress of their line is dead or lost. The hunting takes place during the fag end of flowering season, too late for the bees to attempt the building of a new home and the storing of freshly collected honey.

The race of the giant-bee is gradually dwindling. The number of colonies on the tree apiaries has been showing a decrease year after year. The yield of honey and wax too has been decreasing. The few colonies which we still find possible to destroy are the swarms of such of parent colonies as escape the hands and the eyes of the man. It deserves to be preserved by closing the forests once in three-four years or by a system of dividing the forest into compartments or blocks, each block to be closed once in three or four years by rotation permitting exploitation during only the remaining period.

Domesticating the Giant Bee

As stated already, little attention was paid

to the wild bees by our governments and scientists till recently. Attempts at domesticating them are being made at Wardha (Maganwadi) by their bee-expert. One or two others are making similar attempts in other parts of this country; but their work seems to have been handicapped for want of funds. The Village Industries Committee of the Government of Bombay has also been giving some attention to the subject since the last three years, which has two objectives : (i) to attract the bees into constructing their combs in specially-made frames and (ii) to extract the honey from the combs in a scientific manner and to arrange to market both the honey and the wax systematically.

An Experiment

It became possible to induce the bees to construct their combs in artificial frames in the very first year of the attempt. Bees were attracted into them as a result of the coating of the inside of the frames with bee-wax. The frames had been tied to trees visited by the bees in the previous years. The frames were made of batons 3" in width. It was realised

later on, that the batons should have been at least 6" in breadth, and the frames should have been bigger in size. An unusually strong storm blew over the area during that year. Some of the combs got detached from the frames and fell scattered on the ground. The experiment is intended to be repeated with bigger frames having broader sides. If success would attend it, arrangements would be made to raise or lower the frames by means of pulleys tied to the branches beforehand. No necessity would then arise for the bee hunters to carry on operations on the trees. The scaring of bees with the help of smoke or chemicals standing on firm ground would be easier and safer. Within a given time a bigger number of combs could then be harvested and the honey from them extracted, thereby lessening the cost of production. The frames might again be coated with wax and raised to their original position on the trees by means of the pulleys; probably the bees might begin to work on them again. The massacre of bee-life might be obviated altogether by this process.

Extracting machines, which when turned centrifugally could throw out the honey from

the combs, into them, were devised. Experiments showed that the machines could take out honey from the combs more completely within about a third part of the time required for squeezing. The strain on the hand was less. The honey thus extracted contained no impurities of the type noticed in the squeezing process. When filtered or strained, pure honey of a transparent colour and sweet aroma resulted. When ripened, it lasted well.

Labourers Profitted

The extractors became popular in a very short time with the coolies and the bee-hunters. 7 extractors are now in use in the Yellapur range of the Eastern Division of North Kanara. They were devised by the Village Industries Committee, Bombay State. In the first two years, they were taken to the apiary trees, and the extraction of the honey was done underneath them during the night itself. In the third year, a building at Yellapur was hired for the purposes of extraction and processing. The combs, as soon as severed from the branches of the trees were brought to this building in specially-made receptacles, and the extraction

was done during daytime in very clean surroundings. It became possible to remove from the combs the portion containing the brood completely. No portion of the wax was wasted. This arrangement has met with the approval of all the parties connected with the exploitation of the honey combs. Demand has come for the opening of more honey extracting centres. The labourers have been already organised into a co-operative society with headquarters at Yellapur, the jurisdiction of operation being the Eastern Division of Kanara. They have agreed to harvest the combs themselves and to bring them to the honey-houses where an advance payment on the weight of the honey combs would be made to them. Arrangements will be made for the transporting of the combs from the forests to the honey houses. Arrangements are also being made to process the honey after extraction in a scientific manner and to market it. Thus is the middle-man being gradually eliminated.

Sting Resistant

The workers were provided with bee suits made of duck cloth to fit their bodies closely.

The suits minimised the stings in some cases and eliminated completely in others. There is a common belief that persons living on a diet consisting of extra quantities of onions do not experience either too much of pain or too much of swelling of the flesh from bee-stings. Hence the labourers are kept on such diet during the period of bee-hunting. It is not possible to state whether the immunity, complete or partial, is due to the effects of onions on the human system or to the flesh being accustomed to the stings. If it is due to the onions, a scientific explanation should be attempted to be given. Whether the result is due to the one or the other cause, it is amply clear that the injection of certain kinds of serums a day or so before the commencement of the operations would operate to relieve against the stings. If such serums do not exist, our scientists might do well to invent a few kinds of anti-bee-venom serums.

