A HAND-BOOK OF



BEE-KEEPING FOR INDIA.

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HAND-BOOK OF BEE-KEEPING

FOR

INDIA.

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PART I.—Theory.

CHAPTER I.

INTRODUCTION.

THE old system of bee-keeping had the one merit of simplicity, but its profits were more precarious and much smaller than under the improved system. The hives were closed and their contents could not be examined until the bees had been suffocated: in the autumn each hive was weighed, the heavy and light ones were taken and their bees suffocated, the medium ones were left to winter, and work and swarm the following year; the bees suffocated were labourers lost. The bees managed their affairs as they pleased, they swarmed as their instinct guided, and if they were failing from any cause the bee-keeper could not come to their assistance with a remedy: queenlessness, and in bad years starvation, caused the extinction of numbers of stocks, while the honey harvested

was commonly in a less marketable form, or only separated from the wax by methods which greatly impaired its commercial value. Bee-keeping under such conditions could not be expanded beyond a very small industry, and its profits, although relatively large, were absolutely small and precarious. Indian bee-keeping is for the most part worse than the old European method described above, for there is no weighment of hives, and every stock, rich or poor, is ruthlessly robbed.

2. The first great improvement was the invention of the bar-frame hive; the German and Italian form is the invention of Dr. Dzerzon; the present English and American form is only about 30 years old. The improved hive rendered it possible to examine the combs and bees at any time, to feed, to take brood and stores from one hive to give to another, to change the queen, make artificial swarms, and generally to control the breeding, and take the stores without injuring the bees. The invention of the honey extractor then rendered it possible to take the honey and save the combs to be refilled. Artificial comb foundation is an invention which enables the bee-keeper to save the great expenditure of labour and time required to make combs from freshly secreted wax, and it enables him to get his frames quite filled with honey and brood, and to at the same time keep down drone breeding. A number of observers have chronicled the life history and anatomy of the bee, and these are now so far understood, that bees can be bred as

certainly as poultry; many of the ills and accidents bee life is liable to can be successfully dealt with, and bees can be fed on substitutes for honey and pollen, so insuring their existence in due number irrespective of their natural food supplies, and a large number at the season when honey is plentiful. The invention of queen cages, smokers, nuclei, the system of artificial swarming, sectional supers, etc., has made bee management easier, simpler, and also more certain in its results: whereas the old system was one barbarous to the bees, less productive, precarious, and not admitting of expansion beyond the limits of an industry to be pursued by the peasantry on a very small scale, the new system has rendered it practicable to keep bees on a large scale as a remunerative employment.

3. Bee-keeping is not an industry which can be profitably pursued without any capital at all, nor is it an industry which yields large profits without labour, knowledge, or experience; but if started with very trifling capital and working expenses, the capital may be rapidly increased as experience is gained, by the mere investment of the income, and the natural increase of well-cared-for bees; the return for the capital is as certain and relatively much greater than in any other rural industry.

4. As to the possibility of keeping bees in India, of that there can be no doubt; the development of young bees demands a high temperature and a moist atmosphere, and the mature bees love the sunshine; on the other hand, in their warm nest with its accumulated

stores rendering it unnecessary for them to leave the cluster, they bear the severe cold of the German winter, they can live in Switzerland 4,500 feet above the sea, and they are wild in the hills in India, where there is both a severe winter and an immense rainfall. The hive bee, like man himself, by its providence and its ability to protect itself against its enemies and the elements, can inhabit widely differing climates: it is profitably cultivated in the temperate and tropical zones; why should India, the home of the wild bee, be an exception? In the hills there is abundance of wild pasturage, in the plains millions of acres of cultivation offering to the bees abundance, and the dense population have a love for sweets infrequent in colder climates. In America, where the honey bee is most successfully cultivated, there were no hive bees until they were imported from Europe. This is also the case with Australasia, where even now the Italian bee is being introduced.

5. If it be asked why has not bee-keeping been carried on hitherto by the people of India, the reply is that bee-keeping of a kind worse than the old system of Europe is carried on over almost the whole of India in the plains and on the slopes and plateaux. That this precarious and comparatively unproductive indigenous system has not been replaced by the modern system is not surprising, seeing that the improved system is comparatively new in Europe and America, and that even now, in countries so far advanced in the rural arts as England, France, and Germany, the old

European system is still commonly carried on; in Belgium and Western Europe, the old system is almost universal. Only in Germany and America is bee-keeping on the modern system carried on in large apiaries, although in England many small apiaries are as advanced and as well managed as the American or German. It is not to be wondered at that what has comparatively recently been discovered in Europe has not yet spread to India.

6. As to the productiveness of the indigenous hive bee under the best system of culture, the data available is very limited; there can be, however, no doubt that the indigenous bee is sufficiently productive to be very remunerative. The Italian bee is probably better,—it is certainly easier to handle, but bee culture commenced with the indigenous bee can be readily extended to the Italian bee. The latter has been successfully introduced, and will probably very shortly be distributed for breeding in the hills. As to the quality of the products produced by the indigenous bee and the imported bees, Mr. Todd, who keeps the indigenous bee, produces as excellent honey in as marketable a form as any produced elsewhere. The extracted light honey sells very readily at 12 annas to one rupee a pound, while the darker qualities just as good, or even better in flavour, would probably be quite as valuable in India, as the native consumer has not yet got the European prejudice in favour of the lighter kinds. Bee-keeping in India has before it a great future; as in the other economic arts it is for the

European to lead, when the benefits to be derived have been demonstrated no doubt the natives of India will follow. Beyond the material profit, the intelligent bee-keeper is rewarded by the intellectual pleasure afforded by observing the phenomena of bee life, for over most persons who keep bees the pursuit exercises a fascination few cultured persons can resist. Apart from the fanciful writing on the economy of the bee hive, there is much of deep interest connected therewith; the sanitary precautions, the foresight, the division of labour, the courageous self-sacrifice of the individuals for the common good, and the untiring industry and vigilance of the workers, to whatever cause due, appeal to every lover of nature and bear upon some of the greatest philosophical problems, *e.g.*, the question of animal automatism.

CHAPTER II.

SPECIES AND VARIETIES CULTIVATED.

7. Entomologists understand by bees a great number of kinds of four-winged insects differing very widely in their structure and habits; the bee-keeper is only interested in the genus *Apis* familiarly termed the hive bees, of which *Apis mellifica*, the European hive bee, is the type. The honey bee is extensively cultivated in Europe and America, bee farms occasionally numbering over a thousand hives. The largest apiaries are found in Germany and Eastern Europe and in America. Of the relative values of the several species

or varieties of the honey bee cultivated in Europe and America there is difference of opinion; there can be no doubt that, generally speaking, the Italian bee is better tempered and much easier to handle than the black bee, and it is preferred in America, where some of the most experienced bee-masters think it proof against the wax moth; it is admitted to be relatively prolific. The Egyptian bee, extensively cultivated in Egypt, was introduced into Europe, but found undesirable, being vicious and not subdued by smoke. Many varieties of honey bee are puffed by vendors and sold at high prices, but excepting as means of crossing for strengthening the varieties under cultivation, their superiority is doubtful, and in some instances they possess very undesirable qualities rendering them inferior to the black or Italian bees.

8. In India the bees are divisible into three species,—*Apis florea*, a small bee building a single comb on trees, walls, and bushes; *Apis indica*, a bee building a number of parallel combs in cavities in trees, &c.; and *Apis dorsata*, a bee building an immense single comb under the bough of a tree or overhanging rock.

9. The cultivation of unicomb bees has not been attempted; the mere fact of their building only one comb, and that in the open air, renders cultivation by the usual means impracticable, *e.g.*, the one comb cannot be taken without taking the brood with the honey. *Apis indica*, the bee which admits of cultivation as a hive bee, is very generally distributed over the plains

of India, the slopes of the mountains, and on the plateaux; it thrives wild in Bengal, where the weather is relatively warm all the year round, and at altitudes having frost and snow in the winter. The several varieties of this species differ in size and depth of colouring, and it seems probable they differ in temper. The variety found in Bhutan appears milder in temper, and is larger than any other variety I have seen; whereas the usual size of worker cells is 6 to the inch; those of the Bhutan variety are only $5\frac{1}{2}$ to the inch. There can be no doubt bees may be cultivated in most places in India, while if any particular variety is found to possess superior qualities to others, that variety can be introduced elsewhere; the transport of queens and small stocks and a trade in the same would be part of the business of apiculture, just as the supply of queens and stocks is carried on by breeders in Europe, many of whom breed and export bees only, without reference to harvesting honey or wax.

CHAPTER III.

DESCRIPTION OF THE HIVE BEE.

10. The inhabitants of a hive are of three kinds,—workers, drones, and a queen or mother bee. Workers form the great majority; they are sometimes called neuters, but are really imperfect females. They do all the work of the hive, collecting honey, pollen, propolis, and water; they secrete the wax, build the comb,

attend to the young, and defend the hive against intruders. They are provided with stings, but do not lay eggs excepting in a queenless hive when a worker may lay eggs; but these eggs are all drone eggs, never worker or female. The worker is the smallest, and workers are always present in every hive at every season of the year. The worker (*Apis indica*) is also distinguished by alternate yellow and black stripes across the abdomen, by its being narrower and more pointed at its posterior extremity than the drone, by the possession of a long tongue and strong jaws, by the shape of the head, which is almost globular in the drone and flat in the worker in consequence of the drone possessing much larger compound eyes. Bees have two kinds of eyes,—simple eyes, of which they have three in the centre, and compound eyes, the great eyes at the sides of the head; in the worker the compound eyes are situated at the sides of the head only, and the simple eyes are on the top of the head. In the drone the compound eyes are relatively very large, meet at the top of the head, making the head bigger and more globular than that of a worker, and the simple eyes are thus lower down and on the face. The workers have also nine rows of bristles on the hindermost legs, forming the so-called pollen baskets, on which pollen and propolis are carried.

II. The drone is somewhat but not much longer than the worker, but is much thicker and very blunt, and hairy at the posterior extremity; the Indian species has not the yellow rings of the worker, but is much

darker. Drones fly with a different sound, and have a more erratic flight. Normally there are no drones during the rains in the plains and the winter in the hills. As swarming time approaches drones are bred, and as soon as the honey harvest ceases and swarming is over the drones are destroyed or die. Drones have no stings, they do not work, not having the natural instruments of workers; they fly in fine weather during the warmest hours of the day, at other times they remain on the combs. It is supposed they may by their presence aid in keeping the brood warm, but this is doubtful, as they are only present during the warmest season.

12. The queen is the mother bee, the only perfect female in the hive; she lays queen, worker, and drone eggs. Upon the existence of the queen depends the existence of the stock; the head of the queen is like that of the worker, the jaws and tongue differing; the colour of the queen resembles that of the worker, but is commonly more uniform, the stripes being less distinct and darker; queens differ in size and colour, being far less constant in these points than workers. The queen has the thickened hind legs of the worker without the pollen baskets, but the most obvious difference between queen and worker is the greater length of the queen's body and her relatively shorter wings; the queen has a curved sting, which she only uses against other queens. Workers and queens respectively differ in size; they also vary with certain conditions,—the worker gorged with sweets is much

longer than the same individual empty, and the length of the queen's abdomen is greater in the breeding season than at other times. When not laying, the queen is sometimes distinguished with difficulty, particularly if naturally a small queen: in a crowded hive it is sometimes very difficult to find the queen. A great advantage possessed by Italian bees is the ease with which the queen is distinguished from the worker; the queen of *A. indica* often differs so little from the worker that she is very difficult to find.

13. Bees vary in appearance with their age,—young bees are more hairy, and when just hatched their hair appears lighter, giving them a powdered appearance; old bees may have lost much of their hair, and the abdomen may be almost denuded of hair and quite polished; very young bees are slower in their movements and cannot fly, so that if shaken on to the ground they cannot rise again and are lost. Young bees are far less likely to sting if handled, and they receive a strange queen or workers readily where old bees would destroy the former and enter into deadly conflict with the latter. The proportion of young bees is known by the quantity of brood in the hive.

14. The number of bees in a hive differs widely with the stock, some being better than others, and it varies with the season of the year. After wintering a weak stock may be reduced to a few hundred bees, a strong stock at the height of its development may contain 60,000, or even more; 15,000 to 40,000 is a common estimate of the number in a full hive;

the former number would constitute a weak stock, the latter a strong one, but the latter may be greatly exceeded: 6,000 to 8,000 bees are considered a weak swarm, 12,000 to 15,000 a medium swarm, and 20,000 a strong swarm. The above figures are for European bees; the Indian species is much smaller than the European, but it does not appear inferior in number to the above figures, it being considered that the number in the case of European bees is increased by artificial means during cultivation. Stocks of *A. indica* admit of being made very strong. The number of drones may reach 6,000 if the bees are left to themselves; it varies with the age of the queen, and should usually be from 600 to 1,500 in the summer, drones being entirely absent in the winter and spring.

15. During fine weather at least one-third of the workers are out at one time.

16. Workers live only six to eight weeks in the hard-working season; those hatched out in the autumn live through the winter, or in the plains some of those hatched just before the rains live through the rains, those living through the inactive season live long enough to rear brood to take their place when the breeding season returns; they may live eight months, or in queenless hives longer; they do not live through the year as a rule, but the extreme limit possible, provided they do little or no work, is probably more than a year. Drones are hatched in the spring or early summer and destroyed in the autumn by the workers, being bitten worried, and driven out: the performance of the sexual function causes death of the individual drone. In a

queenless hive, however, drones are tolerated at any time; and generally, if not likely to be required they are destroyed, if likely to be required they are tolerated; thus they may be destroyed in midsummer if swarming is stopped by bad weather and honey fails, or they may be tolerated in winter if the hive be queenless. Observation of the treatment of the drones affords the bee-keeper valuable information as to the condition of the stock, and the honey supply. Queens normally live several years, they have been known to lay well up to five years of age; they are at their best in their second season.

CHAPTER IV.

THE HONEY COMB.

17. The honey comb is first made of wax; it is commenced above, built downwards, and fixed firmly to the top bar and sides by means of propolis, a dark resinous matter collected by the bees from the buds and bark of trees. The wax is secreted by the worker bees in glands situated under the abdomen and between the rings; there are four of these on each side forming the so-called wax pockets, and the wax is exuded at the proper time in the form of small pearly scales, which may sometimes be seen on the hive floor of newly-hived swarms or other bees building. Wax is a fatty body melting at about 142° F. All the comb is not built at once; at first sufficient is built for the immediate needs of the swarm or stock,

and this is added to from time to time as required. The cakes of comb are built of different shapes according to the shape of the cavity the bees live in; but when they have room, as in a hive, the comb is naturally built in a somewhat triangular form, the base of the triangle being above, and the apex, usually very much rounded, below. The bees would thus not usually fill the rectangular frames of a hive, but the bee-keeper supplies more comb and more regular comb than the bees would build if left to themselves; he thereby gives more room for brood and honey, hence he gets more bees and honey than would be produced naturally. But these large rectangular sheets of comb render it more difficult for the bees to get from comb to comb, particularly during winter; the bee-keeper remedies this by cutting holes through the combs, and by making passages over the combs.

18. When the honey comb is first built, it is white or almost white and very fragile, but after it has been used by the bees it hardens, and being used for brood the silken cocoons of the young bees left in the cells year after year strengthen it: the cells appear to be varnished with a dark-brown varnish of propolis; hence old comb is dark brown and much stronger than new comb; the bee-keeper prefers the old combs for this reason. Although dark in colour, the honey from them does not differ in colour from that taken from new white comb, and the wax from the darkest comb is light yellow: obtained from some sources in India, wax is dark orange in colour. Old comb is warmer for

brood and for bees to winter on, and if bees have to be transported any distance, only old tough comb can be packed.

19. Before a swarm leaves the parent hive, the bees fill themselves with honey; this honey is the material by the consumption of which wax is produced. To produce a pound of wax the bees consume from 16 to 20 lbs. of honey, and the loss of time raises the cost of the pound of wax to the equivalent of 25 pounds of honey; hence one reason of the great importance of modern practice. Good comb is never destroyed unnecessarily, but emptied and given back to the bees, and old comb is supplied to swarms that they may commence to work and breed at the maximum rate at once, thus avoiding the delay, and in a great measure the expenditure of honey and labour, required to build new comb.

20. The quantity of comb filling an ordinary hive weighs about 2 lbs., and the weight of comb when full of honey does not probably exceed 10 per cent. of that of the contained honey.

21. Bees build three kinds of cells,—worker cells, which are the smallest; drone cells, which differ from worker cells only in size, being larger; and queen cells, which are ovoid in shape, are usually built on the edges, but sometimes project from the face of the comb. The worker cells are 6 to the lineal inch, or 36 to the square inch in most varieties of *A. indica*, but the Bhutan variety builds cells as large as $5\frac{1}{2}$ to the inch, or 30 to the square inch. A square inch of

brood comb thus contains 72 and 60 young bees respectively. These cells are the most numerous; they are the first cells built, and often the only kind present. Drone cells are built in a far smaller number later in the season, and when the queen is young none may be built the first year. The worker cells of the European bee are 5 to the lineal inch, 25 to the superficial inch, or a square inch of comb contains 50 bees on both sides. As the worker comb is built first, the upper part of the comb is commonly worker size, and the drone comb is built at the lowest part of the comb or at the edges. Drone cells are larger than worker cells; the drone cells of the Indian bee are 5 to the inch, the Bhutan variety building larger cells, as its worker cells are larger; the drone cells of the European varieties are about 4 to the inch. Cells vary in size within 10 per cent., and they are not so regular in shape as usually stated, being occasionally even four-sided. As each bee leaves its cocoon behind in the cell, the cells are gradually contracted until they are so small as to dwarf the bees bred in them; the bee-keeper arranges for renewal of the comb gradually, but the cocoons are so thin that combs may be used with advantage seven or eight years before appreciably affecting the size of the bees. In a state of nature much comb is destroyed by moth during the inactive season, when the bees are few and quiescent, thus providing for renewal of combs. Whereas worker comb is always present, drone comb is only built under certain conditions, *viz.*, when honey is being gathered,

the hive is well populated with workers, and the swarming season is approaching, *i.e.*, with the return of the warm season. When drones are required early for breeding, their production is hastened by artificial means, *viz.*, by stimulative feeding and by inserting artificial drone-comb foundation, or old drone comb kept for the purpose. Queen cells differ widely from the others; they hang with their mouths downwards, and are somewhat acorn-shaped. The bees build a cup opening downwards, they then elongate it to a conical shape, cover it with an excess of wax, and corrugate it with miniature comb on the outside, somewhat like the outside of a thimble. One day or sometimes two before the queen is hatched, the bees thin the end of the cell, removing the point and leaving a thin cell wall with a flat end; when the young queen is ready to emerge, the cell is opened below by a circular lid, which hangs open after the young queen has emerged. Queen cells are ultimately cut down by the bees, who may in weak stocks leave a small cup, or clear away the whole cell; those on the face of the comb are usually removed entirely.

22. The combs of *A. indica* are naturally built $\frac{5}{16}$″ to $\frac{3}{8}$″ apart between the faces of the combs, the worker brood comb is about $\frac{3}{4}$″ thick, drone brood comb reaches almost 1 inch in thickness, store comb $1\frac{3}{16}$″ to $1\frac{3}{8}$″, but the bees readily build out to the thickness of the sectional supers used in Europe, $1\frac{3}{4}$″.

23. The comb is used by the bees for several pur-

poses. The cells are the receptacles for eggs, and are inhabited by the young bees from their emergence from the egg as minute maggots (larvæ), while they pass through their changes and growth until they ultimately gnaw their way out as perfect bees. The large or drone cells are used as receptacles for drone brood only, for which they are specially suited by their larger size ; the smaller or worker cells are used for worker eggs and the resultant brood. The cells are used as resting places for tired bees, which creep into cells containing eggs or into empty cells and remain motionless therein 15 to 20 minutes at a time, apparently resting. The comb is also used for storing honey and pollen; cells used for honey are frequently lengthened until the comb is $1\frac{1}{2}$ to 2 inches in thickness at the upper part or store comb, and these cells are made to incline upwards in such manner that the honey may not run out previous to its being capped over.

24. When the combs contain brood, the honey is stored at the upper part of the comb to about one-third of the depth of the comb or less. If drone cells be present, and drones are not being bred in them, these are readily used as store cells, particularly if near the top or back of the hive, or if the bee-keeper has inserted drone comb to breed drones. As breeding is increased the brood reaches the top of the comb, and may cover every comb ; on the other hand, if honey is coming in very rapidly, the bees will fill every brood cell as it becomes vacant, and so even the cells necessary for brood may be filled with honey and breeding be prevented ;

this accident sometimes happens through ill-managed feeding: the bee-keeper remedies it in either case by clearing the brood combs with the extractor. When the combs run across the entrance, the back and front combs are used for brood last, and these are filled from top to bottom with honey until required for brood; they are also so used as soon as the brood nest is contracted. When the breeding season commences, the honey is cleared from the back combs and brought into the brood nest, and this is sometimes hastened by the bee-keeper cutting the caps off the honey cells so as to hasten consumption of their contents, and so stimulate breeding. The brood of a fertile queen is compactly arranged on each brood comb, at first in a patch on one comb, then it spreads to other combs and upwards; the first comb used for brood is in the centre or near the front, but not the first comb, and the outside faces of the end combs are used seldom. Worker and drone brood is normally always raised in the proper cells respectively, but under certain abnormal conditions the eggs are irregularly distributed in small patches and singly all over the combs; drone brood is reared in worker cells, and several eggs laid in one cell (*vide* Arts. 47, 48). Pollen is not all placed together as honey is, but distributed through and near the brood combs.

CHAPTER V.

GENERAL ECONOMY OF THE HIVE.

25. The whole economy of the hive is directed to the preservation of the individual and perpetuation of the race, with the exception of some apparent anomalies present under exceptional conditions, when the energies of the community seem paralyzed or misdirected. The individual is sacrificed to the preservation of the race when necessary, and there is a stern utilitarianism ruling bee actions, which, whether it be attributed to highly developed instincts or more or less to calculation, is exceedingly interesting.

26. The work of attending to the brood is performed by the young bees, sometimes termed nurse bees, and these generally do the work to be done inside the hive—a manifest economy of labour, as the young bees cannot work outside until from 5 to 10 days old. The bees keep their hive clean; they remove outside and throw down beyond the flight-board all bees dying in the hive; they take out small pieces of wax or other matter they do not require and can remove. If a slug or other small animal penetrate into an active hive, it is stung to death, and if it cannot be removed, it is covered with wax. Bees do not void fœcal matter in the hive unless diseased; this is one great cause of the serious loss of life which takes place when bees are shut up on long journeys without getting a cleansing flight. It also leads to disease if bees in winter are fed on thin

liquid food, or disturbed during this time so as to excite them to feed at a time when they cannot go out. During hot weather, when the hive has many inhabitants, a number of bees may be seen at the entrance fanning with their wings, while others fan inside, providing thus for changing the air in the hive and cooling its interior; the importance of this is obvious when the vast number of bees in a full hive is considered. The temperature of the hive has, however, to be kept up to hatch the brood, and crevices in the hive walls and the crack between the hive and floor-board are carefully sealed up with propolis to keep out draughts. Comb frames are also liable to be fixed down in this way, to prevent which they are hung on a thin edge of metal or wood.

27. Bees are fond of the warmth of the sun; they begin work early as soon as the sun is up, and they work until nearly dark; they may be seen coming in in the summer, when it is almost dark. At night they go up into the combs and keep together, hence hives are always closed for removal after dark. Bees are believed to fly within a radius of two miles from their hive. If a hive be moved a mile and half, very few, if any, bees are lost; but if removed a short distance, many return to the old place and are lost. Hives cannot be moved short distances excepting with certain precautions. The bees appear to fly round and observe the neighbouring objects before starting, and young bees come out and fly about the front of the hive occasionally, before they enter upon outdoor

labour. The bees working outside bring in honey, pollen, propolis, and water; the honey is carried by the bee in its honey stomach, the water is used by the bee to slake its own thirst and to soften solid sugar given as food in the hive and crystallized honey. The warmth of the hive causes evaporation, and the moisture in the interior air in a full hive is considerable water is probably consumed in considerable quantities. Pollen and propolis are carried on the outsides of the legs of the workers; the latter is resinous matter, used to close up cracks, fix combs, &c. Pollen is used as food for the brood; it is mixed with honey when stored, to keep it. In the absence of pollen, bees will take pea flour, bean flour, or wheat flour instead, but they evidently prefer pollen. Pollen supplies the nitrogenous matter which is absent in the composition of honey. Bees cannot bring up brood without pollen or some substitute for it; the bees live during the winter on honey.

28. A somewhat high temperature is necessary to admit of the bees working the wax and hatching brood; for the latter purpose a moist atmosphere is, no doubt, necessary. At low temperatures wax is hard and brittle, it only becomes plastic with the heat of summer. The eggs are kept warm by the bees clustering upon them, and the bees keep themselves warm at night and during the winter by clustering on the combs. If a hive has more comb than the bees can cover, they do not cover it with scattered bees, but the bees all collect on as much comb as they can cover

closely, leaving some comb uncovered; and in the inactive season the number of bees being greatly diminished much comb is left uncovered. The bee-keeper removes these combs, usually fumigates them with sulphur, and stores them for future use, at the same time contracting the size of the hive so as to economize the heat. If not removed, the spare combs are likely to be destroyed by moth. Their destruction in indigenous stocks in the plains, during the rains, is almost certain; Italian bees protect their combs effectually against moth until the bees are reduced to very few indeed. As hot air is lighter than cold, the bees cluster above, and it is very important in wintering that the hive be closed above to prevent loss of heat. In winter the temperature of the interior of the hive should not sink below about 50° F., and in summer it should not rise above about 98°, as above the latter temperature the bees are less active. On hot days the fanners are very active at the entrance. They may be seen standing all along the entrance fanning vigorously. The change of air no doubt helps to keep the hive cool. In winter the moisture given off by the bees condenses and runs down the hive sides; the use of chaff cushions, straw, and similar permeable non-conducting materials to cover hives, has the object of allowing some of this moisture to escape. This permeability with non-conductivity for heat is what renders straw such an excellent material for hives.

29. In the day-time the entrance to the hive is

guarded by bees, who may be seen to examine other bees seeking entrance; a tap on the flight-board will usually bring these sentinels to the spot, and they will be found very ready to attack if irritated. These bees kill any bee from another hive seeking entrance, unless the intruder is laden, in which case, it is said, she is admitted. The bees evidently recognize the inhabitants of their own hive, however numerous. In defence of their hive the workers do not hesitate to sacrifice themselves; they attack hornets, wasps, ants, or other assailants in the most courageous manner, acting together to destroy the enemy. It is a mistaken idea that bees are ready to sally forth and attack *en masse*. Carefully handled, they usually show but little disposition to sting, and stings when inflicted are usually the acts of individuals not acting in concert. At a short distance from the hive, bees show no disposition to sting unless actually seized,—their first desire is to escape. Bees do not apparently sting a queen; strange queens are clustered upon (technically "balled") and suffocated. Drones are not killed by being stung; they are worried and driven out. A strange bee, ant, wasp, or other similar intruder is seized by a number of workers, and the bees can be seen trying to use their stings. Flies settling on the flight-board are driven away; they are sometimes seized and stung, if they enter they are killed and brought out. The indigenous bees are distinctly inferior to the European bees in keeping their hive free from intruders. *Apis indica* will share a cavity with wasps; spiders, cockroaches,

and other vermin will sometimes be found in the hives, while the Italian stocks under similar conditions are quite free ; the wax moth may be found on the floors of indigenous stock hives, while the Italians keep their hive quite free from this pest, and indigenous stocks in Calcutta certainly do not guard their entrance as the European bees do.

30. While bees readily defend their own stores at the risk of their lives, they will also attack another hive when this other hive is weak or queenless, and honey fails in the fields. If fed on honey outside the hives, or if syrup or honey be spilt about the apiary, the bees become demoralized, and instead of working at the flowers they attack each other's hives ; a general war may break out in the apiary ending in the rapid destruction of every stock, unless the bee-keeper can stop the carnage. The existence of robbing is recognized by bees being dragged out by several others, and by the fights between individual bees ; the combatants hold each other, roll about together, then ultimately they either separate or one stings the other, when the latter curls up and dies at once. On observing this, the bee-keeper reduces the entrance to admit only one bee at a time, preferably to a long narrow passage easily defended, care being taken to keep this little passage clear of dead bees and other possible obstructions, and to ventilate the hive by means of a feeder, or the stock may be destroyed by being closed up. If reducing the entrance is insufficient, the hive is closed till sunset. Bees when robbing are more prone

to sting. As an outbreak of robbing threatens the existence of the stocks, the bee-keeper has to be ready with remedies and preventatives, and to be on the alert against it when the honey supply is failing. Weak stocks are united, queenless stocks and nuclei require special care to avoid their being attacked by strong stocks.

31. When food fails, the bees sacrifice drones, drone brood, and even the worker brood. When lavæ are brought out of the hive, it is evidence the bees are short of food, and the bee-keeper observing this feeds up the hive at once. The queen is the last to die of starvation; if she be confined with a few workers without food, the workers give the queen the honey in their honey stomachs, and they die of starvation. If from injudicious management too much food is taken from a hive, when the weather permits, the bees may attack other stocks; when starved in the winter from insufficiency or inaccessibility of their stores, the bees simply die in the hive; and when this accident happens, the queen succumbs last, and therefore sometimes the queen of a starved stock may be saved, although most of her bees have perished.

32. Apart from the economy of heat, bees have a habit of clustering, and they always cluster in the upper part of the vessel or hive they are in, so that the mass hangs downwards, the bees holding on to each other by the hooks on their feet. Swarms cluster in this manner. If bees are frightened they readily cluster in this manner, leaving their combs and hang-

ing from above in one mass. Knowledge of this fact is of great importance in manipulating.