APPENDIX I

BEES AND THEIR COLONY

*A note by F. S. Stuart on the division of
labour in a bee colony*

[Extracted from the City of Bees]

“Look at this head, not much bigger than a grain of dust. Its five eyes are only the first of its wonders. Do you see the two antennae? By these, the bee conveys emotions, needs, desires, threats. In a worker bee, each antenna has twelve supple joints; a man's arm seems clumsy by comparison. This tiny head has three pairs of jaws, and a tongue which is a miracle of perfection, and carries out tasks of infinite complexity.

The three pairs of legs which support the flimmering body are also equipped for special tasks. Here is a curry-comb of stiff hairs, there a spur with which to remove pollen balls; this jointed leg is made to collect pollen or propolis; it forms jaws that help to load the pollen-baskets, and has hairs essential in the architecture of wax. This tiny foot, so

small that it can hardly be seen by man's coarse eye, is five-jointed, and carries formidable claws. Between the claws is a cushion, which secretes a gum so that the bee can walk on any smooth surface, even upside down.

Breathing takes place through gills in the sides of the body, which may be said, almost, to be one single lung; through these orifices, air-sacs can be filled to assist flight. The fairy body is clad in a sort of scale armour. It is tough armour, and it has another purpose as well; in the ventral plates, the wax that is essential for bee community life is secreted.

The bee is just as wonderful inside its minute body. It is intricate almost beyond belief. The sting alone, which looks so insignificant, seems more like a weird and beautiful flower, when man's clumsy eye, examining it, is, by the aid of a microscope, brought to something like the analytical perfection of the bee's eye. When the sting is used in anger, it comes quick as a lightning flash; yet it is never used until the surface to be penetrated has been tested with sensitive feelers, ending in nerve points that tell the attacker just how deep the barb can be plun-

ged into the victim. In such processes, as this, man's conception of time is elephantine; what seems to him but a split second gives the bee time enough carefully to feel the surface, and then to select any thinner part of it, and so to plunge in the sting.

Bees, it seems, know quite well that to sting is to court death. Rarely, indeed, can the sting be withdrawn. Its barbs grip the pierced surface, and through a blow, or often because of the bee's own agonised or furious motion, sting and entrails are torn out, and the attacker crawls away to die. In combating any creature of its own size, or a little bigger, the bee dreads to sting. It fights ferociously, instead, with claws and jaws. But when mouse or badger, man or ox or even elephant, threatens the colony, ten thousand stings are tensed for the assault, and if need be, ten thousand lives flung away with no more care than one. A fine needle, by comparison, with this sting, is as thick as a crowbar wood seem beside the needle. Nor is the sting a simple thing; a sheath makes the first penetration; then darts drill in and out faster than the human mind can conceive; then poison pours

down the darts, as they deepen the hole that has been made.

At the city gates, as one enters this golden palace, stand the sentries. These are old bees worn in the wars. They are selected specially for their abnormal quickness and strength. Their task is to examine everything that enters, and to kill all strangers. Each colony has its own distinctive smell; no matter how many flowers may have been visited, no matter if the bee has rolled in pollen till its back is mantled with glowing dust; yet the sentries cannot be deceived. In and out of these gates, at the heart of a summer day, fly tens of thousand of bees. Many hundreds may come and go in one minute; but never a stranger can pass, never a bee may enter without being examined by half a dozen quivering sentries, each one ready to launch, like a thunderbolt, a fatal blow.

Just inside stand the fanners, whose task is to ventilate the city. They are poised with claws gripping the ground firmly, and wings vibrating so fast as to be invisible. There is no random labour in this; everything is planned; line upon line, the fanners stand, to keep the air currents moving exactly at the

velocity and in the directions which the city needs. When honey is put in the cells, it contains more water than may safely be allowed to remain in it ; the bees raise the temperature and drive off the moisture, and the damp air is continually driven out by the fanners while a current of fresh, dry air is drawn in and circulated round the combs. To complete a pound of sealed honey, the bees must evaporate between half a pint and one pint of water from the cells and send it out of the hive. A fatiguing task this fanning must be ; but it achieves by a labour, just as much as man can do with machinery, and it is infinitely adjustable to weather conditions and to the city's requirements.