33. Bees are intimidated by blowing on them a little smoke from burning rag, paper, dry wood, or other suitable material; they then go to the open store cells and commence to fill themselves; this renders them heavy and less active, and renders it possible for the bee-keeper to handle them with very little risk of being stung. The reason swarms are easily handled is the fact that the bees are gorged with honey, but within a short time the honey probably becoming absorbed, they become much more difficult to handle. Bees are also intimidated by jarring their combs, and if a box or hollow log containing comb and bees be smartly struck with a stick, a hammer, or even with the hand, so as to jar the combs, the bees leave their combs and cluster above. If a tree trunk containing bees be cut with an axe or adze, the shocks frighten the bees and produce the same effect, so that smoke is not necessary to quiet them. It should be noted that bees will not in such cases pass through a hole; if an attempt be made to drive bees through a hole in the top of a box or hive into a box placed above, the bees will in most cases merely cluster on the roof of the lower box.

34. Under some circumstances, bees will leave their hive, absconding in search of a new home elsewhere. The principal conditions under which this occurs are—accident to the queen when the bees cannot breed another; bees too few to attend to the eggs the queen

lays and to cover brood; failure of food in the hive; hive too hot, particularly in portable hives, when the bees are shut up on a journey—in this case they abscond when they get their liberty again; hive invaded by ants or subject to other cause of annoyance; bees and combs roughly handled in transferring them to a hive, &c. The indigenous bees are very prone to abscond after being transferred, so that stocks captured are very frequently lost from this cause; this accident is best avoided by transferring the stock in its old hive to its new stand, and abstaining from transferring to the new hive, or interfering with the combs, until the bees have been a fortnight at their new place, when they may be transferred as quickly as possible with very little risk of loss. If brood be present in a hive, bees will stay in it under very adverse circumstances, and a comb of brood is commonly applied by the bee-keeper to keep small stocks from absconding, and to retain swarms in hives they might leave; but the indigenous bees forsake their brood after being transferred much more readily than European bees do; hence special care is necessary in transferring them. Bees will not generally forsake their queen, hence caging the queen on a comb is a common preventative of absconding, but even this is not always successful with indigenous bees; they may let the queen die in the cage.

35. Much nonsense has been written about the authority of the queen in the hive, &c.; this is exploded. The whole of the members of the community seem to

act together for the common good ; the workers follow the queen in swarming, they feed her, and her absence from the hive gives rise to evident disturbance of the work of the community ; but they remove her if worn out, and her authority is a myth. When deprived of their queen, bees show their concern by a general excitement lasting several days, and shown usually in the morning ; they then settle down to work, but not with the same spirit as a stock with a fertile queen. They do not defend themselves apparently with the usual vigour, and hence such stocks are liable to be attacked and robbed by bees from other hives.

36. Bees, no doubt, under some circumstances, object to foul odours. A gentleman keeping bees in his verandah finds they never attack any of his servants but the sweeper, although the servants are continually passing in and out close to the hives. It is generally stated bees object to the close proximity of perspiring animals, and the bee-keeper is less likely to be stung if his person and clothing are free from odour, particularly the odour of recent bee stings. In uniting bees of different stocks, they are sometimes sprinkled with scented syrup to give them all the same scent : this is possibly useful, although when full of syrup bees are less inclined to fight, and the syrup without the scent may be sufficient. Hives once used should always be cleaned before being used again ; a hive smelling of mice is particularly disagreeable to bees, and may cause them to abscond.

37. If a stock be fed with syrup or pollen, or if it be

repeatedly smoked, a large number of bees will return to the hive from their work in the fields, and within a few minutes of feeding a hive quite a cloud of bees will be seen before the entrance; whether they can communicate with each other or not, there can be no doubt whatever that they do act together this way precisely as if there were some medium of communication between the bees in the fields and those in the hive. The bee-keeper sometimes applies knowledge of this fact,—*e. g.*, when he wants to get a number of old bees to put into a stock sold, he opens the hive and gives a puff of smoke at intervals; the result is, the bees return. He could thus take a large number of bees from the hive, or he may even remove the stock with much less loss than if he did not, as it were, have the bees out called in.

38. Where there is a cold winter, as in the hills and in temperate climates, bees do not breed during the winter; the queen then rests from egg-laying; there are no drones in the hive; the workers collect in a cluster in a centre of the hive to economize heat, and do not labour in the fields. If the hive has a due number of workers to keep each other warm, the consumption of food is relatively much less than in a hive containing fewer bees. The bees do not really hibernate; they feed, and unless food is not only present but easily got at, the bees starve. If bees are tempted out by the sun during frosty weather, they are apt to fall and die of cold; hence the entrances of hives are commonly shaded to prevent this accident. At the end

of the winter the population of the hive is greatly reduced; in the spring the surviving bees fly and recommence their labours; the queen commences laying; the brood spreads through the hive, and the number of bees increases rapidly. When the hive is full of bees, and honey is being collected in plenty, drone comb is built if not present, and drones are reared; then comes the swarming season. Queen cells are built, and as soon as these or some of them are capped, a large number of bees fill themselves with honey, and headed by the old queen leave the hive to seek a new home and form a new community. The honey with which they are filled serves them to start with, and enables them to secrete wax and build new combs in their new home. The young queen is impregnated by a drone and becomes the fertile queen of the old hive, or she issues with a second swarm, called also a *cast* on a second young queen coming to maturity. The number of queen cells built may vary from three or four to thirty, and several casts may go out, but as soon as the swarming fever is over the queen cells are destroyed, their inmates are slain by the queen in possession, or if two queens are hatched together, they fight until one is destroyed, one queen never tolerating the presence of a second. In the autumn the workers fall upon the drones and destroy them; the workers cease from their labours and lay up for the winter, so completing the cycle. In the plains the bees act as above; but where, during the winter, the temperature does not fall so low as zero, the rainy season corre-

sponds in the cycle to winter in the hills and in Europe, but the bees come out during fine days. During the rains the brood nest is contracted, and much comb left uncovered; the wax moth then invades the hive, and no doubt in a state of nature, or where crude systems are in force, much comb is destroyed.

CHAPTER VI.

SWARMING AND BREEDING.

39. After queen cells have been built and had eggs deposited in them, and when one or more has been capped over, the old queen, accompanied by a large number of bees, leave the hive, forming what is termed a swarm or first swarm. The number of bees in a swarm is very variable; in Europe 15,000 bees are considered a medium swarm; it measures about a gallon and weighs about 3 pounds: 25,000 would be considered a very good swarm. Indian bees are much smaller, and the data is not available in their case; the number of individuals in a first swarm may be less than the number in a European swarm; the swarms measure much less; two quarts would be a good swarm in lower Bengal. If small hives be used, as is often the case when common earthen vessels do duty as hives, or if the bees be wild and lodged in a small cavity in a tree or wall, the swarms must necessarily be small. A small hive compels bees to swarm early for want of room, and it is obvious that a small

hive by hastening swarming produces small swarms. Swarming may often be prevented by enlarging the hive; it is hastened by crowding the bees into small hives; hence, although only one factor, the size of the hive has a great influence on the size of the swarms, their number, and the earlier or later period at which they issue. Readiness to swarm renders a species less profitable, and troublesome. *Apis indica* is a swarming bee in a state of nature; to what extent this can be dealt with by art remains to be determined: this defect renders the importation of *Apis mellifica* of great value. Swarming species also breed more drones.

40. As a large number of queen cells are prepared and inhabited by queen lavæ, a number of casts may sally forth; the community being thus so divided that the latter casts, and even the stock remaining, may be too few or too ill-provided to survive the winter. The first swarm is headed by the mother of the old hive, a *fertile queen;* it takes place in the height of summer, when the hive is crowded and drones and queen cells are present; it leaves after one or more of the queen cells are capped. First swarms do not, as a rule, issue excepting during fine weather, and in the warm hours of the morning; should the weather become suddenly cold or wet, the swarm does not issue, queen cells are destroyed, and swarming is put off for the time until new queen cells are ready for capping, or the swarming may be checked for the season by unfavourable weather. The swarm being led by a fertile queen generally settles on a tree, bush, wall, er other

object, a short distance from the hive. Where many bees are kept, sometimes several swarms issue at once, and two or more may collect in one cluster. If the first young queen destroys the others yet in their cells, the swarming ceases; if, however, this is prevented by the bees, one or more after-swarms or casts issue. In the latter case the young queen utters a shrill sound, which the bee-keeper recognizes as indicating the probability of other swarms issuing. The second swarm usually issues on the ninth day after the first, and others at intervals of one or two days afterwards. These after-swarms issue at any time of the day with less regard to weather, and being headed by active virgin queens, they often cluster far from the hive. Sometimes these after-swarms contain more than one queen, in which case ultimately all but one is killed in fighting, the victor remaining to perform the maternal function for the stock. In this way one hive may send forth four or five swarms, these after-swarms being unprofitable and the old stock so weakened that it also is rendered unprofitable. The value of swarms depends on their issuing early; a second swarm, if early, may sometimes be profitable, but, as a rule, should be prevented. Naturally *Apis indica* swarms to such an extent that many stocks are lost during the winter and the rains from cold and starvation; in fact, the natural stocks captured in the plains will generally be found very weak, although occasionally a large area of comb may be found. In America, where the introduced European bees are now found wild, it is found that when wild

they are not comparable in the matter of productiveness with those cared for by the bee-keeper.

41. The queen leaving with the first swarm being the mother of the hive is capable of laying the several kinds of eggs, but the young queens require to be impregnated by the drone before they can lay worker eggs; if from any cause this does not take place, the queen only lays drone eggs, and is useless to the bee-keeper, as the stock headed by such a queen is obviously doomed to rapid extinction. Normally the queen goes out to meet the drones after three days from leaving the cell; this wedding trip takes place on a fine day, and usually in the warmest hours of the day; if not successful, it is repeated again and again until impregnation is accomplished, known by the queen returning with the organs of the drone attached to her, and by her generally commencing to lay eggs in two or three days. If from any cause the queen does not become impregnated within about 30 days, she is confirmed as a drone-breeder and useless. Virgin queens kept through the winter cannot be impregnated next season. The impregnation of the queen only takes place once in her life, and after this has taken place she never leaves the hive again excepting when she does so with a first swarm. The impregnated queen lays worker and drone eggs, the unimpregnated queen only the latter; the first year the former may lay no drone eggs, or she lays them only towards the swarming season; but as she gets older she lays more, and may towards the end of her fertile life lay only drone

eggs, the effects of the impregnation apparently becoming exhausted. Hence the age of the queen is a matter of great importance to the bee-keeper, who keeps a reserve of queens and replaces the laying queens before they exhibit any tendency to fall off in their laying powers. The bees themselves ultimately replace queens when their laying powers decrease, but the bee-keeper does not wait for this. The use of young queens also keeps down the number of drones. If a queen has shown exceptional excellence in the number, temper, beauty, or industry of her progeny, the bee-keeper may keep her longer than usual, for breeding other queens or drones to multiply his stocks, or with a view to breeding for sale; otherwise he replaces her usually in the third year.

42. The eggs are white, cylindrical, slightly curved, and fastened by one end to the bottoms of the cells. They are less than $\frac{1}{16}$th inch long; drone, queen, and worker eggs do not differ in appearance. In three days the egg is hatched, the lava is white, has no limbs, lies coiled at the bottom of the cell, and is fed by the workers with a whitish fluid. By about the tenth day it is straightened out, nearly fills the cell, and is capped over by the workers with a mixture of pollen and wax; darker, more porous, and more convex than the caps of the honey cells. Worker lavæ are capped with nearly flat caps, drone lavæ with caps raised almost to hemispheres; the kind of brood is readily distinguished by the capping. The lava spins an extremely thin cocoon, and changes through the pupa state to a per-

fect bee, which gnaws its way out, leaving its cocoon behind it. A fertile queen during the breeding season lays 2,000 to 3,000 eggs a day.

43. Workers emerge on the 20th to 21st day and drones the 24th to 25th day. Queen cells are sealed about nine days from the laying of the egg, and seven days later, *i. e.*, the 16th day, the queen comes out of the cell. If there be no queen in a hive the bees can raise a queen from worker eggs, or young lavæ not more than three days old; in the former case the queen will emerge 16 to 17 days after the worker egg was laid; in the latter case the queen may be raised in 10 days a three-day old lava being taken, and thus six days saved. The rule is to reckon always 16 to 17 days from the laying of the egg. One, or sometimes two days before the queen emerges, the workers gnaw the apex of the cell thinner, and this is a sign the queen is almost ready to come out. When the lava emerges from the egg, it may, strictly speaking, be said the egg is hatched; but when bee-keepers refer to brood hatching out, emergence of the perfect insect from the cell is meant.

44. Young bees attend to the brood. If a hive has few old bees, the young bees will go out in about five days; if there are no young bees the old bees will attend to brood, but young bees are necessary to rapid breeding. Properly a hive should have both old and young bees, excepting at the end of the winter, when it has only old bees; if it consist of young bees only it must be fed; if of old bees only, breeding will be

slow until young bees are raised or added by the bee-keeper.

45. In the plains of India the rainy season appears to correspond to the winter in the cycle of bee-life, but in those parts where during the winter months the temperature sinks to zero, this is the time of inactivity. In Lower Bengal bees begin to work soon after the rains cease. Bees breed when food is coming in and the weather is fine; a failure of the supply of honey and wet and cold weather causes the workers to destroy the drones and drone brood even in the summer; the bee-keeper keeps the bees breeding by slowly feeding them when the income from natural sources fails; the breeding is regulated by the income, not by the stores in the hive. Breeding may also be stimulated by uncapping the honey in the hive. A certain temperature, 95° to 100° F, is necessary for the brood, and this is obtained by the heat from the bees who cover the brood. Bees cannot rear more brood than they can cover.

46. Breeding is commenced on the centre of one comb, the patch of brood is enlarged, new patches commenced on the next comb, and so the area of the brood is extended until it reaches the outside combs. This spreading naturally takes place gradually, but the bee-keeper hastens it; when two combs have brood on them, he inserts another comb with empty cells between them, feeding slowly; the queen fills the empty cells with eggs, and the bee-keeper repeats the process, inserting another comb. The effect of this

(technically termed spreading the brood) is to cause the bees to breed far more rapidly than they otherwise would do. The process is not carried on so rapidly as to expose the brood to the accident of getting chilled, but as rapidly as the bees can cover the brood, and the hive is contracted to keep the bees crowded.

47. When a hive has too few bees to cover the number of eggs the queen lays, she lays several eggs in each cell, and the bees commonly destroy all the eggs so distributed. The queen may cease to lay, the stock is in danger of extinction, and it may swarm out and abscond. Sometimes the bees put matters right themselves, ultimately managing to get only a sufficiently limited number of eggs, one in each cell. Such a stock may be saved by giving young bees from another stock, by giving a comb of capped brood, or even by careful slow feeding with meal and honey, contracting the combs and reducing the size of the hive to two combs only; thus labour and heat are economized, and the bees amused and so kept from absconding. Under such circumstances smoke should not be used, and care should be taken not to disturb the bees more than necessary. This state is commonly that of imported European bees on arrival, and was that of the Italian stocks imported in 1882.

48. When a hive is long queenless and cannot breed a queen, a worker bee may assume the functions of queen and lay eggs; but as such a bee cannot be impregnated, all the eggs are drone eggs, and the brood may be recognized as drone by the capping. Such

eggs are laid scattered over the whole comb, not in a compact mass in the centre of the comb like those of a fertile queen, and drone eggs are laid in worker cells. A hive having a drone laying worker or queen rapidly loses its population entirely from the absence of workers. Drone brood may be hatched in worker cells as a consequence of the bee-keeper giving only worker comb and purposely keeping down the drone comb ; in this case the drones are likely to be smaller in size.

CHAPTER VII.

ENEMIES : DISEASES : ACCIDENTS.

49. The more important enemies of the honey bee are in the order of their importance :

The Wax Moth.—The moth lays its eggs in crevices in the hive and in or about the combs. The egg hatches into a greyish caterpillar with a brown head ; the caterpillar surrounds itself with a silken tube which it extends through the comb ; it grows rapidly and destroys the comb and brood in its path. The ravages of the wax moth may be readily seen on looking through an infected comb at a good light. In the commencement its web is like fine spider's web, stretched across the cells ; this and the presence of gunpowder-like grains, the excrement of the moth, are evidence of its presence. It is sometimes found in India on brood combs in strong wild stocks, but, as

a rule, it devours the comb not covered by the bees. All empty comb removed from a hive, or comb left uncovered in weak stocks, is rapidly destroyed by moth. In the rains the moth is very prevalent indeed ; it appears to be almost always present, for if a clean comb be removed from a hive and kept in a closed warm place, moth will generally make its appearance, and if then removed, the comb may be kept in a closed box without moth re-appearing.

Remedies.—The first remedy is strong stocks ; with European bees this is a sure safeguard. The Italian bee is esteemed by American apiarists as a remedy against moth, and its great superiority over *A. indica* is certain, for Italian hives keep quite free even when much of their comb is uncovered, while the indigenous hives require frequent examination to destroy the moth. The prevalence of moth renders the importation of the Italian bee a measure of great importance in developing apiculture ; the American experience of its being proof against moth has been amply confirmed in Calcutta ; there can be no doubt the tropical climate is very favourable to moth, and *A. indica* is not so vigilant against intruders as *A. mellifica* is. As a general rule, there is little to fear from moth if stocks be kept strong, all uncovered empty comb be removed, and no cracks or crevices be allowed in the hive. Cracks may be filled with clay, earth, or putty ; double-walled hives with closed spaces between the walls should not be used. Combs removed may be subjected to the fumes of burning sulphur with advan-

tage, two fumigations at a week's interval being used; combs should not be stored laid together, but kept apart by straw or hung apart with air spaces, the moth does not then get from comb to comb. In the winter combs may be exposed, but in the plains they should be kept in a closed box, barrel or earthen vessel, and examined from time to time, the moth being cut out if it appears; the combs may then be considered clear, and may be stored safely in a well closed receptacle for future use. Hives of indigenous bees should be examined occasionally for moth. The use of frames with saw cuts for inserting wax in the top bar should be avoided; the saw cut invariably harbours moth where the bees cannot get at it. Dirty quilts covered with wax and propolis and old pieces of rejected comb harbour moth; all rejected comb should be melted as early as practicable.

Hornets prey upon bees; they seize the bee when at rest and carry it off. *Wasps* steal honey when they can, but being so much larger than the bees in India, they are not troublesome unless the hive entrance be larger than it should be. Several *insectivorous birds* prey on bees, and will alight on the flight-board and capture bees. Flight-boards should not be large, and may in some cases be removed altogether to prevent their affording alighting places for hornets and birds. Birds may be shot or trapped; a net may be used over front of hive against birds and hornets; a small piece of wire-netting over flight-board through which hornets cannot penetrate, or bamboo, cane, or string-

netting, may serve the same purpose. The best remedy for hornets and wasps is the employment of a small bag net to catch them, and the destruction of their nests by pouring or syringing into them, preferably at night, turpentine, kerosine, or boiling water, then stopping the entrance with a rag. In the spring and summer all nests about an apiary should be destroyed.

Mice penetrate into hives in the winter, devour comb and honey and disturb the bees; the entrances should be contracted to prevent this. *Ants* are sometimes very troublesome, spots where they are in great numbers should be avoided. The smaller kinds penetrate into the hives, make nests and feed at the feeder: they are a nuisance and may give extra work to the bees, but are not destructive to the bees. The large black ants and the tree ants sometimes attack the bees and render hives untenable; the bees cannot defend themselves, as they cannot sting the ants through their armour. It does nor appear that bees are usually so attacked, as they build naturally under houses and in situations where they would be very liable to attack, but a hive of Italians at Calcutta was attacked by black ants, and hives of *A. indica* have been assailed by tree ants. The best safeguard is placing the hive on a stand supported on a single post fixed in the ground, and surrounding the foot of the post by water by means of an earthenware or zinc vessel, of such shape that the post passes through its centre, the space between the inner edge of the vessel and

the post being filled with clay; or the vessel may be fixed on the post above the ground. The ants are more commonly troublesome during the rains; the small black ant is more troublesome than the red ant, because it can walk over water if the water is not very clean; a bamboo hoop floating in the water-vessel will give a foot-hold and enable the bees to drink at it with safety. Ants are more likely to be troublesome when the bees are being fed, coming for the bee's food. Ants take off dead bees and other rejections thrown out, and will clear an empty hive of small vermin. Toads eat bees, but in India hives should not be placed on the ground as they are in America, and sometimes in England; then toads are not to be feared. Lizards should be destroyed whenever found under and about hives. Hawk moths and some wild bees will steal honey, and several small beetles do injury inside the hive, destroying comb and brood. A small parasite, the bee louse, may be found on imported bees, particularly on the queen; these may be removed from the queen by tobacco smoke; they are a sign of ill-health apparently, and should be removed by gently smoking the queen, she being in a cage or on the hand. The frame hive gives such facilities for examination, that vermin in the hive may be found and extirpated in the course of the usual examinations, or it may be specially sought for. Earwigs, cockroaches, and similar vermin may be found in hives of *A. indica* and very weak stocks of European bees; they do not appear to be injurious to the bees. The

large creatures may be kept out by a grating before the entrance. Spiders may sometimes be found in and about hives; they should be destroyed.

With ordinary care, bees are readily sufficiently protected, and statements as to their utter destruction by enemies ever rendering apiculture impracticable are erroneous; the cases cited will be found instances of accident or mismanagement.

50. The principal diseases bees are liable to are *dysentery* and *foul brood*. Dysentery occurs when the bees are confined to their hives in the winter, and disturbed so as to compel them to consume food when they cannot go out. It is also produced by giving watery food and leaving unsealed and fermented stores in the hive during cold weather; it would probably occur only in those places having a severe winter. The bees soil their combs, and are sluggish and weak, and the hive has an offensive smell. The disease appears at the end of winter and beginning of spring; it is due to bad management, and may be prevented by letting the bees winter on sealed stores only, removing all unsealed with the extractor on the approach of winter, and giving candy if it be necessary, to feed late. It is cured by giving clean combs and hive, feeding with sealed honey or candy, then leaving the bees undisturbed, and keeping the hive well ventilated and warm.

Foul brood is the most serious disease; it is due to a fungus which destroys the brood, which rots into a dark putrid mass in the cells. If not checked, it destroys the stocks and spreads rapidly to other

hives. Its existence in Bhutan has been reported. The best treatment is to destroy all infected combs, disinfect the hive, and spray the other combs with salicylic acid solution; give clean hive and combs, feed the bees on syrup or honey with salicylic acid, and remove the queen for a few days. All hives near should be fed on syrup with salicylic acid if feeding, and a thorough disinfection of hives, stands, and all appliances used throughout the apiary and the hands of the operator is necessary, so as to destroy all germs of the fungus.

51. The gravest accidents are loss or failure of queen from any cause, and starvation. The first accident is obvious from the absence of eggs, from the presence of drone brood, &c. The bee-keeper then inserts a queen; if he cannot do this, and from absence of drones it is not posssible to breed one, he either unites the queenless stock to another with a fertile queen, or he divides it amongst his weakest stocks. Starvation is an accident to be guarded against, in the hills by careful winter provision; in the plains by occasional examination during the rains,—feeding when necessary. It is better to feed syrup *before* the inactive season, as otherwise feeding excites the bees to untimely activity, and leads to loss of life. In the hills feeding should be well in advance of the inactive season, so that the stores may be all sealed before the cold weather confines the bees. Feeding in the inactive season if really necessary should be with solid food.

PART II.—Practice.

CHAPTER VIII.

WHICH KIND OF BEE TO KEEP: HOW TO PROCURE BEES.

52. Mistakes have been made in selecting the species for cultivation, hence it has, in some instances, been erroneously concluded that bee-keeping is impracticable in the plains of India. Where the natives of the country keep bees in rough hives, the kind of bee they keep should be cultivated. A minute description of *A. indica* would be troublesome to verify, and might prove confusing, but no difficulty need be found in identifying it by the following positive and negative descriptions. The large bee about $\frac{5}{8}$ inch long, which builds a large single thick comb on the under side of a bough or overhanging rock, and has 13 rows of bristles forming the pollen baskets on its hind legs, is unsuited to cultivation in a hive. So also is the small bee which builds a single comb on trees, bushes, and buildings; this bee is slender in form, about $\frac{5}{16}$ inch long, has a broad orange band across the abdomen, followed by alternate bands of black and white; it is exceedingly common, and is the species most likely to be taken by mistake. Both the above species build regular combs; the worker-cells of the large bee are about $4\frac{1}{2}$ to an inch; those of the small bee about 9 to

the inch lineal. There are other bees of still smaller size building irregular nests in the ground and in cavities in trees; these also are to be avoided; they do not belong to the genus *Apis*.

The bee admiting of cultivation is *A. indica*. It differs in size and depth of colouring with locality. In some high regions it is larger than elsewhere; it is between $\frac{3}{8}$ and $\frac{1}{2}$ an inch long, and has alternate dark and yellow stripes across the abdomen; it builds in cavities in trees, rocks, walls, &c., never in the open air; it builds several cakes of comb hanging vertically and parallel to each other; its worker-cells are about 6 to the lineal inch in the plains and the hills to the north-west, but in comb built by the Bhutan variety were found to be only $5\frac{1}{2}$ to the inch. This bee is kept, or rather encouraged, by the natives. It is hived in logs, tubs, earthen vessels, holes in walls, &c. In the Khasia and Jaintia hills, all along the Himalayan slopes, in Cashmere, in Lower Bengal, in parts of the Madras Presidency, and probably more commonly than is generally supposed. The varieties found in the plains are lighter in colour, and have very transparent wings, whereas some of the varieties found in higher regions have darker bodies and a very marked dark-brown colouring of the wings. The descriptions of the habits of the European honey bee described in books are in general applicable to *A. indica*, allowance being made for the difference in the size of bee and the different climatic conditions. There may be differences in habits not yet noticed, and opportunity

has not yet occurred for determining the time from the laying of the egg to the hatching out; these details given are for *A. mellifica*. *A. indica* is no more difficult to handle than the English black bee; it may be cultivated in frame hives. The varieties appear to differ in temper, as they do in colour and size.

53. The beginner should not attempt to import European bees, as this would certainly end in failure; bees *can* be imported, but only by the experienced. Italian bees will, it is hoped, be available in India in a short time, but for the present attention should be confined to *A. indica;* it is easily procured, and it is better to gain experience on the common bee. If the weather is very cold, as winter in the hills, bees cannot be obtained; they must be got during the summer. In the plains they may be obtained all the year round, where the temperature does not fall below about 50° F., but it is far preferable to get them in the summer. To find out what kinds of bees are to be had, suspend a piece of honey-comb in a verandah on a warm day, and note the insects visiting it. If the natives keep bees, hives with bees may be bought from them. The best way to get bees is to capture swarms in the swarming season, *i.e.*, from the middle to the end of the hot season. To the beginner this is more troublesome than buying a hive, but the greater trouble of transferring the built combs of a stock is avoided. If bees cannot be purchased, nor swarms captured, then they must be sought in hollow trees, under house-roofs, in holes in walls, under the raised floors of houses, and in similar

places; they may be tracked home by feeding or watching them on flowers, or information of their whereabouts may be obtained from native villagers, shikaris, and the castes which take honey and wax and deal in medicinal herbs.

54. Having obtained a swarm or stock it has to be conveyed to its new stand. If a hive be closed up entirely, the bees will be suffocated; if it be not very well ventilated and moved, the jarring may excite the bees, they then gorge themselves with honey, their excitement raises the temperature of the hive, so that the bees again reject the honey, and on opening the hive the population will be found suffocated and soaked with honey at the bottom of the hive; hence in moving bees good ventilation should be provided. If in an earthen vessel or hollow log, wire-gauze, perforated zinc, or open cloth should be used to cover *all* openings; if in a box, the whole top of the box should be so covered. Bees bite through cloth, so this is only useful for short journeys. If the bees are excited by exposure to heat or jarring, the increase in temperature may melt the combs down: this result is very readily induced if the combs are new (white) ones; thus swarms cannot be sent far and require very careful handling if they have built their new comb. The principal conditions to observe are:—(1) Close the hive at night, as then the bees are all in; if closed in the day-time a large number of the old bees, those out, will be lost. (2) In closing the hive provide for ample ventilation, not only to supply air but to keep down temperature in case of the hive being

accidentally jarred. (3) The hive should be kept cool in transit, *i.e.*, not exposed to the sun more than unavoidable. (4) It should be carried with the combs vertical and without jar or shock. (5) It must be moved 1½ mile or more, or many bees may go back to their former place and be lost. (6) In moving stocks long journeys, when the bees must be shut up more than a day or two, they must be supplied with water by means of an inverted bottle with a small hole or lamp wick through the cork, or by means of a damp sponge. Their combs must be securely fixed in frames by means of string, and only old strong combs must be packed; the portable hive (Chapter IX, Art. 61) should be used. The beginner should not attempt the transport over long distances. Bees travel best if the hive be so packed that light does not enter it. If a rough hive has been purchased close it after dark, remove it carefully to its new stand, and open it. If an earthern vessel or other small receptacle, place this inside the new hive, so that the bees must pass through the entrance of the new hive to enter the old hive. If in a log of wood, so arrange it (making holes in it if necessary) that the bees pass through the entrance of their new hive to get into their old one. If in a section of hollow tree, put the log upright and the new hive over it. In every case the object is to familiarize the bees with the outward appearance and precise locality of the new hive, and make them pass through its entrance if practicable. Having made the above arrangements, properly protecting the combs against weather and ants if necessary, the bees must be left alone for a

fortnight to get used to their new place. If necessary they may be sparingly fed, but their combs must not be interfered with, nor the hive opened, or the bees will probably abscond. If a swarm has been captured, *i. e.*, driven into a hive or swept into one, then the hive may be put on its new stand at once if close by. When the bees have clustered a number of them commence work; hence if the swarm is to be lodged at a distance, it is better to hang or prop up the hive till sunset, and then gently place it on its floor board and remove it to its stand. As the combs of the swarm have to be built, the bees should be provided with old comb, guides, or foundation, and fed; but they must be cautiously interfered with or they may abscond. A stock purchased or captured may be transferred to a frame hive after a fortnight. The mode of accomplishing this is given in Chapter X, Article 78. Having obtained one stock, this may be multiplied in the usual manner, so that the trouble of obtaining the first stock need not be repeated to obtain additional stocks; but in most places, at the right season, there is little difficulty in getting swarms; old packing cases with holes in them, and furnished with a piece of comb, are readily taken possession of by swarms, and a little syrup or honey readily attracts the wild bees in the neighbourhood, if there are any.