In the golden streets are the nurses, young bees not yet permitted to make honey flights, but none the less busy with work just as important as that of the food gatherers themselves. This is the task of giving the warmth of their bodies to hatch the eggs and lavishing care on the baby bees. For three days the egg must be tended; then an infinitely tiny grub appears. So far, it has fed upon the substance of the egg. Now, it is tenderly

cared for by the nurses, who rear it on a substance perfected in their own salivary glands. After about three or four days more, a tiny amount of semi-digested honey and pollen is added to the food in the golden cradle. On the ninth day from the laying of the egg, if it is in a worker cell, the cradle is well stored with food, and sealed with a porous capping of wax and pollen, through which the little living thing inside can breathe. For thirteen days more, the nurse bees guard the cell and keep it precisely at the correct warmth—too much would scald the inmate to death, too little would make it die of cold, and the variation is but a few degrees either way. For thirteen days, in its mysterious solitude, the little creature is working its wilful way towards the sunshine and the flowers—and towards eventual death.

It stirs. With folded wings and close-clasped feet, it is a perfect thing; God has produced another little life. The nurses hurrying about the combs rejoice; perhaps they reach out eagerly towards it as the newborn bee, impatient for all the joys and agonies of life, bites its way suddenly through the


paper-thin golden barrier that stands between it and every adventure of existence. As the little creature crawls out, looking about upon the world and pruning its wings, the nurses dart into the cell and clean it, and prepare it for the immediate reception of another egg-one more step in the unending cycle of generation.

The furry baby needs little other growth; it is practically as big as the veteran bees who are loading honey into cells nearby with an urgency that is sharper because they know their race is almost run. It springs into life full-fledged.

It plunges its head into a honey-cell and drinks the nectar of the summer blooms. It walks the combs, examining, marvelling, learning. After a while it goes out, blindly attracted to the wonder of the sunshine. Its wings unfold ; and with a humming song of triumph and delight, it climbs the air and looks down upon a lovely earth. Up and down before its dwelling, in and out among the trees and grasses and flowers it goes, remembering once and for all every landmark, charging that strange sense which humans have got only so dimly, which will forever afterwards say which way lies home.

A few hours of play ; then, in its turn it becomes a nurse. And, after nursemaiding, the cycle moves relentlessly on ; the next stage of life is that of architect of the city streets ; at about fourteen days old, unless chosen for sentry work, another stage is reached when honey gathering is begun. A few weeks, only, may be, to taste the glories of the world, to see the sun climb and sink, and help the flowers unfold ; and then comes the end foretold when first life stirred within the egg that was itself scarce bigger than a grain of that dust to which we must all return.

In this insect life, passions surge as in our own. There is no mating love, no jealousy or greed, no comradeship of the sort we know ; but there is hunger, fear, anger, pain, and certainly delight more keen than ever humans know. And, as likely as not, vice and sin as well. This creature, bred of the sweetness and innocence of flowers, may become a robber and a murderer, or may suffer the cruelties of such ; the gamut of the emotions can be run by bee as well as man, and temptations shake them both as mercilessly hard."



APPENDIX II

Dos and Don'ts for the Bee-keeper.

Bees are whimsical creatures; it is impossible to lay down general rules about their manipulation. No two colonies behave perfectly alike. The knowledge of how to behave with them comes only by experience. It is difficult to lay down the 'dos and don'ts' about them. The following are only the general rules :—

BEE-KEEPING

Remember that success in bee-keeping depends on all of the following circumstances :—

- (1) Health and vigour of the bees.
- (2) Honey and pollen resources.
- (3) Skill of management and understanding of bees by the bee-keeper.

Never attempt to keep bees without trying to understand the science of bee-keeping.

Begin bee-keeping with only one hive—increasing the number gradually to five at the most in the first year.

To make the industry paying to you keep at least five hives. Regulate the number of

hives you desire to keep according to the pasturage available. It is not safe to quarter more than 50 at one place.

Bees pay well; but you have to take a long range view of the case and have patience and faith.

Bee-keeping is not meant for those who do not want to put their feet on the soil, do not care to face the elements and do not want to go anywhere near the bees, but are entirely out for profits.

HIVING OF NATURAL COLONIES.

Do not attempt at hiving natural colonies in rain cold or tempestuous weather.

Do not allow combs to be broken while hiving.

Do not administer too much smoke while hiving.

Do not attempt if the hiving occasions too much harassment to the bees or involves too much trouble to the operator necessitating a considerable length of time in the hiving.

Do not remove the hive from the vicinity of the natural home until you are sure that all the foragers have returned to the hive; if necessary keep it there till evening.