55. The beginner should commence with one or two hives only, and increase the number as he gains experience. It is better to commence with two, because one can be compared with the other, and anything noticed in one can be checked by reference to the other. Spare

comb may be used as guides, and should be taken care of. If nervous, veil and gloves may be used, but the latter cause clumsiness, and should be ultimately discarded. The beginner had better not try to get super honey; he requires an extractor, feeders, some kind of smoker, and a knife; he should make himself acquainted with the theory of bee-keeping so as to understand the practice; he should know the different members of the hive, the different kinds of cells, the eggs, brood, &c., by sight; and if he can get a friend to show him how to perform some operations, such as examining a hive, capturing a queen or swarm, transferring, driving, &c., it will be of great use.

CHAPTER IX.

HIVES : STANDS: AND OTHER APPLIANCES.

56. A hive must protect its inmates against damp and extremes of temperature. It must not be easy of entrance by enemies of the bees, and be readily defended against robber bees by the bees themselves. It must have no cracks or cavities in its interior, in which the smaller enemies of the bee may take refuge where the bees cannot get at them to destroy them. It must admit of expansion, doubling, and contraction; it must admit of being opened, every comb examined, and closed again, easily and quickly; every comb must be removable, and every comb of every hive in the apiary must be interchangeable. Frame hives fulfilling these conditions are of two kinds,—the English and Ameri-

can horizontal hive, and the German upright or vertical hive. The former is much the easier to manipulate, is better for beginners, and wherever space for it can be afforded; the vertical hive is well suited for use in very limited space, it is suited for insertion into house walls to replace the wall hives used in Kashmir and elsewhere in India. Several simple and cheap forms of hive have been proposed for use in India by inexperienced persons; these simply admit of supering without any of the advantages of the frame hive, such hives having no arrangement for making the bees work in the super it would generally remain empty, while no provision is made for the use of the extractor. The use of the extractor is far more profitable, more easily applied, cheaper to apply, and more likely to succeed in inexperienced hands, than getting comb honey by supering; and native bee-keepers should at first confine their operations to getting extracted honey. As a material for hives, straw is excellent, but it rots in the rains. Bee-keeping had better be commenced in wooden hives, and other materials can be experimented with after experience has been gained. The objection to many cheap materials is they require the protection of a shed or verandah against rain. Thatching hives is not advisable, as the thatch harbours vermin; straw or paper may be tied *inside* the hive roof as a protection against the sun, if required. Wood will be found the easiest to apply; it must be well joined and weather-proof, but need not be planed. Material is often available in the shape of old packing cases,

and for insertion in a house wall a rough box need only cost a trifle, as cracks and bad joints can be filled with clay, making the roughest work almost equal the best for practical purposes. Good hives are the most economical; they last many years if painted, and are paid for more than once by value of the first season's honey. In making hives the following points should be attended to:—All nails and screws should, as far as practicable, be inserted from the inside, or, in the case of the floor board, below; stout wood is best, light wood an inch thick makes durable hives; if teak or other good hard wood be used, $\frac{5}{8}$ inch is thick enough for roof and outside casing, but it is difficult to make durable joints in such thin wood exposed to the weather, and thin wood is an inferior protection against extremes of temperature. Seasoned wood should be used, as far as practicable; if unprocurable, the boards should be cut up and kept to dry before being nailed together. If cracks do appear, putty or white lead may be used to fill them, and leaky roofs may be prevented by covering the roofs with cotton cloth well painted, paper felt, very thin zinc, tar covered with paper or rag ironed with a heated iron, &c. Large sound packing cases, if not too thin, furnish excellent materials. The corner joints should be made as shown in Plate I. cc'; the end of one board is let a short distance into the other, the grain of the wood is placed as shown with the centre of the tree directed outwards; the nails should be driven obliquely as shown in *c*. Thin outside battens used in English hives do not stand exposure in India; outside battens should be avoided if

practicable ; if used, they should be stout, wide, and fastened at the corners with French nails, well clenched. Hives should be well painted some light colour ; oil paint is better than paint with much turpentine ; but if in use, they must be painted at night with some quick-drying paint. If exposed to the sun no dark colour should be used for either body or roof. Excepting the floor board, it is sufficient to paint the outside ; the floor board should be well painted or tarred underneath, and is better painted above, as it is then easier cleaned. Hives standing very near each other should be painted different colours.

57. *Frames.*—The external dimensions of every frame in the apiary must be the same, *excluding* the thickness of the top bar, and the frames must be about a quarter inch from the hive side, if this space be much exceeded, comb is built in it, if it be much reduced, it is filled up with propolis. The British Bee-keepers' Association have adopted a standard frame ; 8″ × 14″ outside, excluding length and thickness of top bar, is near the standard, is a very convenient size, and should be adopted in India. The length of the top bar should be such as to just move easily between the hive sides ; for the hives figured this is about 15⅜″. The wood may be ¼ inch thick, the top bar may be ⅜ inch; thinner wood may be used, but if much thinner the joints are weak. The width of the frames should be 1 inch for European bees. This may be used for Indian bees, the frames being hung ¼ inch apart, but ¾ inch wide is more suitable. The sticks may be

simply nailed together, but are best dovetailed—Plate I *f*, *f*1, *f*2. Frames may be made very cheaply and expeditiously by making a number at a time, placing a number of pieces together, cutting the dovetails at one operation, and first making a block to hold the pieces in position to mark them, cut them, and nail them up. A brad or wire nail is driven in at each joint. The wood need not be planed inside, it is better rough; on no account should holes, saw-cuts, &c., be made in the frames for fixing wax, as often described in books, —these harbour wax moth. Frames are kept parallel and the right distance apart, if two small nails be driven one on each side of the top bar—Plate I *f*11; these are very useful for beginners, but may ultimately be discarded.

58. The horizontal hive consists of a body box which holds the frames, a floor board on which the body box stands, and a cover. The simplest form has single walls, and is covered by a roof about 6 inches deep, the depth of roof allowing for feeding and supering. Single-walled hives are not suitable for exposure to the sun's heat or severe cold. The double-walled hive has the outer casing to quite cover the body box, and high enough to contain two body boxes; the space, about 2 inches, between body box and casing, may be filled with hay, straw, chaff, paper, or other non-conductor. The floor board should be an inch or more thick; the pieces of which it is made should be joined by halving so that shrinkage of the wood may not leave an opening; it should be strengthened

below by two stout battens, which should be placed 6 inches apart and project in front to carry the alighting or flight board. In the front of the floor board is cut a groove, 8 inches wide and $\frac{3}{8}$ inch deep, as an entrance, the ends of the battens projecting in front are sloped off, and a semicircular alighting board, $8'' \times 4''$, is screwed on to them sloping about 30°. The floor board is shown in Plate III. It is shown in longitudinal section in Plate II, and in elevation in H, Plate I. Single-walled hives stand on the floor board, stout battens being fastened to the hive body to prevent entrance of wet between body box and floor board, Plate I H. The body box should be of one inch plank, the front and back are simple plank, the sides are shown in section, Plate IV B. A rabbet is cut along the top edge $\frac{1}{2}$ inch wide and $\frac{3}{4}$ inch deep; a piece of stout zinc or tin is then nailed along the lower edge, projecting $\frac{3}{8}$ inch above it; the top bars of the frames rest on this strip of metal, the objects of which are to prevent the bees fixing down the frames with propolis, and to prevent bees being crushed in putting the frames in. When packing-case wood is used, and it must be thinner than one inch, the rabbet of the body box is made by removing a strip of wood on each side and nailing on a batten outside; the metal plate is then nailed on inside.

The body box should be $14\frac{1}{2}$ inches wide inside, and $8\frac{3}{4}$ inches deep; it may be $14\frac{1}{2}$ inches long or an inch or two more; $14\frac{1}{2}$ inches is sufficient, and it is better to keep to one size. If the standard

frame be put into such a body box, there will be $\frac{1}{4}$ inch between frame and hive sides, and $\frac{3}{8}$ inch between bottom bar and floor board. The errors, if any, in dimensions of hive and frames should rather increase these spaces, not diminish them. For a single-walled hive battens should be nailed round the body, an opening being cut in the front batten for entrance, or a strip of stout tin, doubled and again bent longitudinally at right angles, may be nailed round the inside of the body box, the latter being deepened to cover edge of the floor board, and the battens shown in Figure H dispensed with. Two battens, about 8 inches long, are fixed at each side, $1\frac{1}{2}$ inch down, to serve as handles and for the cover to rest on, Plate I H. The cover is simply a second box inverted over the first and resting on the side battens; it should rise 6 inches clear at the sides. The top boards may be put as shown in Plate I H, or they may all simply slope backward and be made water-tight with painted cloth, paper felt, very thin zinc bent over and nailed at the edges only, or other suitable material. The roof shown is easily made water-tight with narrow boards. An inch is sufficient projection for the roof; additional ventilation may be given by small holes close under the eaves; if large enough to admit a bee, these must be covered with wire gauze, perforated zinc, or coarse cloth put on *outside*. The ventilator holes in front, found in English hives, confuse the bees and admit rain. For the double-walled hive the body box and floor board are essentially as

described above, the hive complete is shown in sections in Plate II, the body box merely rests on the floor board. The cover is in three pieces, the first piece is 9 inches deep clear inside, and fits another inch over outside floor board; it is supported by small battens *b b* fixed inside and resting on the floor board. The front batten is cut away in the centre to admit of a piece of wood 2 inches wide being placed over the entrance in the floor board, to prevent the bees getting between the hive walls. The upper section is exactly like the lower, excepting that it is large enough to fit over the lower box about $1\frac{1}{2}$ inch down, and is supported by battens *b* resting on the edge of the lower box. The roof is of three boards as shown, held in place by front and back battens outside, and side battens fitting inside, the upper box. The total height at the side *inside* should be 18 inches. To examine the hive it is only necessary to lift off the roof; frames being examined can be held inside the hive sheltered from the wind. The roof keeps in shape best if the side battens are fixed *across* the boards, *i.e.*, parallel with the front and back battens; their *ends* then rest against the hive walls inside. Either of the hives described above may be doubled by placing a second body box on top of the first; to reduce the capacity of the hive, a piece of board $8\frac{3}{4}$ by $14\frac{1}{2}$ inches is placed in the body box Plate II *d*, and this is shifted forward or backward, or removed entirely, according to the number of frames to be used. The single-walled hive is in three pieces, the

double-walled hive in five pieces. Sometimes floor boards are fixed to the body boxes, and the stand is fixed to the hive; these arrangements are very inconvenient; if the hive body simply stands on the floor board without edge battens, the water penetrates during heavy continuous rain between the floor board and body box. In double-walled hives the case is sometimes made in two pieces only: this is objectionable, increasing the labour of opening and closing, and not affording protection on a windy day to the comb under examination.

59. The frames are covered with a quilt; firstly, a piece of unbleached calico, or similar light cloth, is laid on the top of the frames, then, when the bees have had time to go down, a piece of carpet or several thicknesses of gunny cloth is laid on. A hole about 3 inches in diameter should be cut in the quilt and cotton cloth for feeding through; this should not be in the centre, but to one side; it should be closed when not feeding by a piece of similar material, or by arranging the several pieces of the quilt so as to close it. Another object of not putting the hole in the centre is that the feeder may b placed nearer the front or back of the hive as desired. A calico bag partly filled with chaff laid on the quilt is an excellent additional protection: this can be used over the feeder and is better than the frame filled with chaff sometimes used. The spaces behind the dummy board and between the hive walls should be well packed with straw, chaff, paper, hay, or other good

non-conductor, when necessary to protect the bees against extreme heat or cold. The single-walled hive is a very inferior protection to the double-walled hive. The former may be wrapped in thick mats during frosty weather.

60. The upright hive is simply a cupboard,—the entrance and flight board are in front, and it is opened behind by a hinged door with a lock. This hive may carry the same sized frames in two tiers, the rabbets with metal-runners are on the sides, the height below the bottom frame should be an inch, as the floor board is not removable, and must be cleaned with an iron or wooden scraper. The space between the top bars of the lower frames and the bottom bars of the higher should be $\frac{3}{8}$ inch, the depth of the hive from front to back may be 12 to 14 inches. When there are few bees in the hive, only the lower tier of frames should be used, a quilt or a thin board being laid on the tops of the frames, and a small wooden dummy being pushed in to contract the space from front to back; when two tiers are in use a larger dummy board is necessary. The dummies for this hive are best fitted with a piece of glass to admit of inspection without removing them; a small flap at the bottom of the dummy hung by leather hinges is a great improvement, as it admits of an iron hook or scraper being inserted from behind without removing the dummy, to clean the floor board, and clear the entrance. For winter this hive is packed with dry grass, straw, &c., as described for the horizontal hive. (*Vide* Plate IV.)

61. The portable hive for transporting bees is merely a light box made to hold the frames necessary, and having pieces of perforated zinc let into two sides and the top. The principal points are: the box should be light, fitted with a handle or handles, for convenience in handling and to hang it up; it should not be divided to carry more than one stock; it should be large enough to contain two more frames than it is to hold, and the frames should not be nearer than 2 inches to the bottom. It should carry standard frames; the frames should be held in place by nails or blocks on bottom or sides of the box, so that they may not possibly swing; the top should be put on with screws, and a screwed-up opening should be made near the bottom to let the bees fly, if practicable *en route*, or immediately on arrival at destination. A water phial, with a small hole in the bottom or in the cork, may be fixed in the hive, or the bees may be watered by a damp sponge applied from time to time outside;—the water phial is better. The food should be solid candy, or very thick or crystallized honey in comb; the combs should be old, and the frames should be crossed by stout strings, two or three inches apart, to keep the combs from breaking away.

62. The nucleus hive is simply a small hive to contain only three or four standard frames. An ordinary hive divided by boards with the entrances on different sides, serves to hold two or three nuclei. The entrances must be small,—half an inch long is

sufficient; heat must be economized by a good quilt and packing, and the hive must admit of each nucleus being fed.

63. Queen boxes are small boxes for transporting queens with a few bees, as these can be sent long journeys with very little risk of loss, while the transport of a swarm or stock is attended with very great risk. A queen box consists of a small case from 2 to 6 inches side, well ventilated by means of saw-cuts, wire cloth, or perforated zinc; the cage is provisioned by pouring into it candy which sticks to the rough wood, and by fixing in it a half ounce phial with a cut in the cork for the bees to drink at, or for long journeys two or three such bottles. The queen is put in with 20 or more young bees, but if the temperature be low more bees should be used to admit of them forming a small cluster.

64. Formerly, large glasses were placed on hives to obtain white comb honey, but they were found inconvenient and wasteful, because the quantity in each glass was more than the retailer sold at a time, and a part of the contents could not be removed without breaking up the comb. Glasses have been superseded by sections, which can be worked on the top of the frames or in wide frames inside the hive. In the vertical hive, comb may be taken in the upper frames, but more conveniently by inserting one or more wide frames containing sections. In the three-tier hive used in Germany and Italy the top frames are shallower than the lower ones; the upper tier is termed

the honey room, and takes the place of the super used with the horizontal hive; the use of two sizes of frame in the same hive has many inconveniences; it would be preferable to use a section rack or frames of sections. Sections are small open frames, each holding one or two pounds of comb honey; they are of $\frac{1}{8}$" wood, the sides are 2" wide; the 1 lb. section, Plate I s, is 4" × 4", the 2 lb. section 6" × 5", *inside*, the top and bottom of the 1 lb. section and the bottom only of the 2 lb. are $1\frac{3}{4}$" wide, the $\frac{1}{8}$ on each side being allowed as a passage for the bees; each passage is obviously $\frac{1}{4}$" between the sections when two are placed together. The 1 lb. sections are sometimes put on in two or more tiers, hence the top and bottom both afford passage to the bees; larger sections are usually used in one layer, therefore only the bottom is made narrower. One pound sections are worked inside the hive by putting three or six in a frame two inches wide hung at the back or front of the hive, or both back and front, Plate V F, they are worked on the top of the frames by being placed in a rack, Plate III; the rack raises the sections $\frac{1}{4}$" above the frames, leaving this passage for the bees. They may also be worked on the top by simply putting them into frames each containing three, and placing these frames on the top of the hive; in this case they must rest on $\frac{1}{4}$" sticks laid across the hive frames to form passages. Large sections or frames of small ones may be kept together on the hive by string passed round them. The end sections, whether in a rack or not, are best closed

by pieces of glass through which the interior may be inspected without disturbing the bees. Sections are not worked flat and separate unless separators be used; these are simply small pieces of zinc, tin, or very thin wood placed between the sections, Plate III. Sometimes bees will not enter supers; the sections have to be inserted in the hive, when commenced removed to the top with the bees on them, and replaced by others until the top of the frames is covered. The most convenient frame for working sections in the hive is shown in Plate V F.; it is made of tin; the sides are 2″ wide, the bottom $1\frac{3}{4}$″, it is open at the top; the separators are soldered on, the section boxes are simply dropped in from above. In such a frame the sections may be finished in the hive or the frame may be removed when commenced, and placed above with the bees in it, another frame being put in its place in the hive; these frames are more convenient than a rack, very cheap, and applicable to either form of hive. Metal frames and racks must not be left in the hive during the winter or cold weather; they are only useful during the active season. The sections when finished are glazed by a piece of glass fitted to each side, fixed round the edges with coloured paper; a dozen or more sections are then best packed for market in a box having glass in two opposite sides to display the contents, and rope or batten handles at the ends.

65. The best stand for a hive is a single post firmly fixed into the ground; on the sides of this at the top are nailed two cross pieces which project beyond the hive;

on these are nailed short horizontal boards with spaces between for the floor board battens. As a protection against ants the post is best surrounded with a water vessel of burnt clay or zinc (article 49), and a thin piece of rope over the hive passing round the projecting battens of the stand prevents the hive being overturned during storms. The aspect should be south or south-east in preference, but contiguous hives should not be less than 3 feet apart nor face in the same direction. In Europe vertical hives are sometimes placed close together and in two tiers under one shed; in this case the entrances should not be over each other, and the fronts of contiguous hives should be painted different colours. When the entrances of two hives are close together they should have a piece of board placed vertically between them. Hives should be sheltered from the afternoon sun, and, as far as practicable, from strong winds. They should be as low as convenient, as laden bees fly low; the ground round hives should be cleared of grass and weeds; gravel, or ashes covered with gravel, or broken stone or brick rammed down, is a good dressing; a light-coloured ground is best, as bees are readily distinguished on it.

66. For large apiaries a bellows-smoker is most convenient, but it is by no means necessary. A smoker is required to give plenty of smoke, keep alight a long time without attention, not permit sparks to escape when being used, and not be too heavy or get too hot to be carried conveniently. Persons who

smoke may simply use a little tobacco smoke blown from their mouths, cigar, pipe, or chillum. A piece of blotting paper made into a cylinder by rolling it many times round a pencil and tying it with cotton, makes a good smoker, the smoke is blown upon the bees by the mouth; a piece of brown paper rather tightly folded serves the purpose, but is more likely to give out sparks and burst into flame.

A tin mug lined with clay, with a pierced tin grating and cover of wire gauze or perforated tin as a spark-catcher, makes an excellent smoker; it should have a hook to hang it on the edge of the hive and to serve as a handle. A little common tobacco or dry paper, in a bamboo or tin tube, capped with wire gauze, or perforated zinc, may be used, and an excellent smoker is made by fitting a common tobacco pipe with a bent tube over the bowl; on blowing through the stem the smoke emitted from the tube may be directed on the bees. Those who do not smoke will find a roll of stout blotting paper make an excellent smoker requiring only a little extra care in use; or brown paper, a piece of old rope, a roll of common tobacco leaf, a piece of touch-wood, damp straw, or other matter at hand may be used. So long as the hives are few in number, these serve the purpose perfectly well, but demand a little care to avoid blowing sparks on to the bees. A native chillum with a cover made of perforated tin or wire gauze, used to hold any dry fuel giving out smoke and burning slowly, makes a safe smoker. A cheap smoker for India has been devised and

is included in the price list attached to this book.

67. Feeders are for giving liquid food either slowly or rapidly. An excellent slow feeder is made by drilling a small hole in the bottom of a clear rather wide-mouthed stoppered bottle. This may be done by the men who rivet china or by means of a common drill moistened with turpentine. The stopper should fit well and be greased or moistened with syrup to ensure its being air-tight. This feeder is filled while on the hive, or while held in the hand, the hole being stopped by the finger; when the stopper is in it does not leak, and it can be opened and rapidly refilled without removal from the hive; the bees can be seen feeding without lifting the feeder. If instead of one hole several holes be bored in the bottom of a bottle and pieces of rag be inserted, this feeder admits of regulating the supply by the tightness of the rag; the holes may be larger and the stopper or cork should not fit to exclude air. An open vessel with a wooden or cork float may be inserted in the hive if there be room for it. A tin can the size and shape of a frame, on the principle of the bird fountain, is a good feeder; to fill it it is held horizontal; a piece of stick may be floated on the syrup for the bees to stand on. This feeder may be made cheaply in any bazar, and is suited to use in any hive, (Plate IV g.) The bottle feeder is one commonly used; a pickle bottle is covered by a cap, the rim of which is of wood, zinc, or tin, and the top of perforated zinc or

perforated tin; the bottle having syrup in it the cap is held on and the whole dexterously inverted over the feed hole; the bees feed through the perforated cap. The supply of food is regulated by tying over the bottle a piece of coarse cotton cloth, or by inserting a disc of tin or zinc with one or more holes in the cap; unless the cloth is very open it is liable to stop the supply entirely. An exceedingly good feeder is made by making a few $\frac{1}{8}''$ holes in a biscuit or jam tin, and drawing into the holes pieces of rag or string; the tin is covered by a loose tin cover or a piece of glass, and the supply of food is regulated by the greater or less tightness of the pieces of rag stopping the holes at which the bees feed; the inverted bottle feeder has to be removed to refill it, and is not so cleanly in use as the others. All feeders having to be placed over a feed-hole are improved by a $\frac{1}{4}''$ rim for them to stand on to raise them above the tops of the frames; when the feed hole is opened bees come up, particularly if a little syrup is accidentally spilt, and a raised feeder can be put over the bees without crushing them, or it being necessary to drive them down; the edges and holes of tin articles are improved by being tinned with the soldering iron to prevent rusting.

68. Extractors are made in various forms, but they all depend on the same principle for their efficiency; the comb if sealed is uncapped by slicing off the caps with a long thin knife, the comb is then swung round in a circle with the open cells outwards, when the honey flies out in a shower, being impelled by centri-

fugal force; a can of some kind is so placed as to catch the honey, the comb is emptied of the honey without being injured, and it may be given back to the bees to refill, to clean, or as brood comb. If the comb contain both brood and honey, by care in extracting, the honey can be taken out without injuring the brood; the centrifugal force is proportionate to $\frac{r}{T^2}$ in which r is the radius, and T the time of one revolution. As the efficiency is inversely as the time squared, and only as the radius directly the greater importance of speed has led to extractors being made of short radius to be driven at high speed, but high speed necessitates complication, and in the simpler forms makes them laborious to use. With a radius of 6 inches and three revolutions a second, the honey is thrown out satisfactorily, *i. e.*, $\frac{r}{T^2} = \frac{\cdot 5}{\cdot 3^2} = 5\cdot 5$, and this being usually sufficient we may make the radius and time whatever we wish, provided this value is reached. In the simplest form the radius may be long and the speed low; where gearing or other means of gaining speed is applied, the radius is reduced. For general use in India by ryots and others keeping a few stocks, a slinger may be made in any bazar for from 8 to 12 annas; it should consist of a shallow tray of thin tin covered with a piece of wire-netting, and having a ring at each of its four corners, by which it may be hung horizontally to four strings; at the junction of the four strings is a swivel, and from this a single string, which is held in the hand, and by which the tray with the

comb laying on the wire-netting is swung round in a vertical plane. If the length of the string (radius) be 2 feet 6 inches and the tray be swung round three times in two seconds $\frac{r}{T^2}=\frac{2\cdot5}{\cdot66^2}=5\cdot75$, quite sufficient and admitting of being increased if necessary. An extractor may be extemporized out of any light, shallow vessel with a grating or netting to lay the comb on, and strings to swing it by. Extractors for use with frame hives should be of proper size to hold the frames used; the tray may be 3 or 4 inches deep. Extractors are made to hold the comb frame upright on edge, and this is obviously convenient, for if a heavy frame of comb be held horizontal, the comb may break away from the frame and fall; in using an extractor which carries the frame horizontally, the extractor net must be placed against the comb vertically, and then inclined to the horizontal; after the comb has been emptied, the extractor should be tilted to pour the honey out, and then the comb may be removed to be reversed. It is essential, in using the extractor described above, that the strings be flexible, and be prevented from twisting by a swivel, and before trying to extract honey a pint of water should be poured into the extractor and swung; it will be generally found that it can be swung the first time without spilling any of the water. A very simple form of extractor is a vertical can swung in a horizontal plane round a stick. An extractor of this form called "the little wonder" is sold by Messrs. Abbott and Company,

England. A cheap extractor of this form is represented in Plate V; the elevation shows the wire-netting A against which the comb is placed; *C* is the part the honey collects in, *B* is a tube and 8 8 a projection of tin supporting the can, when a bamboo is placed through the tube B and 7. The top 1 has a lid and a small spout *S*; along each side of the netting a strip of tin extends, the frame of comb is placed between these against the netting, the end of the top bar of the frame being stuck into one of the holes, *a* or *b*, 3; an upright bamboo, about 4 feet long, being inserted in *B*, so that the can is a few inches above the ground, the upper end of the bamboo being held, preferably, by both hands, the lower end resting on the ground, the can is swung round rapidly, and the honey is thrown through the netting and accumulates in the reservoir *C*, from which it is poured from time to time by the spout *S*. The bamboo should be guarded by a tin tube with a wire shoulder for the tube *B* to rest on, and the lower end of *B* should be wired, a little oil should be applied from time to time. The can may be rigidly fixed to the bamboo, and the latter may be provided at bottom with a spike and above with a loose handle; the spike is stuck in a board, and the can swung round by one hand grasping the loose handle above. It is an advantage to place the bottom end of the bamboo in a hole, or fix it by a spike to prevent it slipping in use. The more complicated form of extractor is a can having in it two vertical comb cages revolving in a horizontal plane and carrying

two combs at a time; these are driven by a small winch and have multiplying gearing. For large apiaries such extractors are necessary, they are far less laborious to use, and admit of more delicate handling of brood combs; they are in universal use in large apiaries. A cheap form with wooden cone wheels or band gearing could be readily devised, but the simpler forms are sufficient for small apiaries, cheaper, and readily manufactured in Indian bazars. It should be noted that brood is less likely to be chilled when the can revolves with the comb, than when the combs revolve in a stationary can. The best material for extractors is well-tinned iron; wood, galvanized iron, and zinc are very inferior; extractors should be carefully washed after use, and when practicable they should be made to open out, so that every part may be got at to clean. The prices of cheap extractors of the simplest form will be found in the list appended to this book.

69. Veils are useful to beginners to give confidence. A piece of net, leno, tarlatan, or other suitable material, about half a yard wide and a yard long, has its ends joined, a string or thin elastic is run in its upper edge. The elastic passes round the hat and the lower edge is tucked into the coat or otherwise fastened down. The veil is greatly improved by letting in a piece of mica opposite the eyes. Any stout woollen glove will do; the first finger and thumb should be cut off for about an inch, and it is well to dip the gloved hands in water and then squeeze the water out so as

to leave the gloves damp; the bees will drink from the glove but not sting, and the dampness keeps the hands cool. Skilful bee-keepers never wear gloves; very few wear veils, and these mostly under exceptional circumstances.

70. The comb-box is a wooden or tin box with string or wire handles and a lid to exclude bees; its width is sufficient to hold about six frames, its length is equal to the width of the hive body-box, so that it carries the frames hung by their ends as in the hive. It should be two or three inches deeper than a body-box as then small articles may be carried in it; wires, nails, or pieces of tin or wood projecting from the bottom or sides, to prevent the frames swinging, are a great improvement. The comb-box is used to carry the combs taken from the hive for extracting and other purposes; if not covered they would attract bees, inconveniencing the operator, and possibly leading to robbing. The comb-box is also handy for keeping a few combs securely, and for putting in combs with the bees on when removed temporarily during examination of a full hive. Any kind of light box with a lid and handles may be used.

71. The queen cage is used for confining a queen on a comb for a time to prevent her absconding, or being killed by the bees when introducing a fresh queen. The simplest cage is the "pipe cover" cage: it is a round-ended cylinder 1 inch to 1½ inch in diameter and about ¾ inch deep; it is made of perforated zinc, or excellent ones may be made by simply press-

ing a piece of iron wire gauze into shape with the fingers, and cutting it round with a pair of scissors. The queen is placed in the cage and kept in by a piece of card or tin, the cage is placed on the comb, the card is withdrawn, and the cage pressed into the comb to fix it. If of wire gauze, the cage has merely to be pressed into the comb; if of perforated tin or zinc, it is pressed in with a screwing movement.

For melting small quantities of wax a common glue pot or a jam tin placed in an outer vessel of water serves the purpose very well indeed. Starters to make the bees build straight are readily made by dipping a piece of rag fixed on a stick into melted wax, and well smearing with it the middle of the under side of the top bar of the frame. For fixing comb and foundation in frames, wire fixers (Plate V) are very useful; a piece of stout wire is bent to fit over the top and bottom bar of a frame, and small pieces of thinner wire are soldered on to project at right angles. If large for the frame, the fixer may be bent or put on the frame obliquely; the comb or foundation is simply stuck on the points so as to touch the top bar. The fixers are removed in a day or two when the bees have fixed the comb. Tinned wire is best for fixers, it may be tinned by the men who tin cooking utensils. For a large sheet of comb or foundation three fixers are sufficient. Comb may also be fixed by melted wax; foundation may be fixed by melted wax as in making starters, or by simply warming it slightly, laying it on the bar of the frame inverted for the purpose,

and passing a small wooden roller along so as to press the wax on to the frame bar. The wax adheres to the wood, the frame is then held upright, and the foundation put vertical and tied so with cotton thread if necessary. A cotton reel, with the rim taken off, may be used as a roller, and it must be soaked in water before use to prevent the wax adhering to it. Another way of fixing foundation is to hold the foundation in position against the top bar and pour melted wax from a spoon, holding the frame obliquely, so that the small stream of hot wax runs along the bar in the angle between the foundation and the wood. Comb may be tied into frames with tape or string, strips of wood being placed along the under edge of the comb to prevent the tape cutting the comb; this is inferior to the other modes of fixing comb. For rapidly transferring the combs of indigenous bees to frames, the fixers are by far the best.