Do not keep newly hived colony near established ones.

Do not use a rickety hive; exercise utmost caution in purchasing or manufacturing your hives. Get the best ones.

Take care to tie the combs in a vertical position.

Do not remove the queen excluder for about 3 weeks till you are sure that the queen has begun to lay eggs in the new hive.

Take care to clean the bottom board at least once in two days for about two weeks—but in so doing do not disturb the normal working of the colony.

Do not allow pieces of wax or old combs or dead bees or larva etc. to heap in the neighbourhood of the hive.

Take care to keep the water cups at the feet of the rest on which you keep your hives filled with water to keep out ants etc.

WHERE TO LOCATE THE HIVES

Place your hives within easy access to flowers rich in pollen and honey-flow within a distance of 100 to 200 yards from them.

Bees can fly over a distance of a mile for-

aging for honey and pollen; but remember they have plenty of enemies and the farther they have to go from their hives, the greater is the risk of their loss.

Remember that water is as essential to bees as nectar and pollen ; keep a bucket of water with a few cork pieces for the bees to perch upon ; but do not keep bees in a damp place.

Bees can live anywhere if pollen and nectar and water are made available to them ; but the farther you remove them from towns and cities and in the interior of the country—away from noises, smokes etc.—the better are your prospects of a good yield.

Keep your hives away from your cowpens ; bees do not appreciate the smell of animals—and even human smell—till they become accustomed to a man, by domestication.

Keep your hives facing the east ; so that the first rays of the rising sun reach them early, and the bees begin to work earlier.

Keep your hives on a level ground. Otherwise, the combs will make an obtuse or acute angle with the frames, and manipulation and extraction of honey will be difficult.

Keep your hives in a sheltered place away

from winds. Bees do not thrive in areas where winds blow at velocities of over 6 miles an hour.

Keep your hives at a low place so that when returning to the hives laden with honey and pollen, the bees make a downward flight.

Do not keep your hives under direct sunshine. The wax inside the comb is likely to melt away.

Do not keep your hives in places frequented by ants and other pests.

Do not keep your hives in a place of too much vibrations such as in the vicinity of a railway line or a busy road or an engine shed. Bees do not like vibrations.

Keep your hives at distances of at least 4 feet from each other.

EXAMINATION OF HIVES

Do not disturb the bees by opening the hives unnecessarily unless external signs suggest something amiss. It hinders the work of the bees. The disturbance might break open places or smash parts carefully built up by them ; to set matters right many hours of bee power will have to be diverted from the normal work ; sometimes the work of a day.

Homing of bees laden with pollen with water and brisk work are good signs.

Do not disturb them unnecessarily particularly in the honey season; you will lose the honey which you might otherwise have got.

Do not open the hives during heavy rains. Water vapour might get into them and unhygienic conditions might result.

Do not open the hives on a cold day ; you will be chilling the young brood ; and deprive them the warmth of the hives so very necessary for the laying and the hatching of the eggs and the growth of the young bees.

Make your examination as brief as possible, with the minimum of inconvenience to bees in their normal work.

Ordinarily the cleaning of bottom boards in a week or so suffices.

Do not make a major examination of the hives when the temperature is less than 70° F.

Presence of drones near the entrance, clustering of bees on the outside in an idle manner, cessation of pollen gathering are signs of queenlessness. Examine the brood chamber fully ; absence of eggs and larvae confirms the guess. Attend to requeening immediately.

Remember that bees should not be starved. Healthy bees well supplied with stores and sheltered well hardly to desert.

Remember that bees dislike quick movement of others. Handle them as gently as possible.

The object of the examination of the hives are :—

(1) To see if the working is, to all outward appearances, proper and brisk.

(2) If the bees are bringing pollen and water.

(3) If the bees are clustering on the outside idly.

(4) If the colour of the bees has darkened.

(5) If there are too many drones loitering.

(6) If there are newly laid eggs and larvae.

(7) If there are sufficient provisions in the hive.

(8) If the combs have become dark and brittle.

(9) If there are too many drone-cells.

(10) If the comb building is progressing normally.

(11) If queen-cells have been formed.

(12) If the hive has sufficient space for an increased bee strength.

(13) If honey has become ripe for extraction.

(14) If bee strenght is diminishing.

The first five points should be noticed without opening the hives ; 1 and 2 are good signs ; the other three suggest queenlessness. Other tests should be made in the proper seasons with the proper objects in view.

If during the season of honey-flow the bees increase numerically and space in the hive becomes insufficient, provide more space by increasing supers, otherwise the colony might swarm.

Prevent swarming of your bees in the honey season as far as possible by using all artificial means.

If swarming seems inevitable in the light of the behaviour of the bees, attempt at the division of your colony ; but prevent after-swarms at all cost.

If your hive attempts at deserting repeatedly after repeated rehiving, give a brood comb to the hive.

Remove all the dark and brittle combs in advance of the honey season and replace them by new ones.

If your colony is queenless, or if the queen does not lay properly or is injured or is too old, requeen it well in advance of the season of honey-flow or by supplying a young pedigree queen.

If your colony is too weak at the close of the honey season or at the commencement of the cold season, unite it with others, or let it away.

If, as the rainy season or the cold season advances, the numerical strength of the bees diminishes, narrow down the space in the hives either by removing supers or contracting the space by putting up boards. Remember that the warmth of the hive should be maintained if the bees should live; too much space diminishes the warmth.

THE RAINY SEASON AND WINTER

The flora is exhausted in most localities ; start now on one major examination to see how the food situation stands.

Supply stores to all colonies which are in immediate need of them in order that they do not begin to starve soon.

Bees do not like damp and winds. Keep your hives well sheltered either by removing

them indoors or by providing the hives with an all-round cover of leaves etc. that would drain away rain water and keep the hive warm.

Healthy bees, well supplied with stores and sheltered well, survive the rainy and cold seasons easily ; and yield a heavy crop of honey when trees blossom.

Old and established colonies yield more than newly hived ones. It is a crime to lose them.

Strip your hives of supers. (Pile up carefully the surplus comb frames and extracting machines in a cool room). Contract the entrance.

Bees do sometimes get a little honey in the rainy season ; they will fly to gather it at any temperature and under any conditions even in rains until flying becomes impossible. It is in their nature to be busy and working. It is for you to get for them more than a negligible quantity. Plant vegetables profusely. They will give vegetables to you and to the bees sufficient nectar and pollen to carry through the rainy season.

Do not open your hives during days of heavy rains. After the first major examination is over, be contented with an outward examin-

ation. If an internal examination becomes necessary be as brief as possible.

Break up queenless colonies and unite them with small colonies.

Send away all those colonies which have, for no clear reason, given a very poor yield.

Great skill in bee-management and the understanding of the weather conditions is necessary to carry the bees successfully to the blossoming season.

SPRING

Have strong colonies of bees working at blossoming time. Profits can be derived only from colonies strong and healthy (populous).

Keep them in a good honey yielding part of the country-side in order that they may be adequately supported and a good honey harvest is assured—in seasons good as well as bad. Widen the entrance.

Keep only as many colonies as an area can support with pollen and nectar.

Keep them within very easy reach of such plants particularly in the early part of the season. i. e. in the brood rearing season—and

this is the time when bees cannot afford to fly more than 100 to 200 yards without loss.

Remember that location, sunshine, warmth and atmospheric moisture affect and determine nectar secretion.

Remember that sun-lit days, warm nights, gentle rains, and only a little wind are ideal for the manufacture of nectar by the flowers ; and for its gathering by the bees. At low temperature nectar secretion is low.

Egg-laying and brood-rearing are controlled by temperature and food—the former having the better say. If you want to stimulate brood-rearing from blossoming time, begin to attend to the bees and to feed them six or seven weeks beforehand in order to have a substantial population of flying bees when the season starts.

Remember that each honey-season lasts for only a few days ; honey should be harvested then; there is no room for a late-comer. Industry, skill and tact—these alone ensure success.

EXTRACTION OF HONEY

Do not extract honey from the combs till it is fully ripe i. e., before the bees begin to seal the cells.

It pays to go on adding honey-chambers to reasonable limits as the earlier ones get filled with honey and extract all at one time rather than to extract combs from a single chamber.

It pays in the long run to leave traces of honey in the cells rather than to extract them fully.

It pays well not to extract honey from the combs as the collection slows down ; bees require it.

Return the extracted combs immediately on extraction to the hive.

Store away the unwanted honey combs in the rainy season in a cool place safe from the attacks of cocroaches etc.

For distributing wealth equally like so many raindrops in every house, for making the masses of the people self-dependent, for not only the capable few rendering service to the many, but for the many also out of their strength rendering service to the capable few, and for strengthening mutual co-operation between the people there is no plan so natural, easy and efficient as village industries.

—Vinoba