72. If bees were simply put into a frame hive without any guide as to how they should build, they would not build their combs in the frames so as to admit of their removal, the advantages of the frame hive would thus be lost. When transferring the combs are placed in the frames. When giving frames to swarms or additional frames to stocks, it is best to give frames of comb if possible; if comb is not available in large pieces, small pieces may be stuck along the top bar with melted wax, and any small pieces of good comb may be used for this purpose. In the absence of comb or foundation, the top bar may be painted with

melted wax along its centre. The best substitute for comb is artificial comb foundation, *i.e.*, sheets of wax impressed with the forms of the cells. Foundation is made, with the bottoms of the cells flat, termed *flat-bottomed* foundation, or with the bottoms of the cells shaped like natural comb; the latter is in more general use; it is also made of drone and worker sizes, thick for brood combs and thin for supers. It is mostly made by pressing sheets of wax between engraved rollers; it was formerly made by pressing between plates, and is now often made by bee-keepers themselves by means of taking melted wax between wetted plaster-of-Paris moulds. For drone comb of *A. indica* the worker foundation made for the European bees is the right gauge, but this cannot be used in full sheets, as it would encourage drone comb building; it may, however, be used in strips 1 inch to 1½ inch deep as starters. Foundation of six cells to the inch for use in full sheets will, it is hoped, shortly be ready for sale in India. It is better to use foundation in large sheets, leaving, however, some space below for the bees to build drone comb if they wish. The foundation may be readily fixed by warming one edge if necessary, and pressing this on to the top bar of the frame with a piece of wet wood, the frame being stood vertically on its top bar. Sheets of wax are made by dipping smooth wetted boards into melted wax, and then into cold water, or sheets of smooth galvanized iron are sometimes used; the sheets of wax so made may be impressed by stereoplates or by being passed between

rollers, a solution of soap or starch may be used to prevent the wax sticking to the rollers or plates. For making foundation in small quantities the best appliance is a plaster-of-Paris mould. To make this, make two frames of wood and hinge them together to open like a book, fit a board in one, lay a sheet of foundation on the board and close them together, now fill the one with plaster, and when the plaster has set reverse the frames, remove the board, and fill up the other side with plaster; when this has set, smooth off the backs of the moulds, open the frames and remove the sheet of foundation. The following precautions are necessary to success: do not use the plaster too thick; use a very thin oil to grease the foundation sheets, removing all superfluous oil with a sponge; when pouring the plaster, pour a little and rub it in with the finger to remove all air from the cells, then fill up and fill the mould well as the plaster sinks; do not open the mould until the plaster is quite hard. After the plaster is quite hard the mould is used as follows: soak the mould in water, lift and drain it, then holding it three or four inches open with both hands dip the hinges three or four inches into melted wax; close the mould, lift it out, and dip in water; on opening it the sheet of foundation may be removed. The wax is best melted in a double tin vessel with water in the outer vessel, and it should not be too hot. The use of foundation is exceedingly important when spare comb cannot be had; its use saves most of the time and labour necessary for building comb. Comb

built from foundation is more regular than natural comb, and the use of worker foundation enables the bee-keeper to control the building of drone comb. It is also necessary for getting the beautifully white super-comb honey.

CHAPTER X.

MANIPULATION.

73. Bees are not always on the alert to use their stings without reason, nor are they in the habit of attacking in concert; as a general rule they only sting when they are irritated, hurt, or they are protecting their stores. Some stocks will be found much less excitable than others; the former being often those which are near a pathway or frequently examined, but stocks alike in every other respect may differ in temper widely quite apart from these conditions, and the different varieties differ in excitability. They also differ in excitability according to the season. If honey is obtainable in plenty, they are mild, but if not obtainable and robbers are about they are excitable. During the rains in the plains the bees appear less active and less prone to sting, but during warm weather it is better to open a hive when many old bees are out, *i. e.*, during the warmer hours. It will be found also that a stock sometimes shows signs of excitement without apparent reason, and the bees are very ready, some to fly and others to fill themselves: in this case it is better to close the hive and postpone the examination. When bees

are intimidated they at once fill themselves with any honey available; while they are intent on filling themselves, and after they have done so they are harmless unless hurt individually. If they have no honey available they should be sprinkled with thin syrup, so that each bee may have the means of filling herself; a spray diffuser is the best instrument for sprinkling them. They are effectually intimidated by a little smoke from rag, paper, or other suitable material, very little smoke being sufficient; they are also intimidated by rapping on the hive sufficiently hard to jar the combs. Either of these means causes the bees to fill themselves, and if the smoking be repeated from time to time for ten minutes, the bees will be effectually quieted; or if the rapping be persisted in for that time the bees will be quieted, will have left their combs, and clustered in the top of the hive. The rapping may be with the hands or a stick, and at intervals of less than a second, hard enough to jar the combs without being so violent as to break them down. With new white combs, or a fragile earthern vessel for a hive, driving is impracticable. Smoke is usually used for quieting bees, rapping is employed when it is required to drive them from their combs into another hive. It is better in examining a hive to use neither smoke nor rapping, but merely by slow and steady handling to avoid exciting the bees, so that they are not disturbed by the examination; if smoke is used, then very little should be used; the object is not to stupify the bees, but merely to intimidate them, and ordinarily a few light puffs of smoke are ample, and as

the health of the bees may be injured, tobacco smoke should be used very sparingly under ordinary circumstances. In handling the combs care must be taken not to shake or jar them, or some of the bees may rise and attack; hence in cutting down combs from a tree the combs must not be allowed to fall, but be held and gently lowered; sticks may be driven through the comb, or the bees driven from a part of it by smoke, and this part held in the hand. Bees settling on the person must not be brushed off, but allowed to take flight; if touched, they may sting, whereas otherwise they would fly harmlessly away. The bees on a comb are best got off by shaking the comb smartly, holding and moving the frame vertically; a damp feather or a light piece of rag may be used to brush off the remaining bees, but brushing them off irritates them more than shaking them off. Shaking cannot be done with combs not in frames. Bees will often attack the operator's gloves where they would not attack his hands. Bees clustering may be driven by smoking them, provided the attempt be made to drive them upwards, *e.g.*, a swarm may be driven into a box or basket placed *above* them by gently smoking them from below; if an attempt be made to drive them downwards, they will simply cluster closer. For some purposes smoke has to be used plentifully, *e.g.*, when bees are fighting, or in uniting bees of different stocks, when they are balling a queen and an attempt must be made to save her, when transferring and the bees have to be driven from comb to comb, or when they are more than usually

inclined to attack. Bees entangled in the hair are likely to sting, hence the head is best covered when manipulating; but a bee inside the veil is not likely to sting the face; she is too eager to escape; care should be taken not to crush a bee, as the odour of the sting excites others to sting. Young bees may be picked up without stinging, but old bees do not permit such liberties; hives are best examined when a large proportion of the old bees are out. Young bees being less active are apt to crawl on the operator's clothes, and on ultimately getting pinched to sting; hence, after transferring, &c., it is well to see that no such bees are on the person. To watch the bees going in and out of a hive, stand at the side of the hive; when opening a hive stand behind it; never stand close in front of the entrance in the way of the bees going in and out; nor wave the hands about, as quick movements of this kind irritate the bees. Such operations as driving, transferring, &c., should not be done on the hive stand, but some yards distant, an empty hive being placed on the stand temporarily for the flying bees to enter. See also Arts. 32, 33, and 34.

74. The indigenous bee being so small and quick is not readily avoided, but the Italian bee often gives notice of her intention to sting by an angry note of warning; the experienced bee-keeper, recognizing the intention, steps back gently, and the bee retires, content with the effect of the threat. Some persons are far more likely to be stung than others. The bee on inserting its sting cannot withdraw it excepting by

gyrating round it to unscrew it, hence the sting is usually left in the flesh and the poison bag is torn out of the bee and left behind. If now the poison bag be pinched in the attempt to remove the sting, more poison is injected into the wound; the sting should be promptly removed by *pushing it out* with the thumb-nail, beginning at the point of the sting and pushing towards the poison bag. The whole is then removed unbroken. Some persons are affected far more than others; many feel very little pain, and on the same person stings differ in their effects, occasionally being more severe than usual. The immediate effect of a sting is sharp pain, this is followed by swelling which commonly lasts at first about three days; but when the bee-keeper has been stung a number of times, the pain at the time and the after-swelling usually become very trifling; very sharp pain at the time with bleeding from the puncture and immediate swelling are usually followed by rapid disappearance of the symptoms; but where the pain at the time is trifling and subsides at once, swelling may rise very gradually, be extensive, and last three or four days. When the stings are numerous, probably a cold lotion as spirit and water, or cold water on cloths, is the best remedy; hot foment-ations are useful if the swelling is painful. The wound should not be rubbed, the application of ammonia, moistened tobacco leaf, and the moistened end of a partly-smoked cigar, are remedies said to do good in some cases. As a general rule the injury may be left to take its course after the sting has been

extracted, and the less thought of the less the inconvenience; the bee-keeper has the consolation of knowing that after a number of stings he will be proof against them in a measure, and as dexterity is gained he will find that, although he commonly dispenses with the use of veil, gloves, and smoker, he very rarely gets stung. As persons stung for the first time are apt to think their case exceptionally serious, the above particulars are given to prevent such alarm. At first a sting on the finger may cause the whole hand to swell, the swelling may even extend along the arm and last four days; but this is exceptional, and after a little experience a sting will no longer cause alarm.

75. To examine a stock, take off the roof; take off the quilt gently, then take one corner of the sheet and draw it off side-ways, it being commonly stuck to the frames; if it were drawn off at right angles to the frames they might be shifted. Now see which frame has most room; take this frame by the ends and slowly lift it out with the bees on it. If the hive is not full of frames, move back the dummy to give room and shift the frames apart to admit of lifting out and replacing each one; if the hive is full, the first frame taken out must be stood on the ground against the post, or, much better, placed in the comb-box, or stood against the hive side inside, if the hive is large enough, resting on the edge of the body-box. The frames removed from the hive must be held steadily, not jarred or shaken, and the bees may be seen at work on the comb; the queen may be distin-

guished, and the brood in different stages may be readily examined. The frames must not be held horizontal or, if heavy, the comb may fall out. Having examined one side, lower one hand until the top bar is vertical, turn the frame round, then raise the hand again, when the frame will have been turned the top bar being now below; the other side may be thus examined, then reverse the operation and replace the frame in the hive. Having examined the frames, place on the sheet, wait a moment for the bees to go down, then put on the quilt and close the hive. If smoke is to be used act as above, but first blow a puff of smoke into the entrance, and blow a few gentle puffs between the frames as the sheet is raised, giving a puff or two if the bees show a disposition to rise. When frightened by smoke many bees may be seen moving their wings; this may be disregarded, being merely a sign of fear or agitation. If the hive be a vertical one the operation is somewhat more difficult, but is essentially the same; to remove the frames one or two pairs of rough tongs or two wire hooks are useful to draw the frames to the back of the hive previous to lifting them out.

76. To clean the floor board of a hive: if a vertical hive, scrape the board from behind with a chisel-shaped piece of iron or hard wood, and rake out with a piece of hooked iron: when removing frames for examination always examine walls and corners for vermin. The horizontal hive is cleaned by lifting the body-box with the bees and frames on to a newspaper

or mat placed on the ground, remove the floor board and replace it by a clean one, or scrape and clean it quickly and replace the body-box on it. Hives once used should be well scrubbed, inside and out, dried in the shade, and then exposed to the sun to disinfect them. Washing with salicylic acid solution or exposure to the fumes of burning sulphur should be applied if the hive has contained diseased bees. Boxes in which bees have been long confined should be burnt, and small insect vermin in empty hives and frames may be destroyed by simply laying the articles on the ground for the ants to clean them. Wax moth should be extirpated by cutting out the part of the comb infected, and by destroying it whenever found in the hive; a thin piece of stick, a knife, or a piece of wire is handy for the purpose.

77. Driving is technically making the bees leave their combs and go into another box or vessel suitably placed for their reception; the bees having been driven from their combs, the combs can be cut out, inserted in frames and given to the bees in their new box or otherwise disposed of (Art. 33). If a nest of bees is obtained in a log, strong earthen vessel, box, or primitive hive, to drive the bees, proceed as follows: The vessel containing the bees must be open at the top, or it may be reversed if necessary, the new hive should be placed over the other, open below, closed above; it may be placed horizontally on the lower vessel, the junction being closed by wrapping a cloth

round (close driving), or it may be placed with one edge only touching the lower box and open towards the operator like a box and hinged lid, the new hive representing the lid being supported by a second person or by any suitable means, and touching the lower box at the side the edges of the combs are joined to. Rap smartly and regularly with the hands on the side of the lower hive at about half-second intervals; jar the combs, but do not shake them down, and avoid rapping so as to shake down the rising bees; if they cluster and don't move up, give a puff of smoke; in a minute or two, with a loud buzzing, the bees will ascend into the upper hive and cluster, leaving their combs in the lower hive. The operation should be performed in a good light, and watch kept for the queen. Open driving is by far the best, as progress can be seen; close driving, although apparently suited to timid operators, is really more troublesome. As a preliminary, it is best to give a few puffs of smoke and sprinkle the bees with one or two wine-glassfuls of thin syrup, allowing them ten minutes or more to fill themselves. Frames of comb may be temporarily fixed in a hive with small nails, and the body-box temporarily closed above by nailing down the quilt or a thin piece of board; or better, the bees may be driven into a small basket or packing case; this with the bees may be stood on one side, while the combs are cut out and put into frames, and then the cluster may be shaken out on to the frames in the new hive and quickly covered by the sheet and then by the quilt and roof. Driving is

often impracticable for the following reasons: The combs may be new and too fragile to bear the shaking, the bees may be in a thin earthen vessel, possibly cracked, they may be in a wall or tree which cannot be sufficiently jarred by knocking it. If the combs are almost empty and the bees few, the breaking down of the combs is of little consequence; if not done too suddenly, the bees will leave the combs before they fall. If in an old packing-case, hammering on the case will make them cluster on the lid, remove the lid carefully with the bees clustering underneath it, and shake the cluster into the hive.

78. Transferring is the technical term for taking the bees and their combs out of one hive and putting them into another; it includes the operation of cutting the combs out of a hive without frames, and fixing them in the frames of a frame hive. The commonest case is that in which a stock of bees has been obtained in a log, earthen vessel, or other natural or artificial hive, and it has to be transferred to a bar-frame hive. The simplest method, if practicable, is to drive the bees as directed above, then cut out the combs, fix them in frames, and having placed the frames in the hive shake the bees on to them and close the hive. If driving be impracticable—a common case—spray or sprinkle one or two wineglassfuls of thin syrup over the bees, and smoke them repeatedly for 10 to 15 minutes. When they have filled themselves, the earthen vessel may be broken or the log separated, so as to completely open it, and expose the combs and bees.

Have the frames ready, with fixers preferably, or tape and strips of bamboo, or melted wax, to fix the combs. Now with smoke drive as many bees as possible off a comb, cut that comb out and quickly transfer it, fixing it in the frame against the top bar, repeat the operation with the other combs, and ultimately shake the cluster of bees on to the frames placed in the hive. If the old hive has to be broken into several pieces, bees clustering on different pieces may be at once shaken into the hive; if the queen can be found, she should be shaken into the new hive at as early a stage as possible; but in general the bees are driven from comb to comb, and the cluster with the queen remains behind and is shaken into the hive last. This operation is not an easy one, as the combs have to be transferred with some bees on them. To avoid crushing bees, the frames used may be laid across empty ones, and the operation is far simpler when fixers are used than when the combs have to be tied into the frames or cut straight and stuck to the top bar with melted wax. To clear the combs as far as practicable, bees may be brushed off them with a damp feather. (See also Art. 34). After the bees have been transferred they should not be disturbed for two or three days, and transferring should be performed as quickly as possible in the middle of a fine day, the quilt need not be put on if the bees have clustered in the hive roof, or it is otherwise inconvenient, and each frame should be placed in the hive as it is ready. Brood comb should be carefully transferred, as it may prevent absconding,

wax moth if present should be cut out, and drone comb may be left out when transferring. Transferring under the conditions described requires dexterity; the beginner had better wear a veil to give confidence; it should be done a short distance from the stand, not on the stand, as then the bees flying go to the stand, and so leave the operator; it is best done when other bees are not likely to come for the honey spilt, and all spilt honey should be carefully washed away so as not to induce robbing. (Art. 30). The best time to transfer is when the combs are lightest, but there is seldom a choice of time. Transferred bees (*A. indica*) should not be examined for three days, or they will probably abscond.

79. *Uniting.*—Strong stocks are essential to profit in the summer, and are necessary to safe wintering where there is a cold winter. A large cluster is able to keep up its temperature with the consumption of very little food, a small cluster may be quite unable to outlive the cold, or can do so only by consuming much food at a time when bees cannot go out, and hence disease is engendered. The inactive season must be provided for by having stocks strong when breeding ceases for the year, and when the active season returns there must be a sufficient number of bees surviving to perform the work of the breeding stock, and thus weak stocks must be united to winter safely, and in spring the few bees in stocks which have wintered badly must be united to others. In summer uniting is done to obtain great honey yield. Swarms issuing when in-

crease of stocks is not required may, with advantage, be united to stocks, or two swarms may be united together, the object being to get very strong stocks for the honey harvest. Accidents render it necessary to unite whenever the number of bees in the failing stock are worth saving, *e.g.*, loss of queen, when from absence of drones and fertile queens no queen is available, nor can one be bred: this occurs when the queen dies in the winter, or is lost in the autumn. A stock having a drone-breeding queen or a fertile worker must have a fertile queen introduced if practicable; but as this may be impracticable from the non-existence of a spare queen, or because the bees have been allowed to grow too old to readily accept a queen, or are so few that it is necessary to unite to another stock or distribute the bees amongst the weakest stocks. Uniting is also adopted to build up nuclei to stocks, and in artificial swarming, which see.

The three accidents to be avoided in uniting are: (1) the bees united separating again and going to their old stand; (2) fighting; (3) destruction of the queen of the stock to which strange bees are added. If stocks are to be united and one be brought from two miles distant, there is no fear of the bees going back; if the hives are in the same apiary, one of the hives must be gradually approximated to the other (Art. 83), two or three feet a day, being moved only on days when the bees are flying, and the entrances gradually brought into the same direction if necessary; when close together they are unit-

ed, the single hive is placed between the places of the two hives. To prevent fighting it is necessary to remember that full bees are not inclined to fight, that all the bees must be thoroughly intimidated by smoking them well, and that they should have the same scent to destroy their identity; hence the syrup used may be slightly scented with peppermint or any convenient spice, but the smoking is probably sufficient to give them the same scent, although the use of scented syrup is usual. When uniting two stocks both of which have queens, the queens may be allowed to fight, in which case one will be killed; or if one queen is the better, she may be caged on a brood comb for 24 to 48 hours, and the other queen removed; or if one of the queens is a virgin, as in uniting a swarm to its stock or a cast to a stock, and the other laying, the laying queen should be caged and the virgin removed, as in combat the impregnated queen is generally killed, being less active. When a laying queen is removed, she should not be destroyed at once, but kept in reserve in case the other be not received by the bees. To unite stocks: having brought them together, or one from a distance of about two miles, or having removed both to a new place a similar distance from the old stands, smoke the bees well and syrup them; when quite filled, *i.e.*, in about 15 minutes, lift all the combs into one hive, placing them alternately,—the brood combs in the centre,—take out the inferior queen and keep her against accident to the other. Watch

the hive, and if any fighting takes place in 15 to 20 minutes' time, smoke the whole well and repeat it at similar intervals until they remain quiet and are friendly. If the combs are too many for one hive, omit some of those containing honey.

In uniting two very weak stocks, some recommend placing the combs and bees of each stock by itself in the new hive, separating them by one or two empty combs, others place the frames as described above; the mode described is successful if the bees be watched and promptly smoked, and, if necessary, sprayed, until they are amicable. In uniting a queenless stock to a stock with a fertile queen, the queenless bees being almost always old and therefore more inclined to fight, the following method is best: Cage the fertile queen, spray her bees with scented syrup, and smoke them till filled. Serve the queenless bees the same, and then shake them all off their combs into an empty box or basket; place the perfect stock hive on the ground on a mat, sheet, or newspaper, with a stick underneath it, so as to raise its front edge an inch or more, then shake out the queenless bees on to the sheet in front of the hive, and they will crawl in and join the others, being well received if they are filled. This operation should be performed in the evening, and smoke should be applied if fighting breaks out. The hive should then be very gently lifted from the ground, placed on its stand, and the queen released 48 hours afterwards. The above may be modified by driving both stocks, mixing the bees well, then pour-

ing them or shaking them out in front of a hive, or on to the frames of comb, the mixing being best done in the evening. With frame hives the operation is obviously simple: when the bees are in immovable comb hives, the last method described *must* be adopted. The other cases are uniting swarms to stocks, and swarms together. Swarms issuing on the same day may be united by simply shaking them together on to a mat in front of a hive with the front raised. If they issue on different days, the second one should be shaken out on a mat in front of the hive containing the first swarm. In all these cases the body-box of the hive should be gently placed on the mat on the ground, being replaced on its stand after the bees are hived. Swarms are filled with honey, and are therefore well received. In all cases smoke should be used, if necessary. In caging a queen she should be put on a brood comb, if possible, and so that she can get honey or syrup; when releasing her watch the behaviour of the bees towards her, and if unfriendly, smoke them, rescue her if possible, and re-cage her. The latter precaution is seldom necessary in uniting, being most required in introducing queens. When one queen is fertile, it is usually best to save her, as the risk of losing the other on her wedding trip is thereby avoided.

Queens have to be introduced when from accident stocks become queenless, to replace worn-out queens, and in making artificial swarms. When the queen is introduced to young bees having brood in the comb, there is generally little difficulty; but when the bees

have grown old and been so long queenless that they have no brood, great difficulty is experienced in getting them to accept another queen. The difficulty is reduced by first giving them some hatching brood and so waiting until there are some young bees in the hive; but, generally speaking, it is better to unite the queenless bees to a stock having a fertile queen, rather than risk the loss of a queen; an additional reason being that old queenless stocks are, for obvious reasons, weak in number. In introducing queens the following precautions should be taken: The hive should have one comb of brood at least, and the queen should be caged on this, so that she can feed at honey cells, the bees losing a queen or having their queen removed should be allowed twelve hours' queenlessness to find out their loss; all queen cells in the hive should be cut out; the bees may be sprinkled with thin syrup before inserting the queen and before releasing her, and the stock fed while she is caged; be quite sure the stock is queenless before introducing, the best test of which is the building of queen cells, as sometimes two queens may be in the hive and removal of one therefore be insufficient. Do not let the bees breed a queen; do not release the queen if the bees are clustering on the cage; but if they are going about their work as usual, lift off the cage, have smoke ready for use, if necessary; if the bees attempt to bite or ball the queen, smoke them and re-cage her; they may run over her and examine her. The queen might probably, in most cases, be introduced without caging, but she

should be caged in favourable cases 24 hours, with old bees 48 to 72 hours, or even a week if it be found on releasing her the bees attack her. When apparently safely introduced, the hive may be again examined in half an hour, and the next day to see if the introduction has been successful. It is not recommended to introduce the escort bees with a queen received in a queen box, as fighting may ensue amongst the workers and lead to destruction of the queen; the bees should be united to another hive if practicable, and in any case they should be sprayed with syrup, made to fill themselves, and allowed to walk in at the entrance. Only fertile queens can be introduced in this way; virgin queens are not, as a rule, accepted. Sometimes queens fly away, but it is said they return soon if the hive be left open, and clipping the queen's wing, practised much in America, prevents this. The author has had queens fly, but they returned.

80. The combs at the back of the hive, or in a doubled hive, those in the upper box, are removed for extracting. Take one or two combs from the first stock, place in a comb box, and remove indoors; uncap the comb by means of a honey knife, or any long, thin sharp knife, preferably warmed by being dipped into hot water, place the uncapped side against the wire of the extractor, being careful to avoid holding the heavy frame horizontal until on the extractor, as otherwise the comb might fall from the frame. If there is brood in the comb, cover the extractor with a cloth or lid while extracting. At the time of taking the combs move

the combs in the hive and insert one or two empty combs in the centre of the hive; in the latter case a comb of brood between them, or the combs extracted may be re-inserted or substituted for others in another hive. To get the bees off the comb, lift the comb out and shake the bees off by a smart vertical jerky movement, shaking the bees on to the top of the frames or on to a mat placed in front of the flight board; any few not shaken off may be gently brushed off by a wet feather, bird's wing, edge of a piece of paper, rag, or a lightly-held bunch of light thin grass or fern. Care must be taken not to break the comb in shaking it. Extracting should be done indoors, as otherwise bees get into the extractor, and robbing may be induced; if robbing exists at all, it is a sign the honey supply is failing and the extractor must not be used. Great care must be taken that a hive full of brood is not left with too little food; if it be found too much has been taken, the bees must be slowly fed. When honey is coming in fast, the extractor should be used to clear the brood nest; but as this is dangerous to the brood, the beginner should confine himself to putting the empty combs in the brood nest, which has the same effect, unless the honey glut is very great. The use of the extractor acts in the same way as enlarging the hive; it gives more vacant cells, and thus often checks swarming. The extractor has the additional advantages of being easier to manage than the appliances for getting comb honey, yielding probably in most cases twice the quantity of honey; allowing of honey being taken from

stocks too weak for successful supering, and taken in bad seasons when supering would be impracticable; the extractor enables the apiarist to take uncovered honey from the combs at the approach of winter, and so avoid the risk of dysentery, and combs removed for wintering may be emptied for use as brood combs next season. It is obvious from the above that the extractor produces quite as good a product, in larger quantity, and at lower price, than supering for comb honey, and the extracted honey is easier to keep, pack, and transport. The ease with which the extractor may be applied renders caution in using it necessary to avoid starving the bees, as rapid extraction during a honey glut from a hive full of brood may lead to this accident if the income be suddenly checked and the hives not well looked after.

81. Comb honey may be obtained from inside the hive or in sections or frames placed above the brood nest; the former is the easier and is applicable to weaker stocks; but commonly when a difficulty is experienced in getting the bees to work in supers, the super sections or frames are placed inside the hive, and when commenced, removed with the bees on them, to the top. Before comb honey can be obtained, the hive must be crowded and have plenty of brood; if it is not crowded, then the capacity of the hive must be reduced by a dummy until the space allowed is crowded: in this case expansion upwards into a small super may be induced, or, what is more suitable, a frame of sections may be hung on each side of the

brood nest. In the case of a super being put on, the bees must be crowded into it, so that, as a general rule, supering is performed only on strong stocks; as however, bees will sometimes swarm rather than enter the super, they are commonly enticed above by the use of sections worked out or partly filled in the body box. For comb honey the sections are fitted with specially thin foundation, comb or wax starters may be used, but if dark comb be used, the appearance of the comb honey is spoilt. Separators should invariably be used. Drone comb may be used for supers; but if the hive contains very little or no drone comb, as is sometimes the case, the queen is apt to lay drone eggs in the super. Put sections in frames and hang one frame on each side of the brood nest, crowding the bees if necessary; when the sections have been worked out or partly filled, remove them, replace them by others, and place those removed above the hive with the bees on them. Cover the super up warmly to prevent the bees going down at night, and as the sections are filled remove them and replace them by others, either from the body box, or fitted with unworked foundation. If the outside ones are worked very slowly, these may be removed to the places of the full ones removed. Super comb should be removed immediately it is capped; as if left on after this, it is discoloured and so deteriorated in value. When removing the sections or frames, the bees may be shaken or brushed off; many will fly off if the section or frame be left uncovered while arranging the hive; when the whole super crate is removed at

once, it may be taken into a room, and allowed to cool, when the bees will fly off; or it may be placed in a dark box with several cork holes in it, the super being placed in the box, one or two holes are uncorked, and the bees issue from these; if bees are seen to enter the holes, cork them and uncork others. In general, the simplest method is that first described, shaking, and a damp feather being used to get the bees off, the sections being removed one at a time and put into the comb box as cleared. Generally strong stocks and good honey supply are the conditions under which supering is likely to be satisfactory.

82. Doubling is a means of getting an enormous number of workers in one hive, when the honey collected is taken with the extractor. It should be noted that doubling and adding swarms to stocks, *temporarily* increase the number of workers, as only one queen exists to the increased number of workers; but the number of workers being absolutely large, honey is brought in in great quantity, while as only one queen is laying the consumption is relatively small and the surplus great. Another important advantage of doubling is the liability of strong stocks to swarm is thus checked, and the consequent loss of time and labour saved. Obviously doubling should be done when honey is obtainable, and so that the doubled hive may have its maximum population when honey is most plentiful. Select a strong stock having a large quantity of brood, remove the brood combs, shake off the bees, place all the brood combs into an empty body box,

and place this on top of a second strong stock, fill up the depleted hive with empty comb or foundation, and, if necessary, fill up the doubled hive by adding comb, extract from the upper storey of the doubled hive as honey is stored. The uniting of two strong swarms early in the season is sometimes termed doubling, and in an excellent mode of increasing the honey yield when increase of stocks is not required.

83. Hives to be removed should be closed at night, when all the bees are inside; if required to be moved a short distance, they should be removed about 3 feet a day, not counting the days on which the bees do not fly. Swarms should be moved the evening after swarming before they have built their comb. Stocks removed two miles do not lose bees by their returning to the old stand. In moving hives it is necessary to provide for ventilation, to prevent the frames swinging and the combs breaking down. Ventilation may be provided for by replacing the quilt by a piece of perforated zinc, or putting on a board with a hole in it, covered with gauze or perforated zinc, or by putting on the perforated part of a feeder over the feed-hole. In conveying stocks long distances, the portable hive should be used. To prevent frames swinging on long journeys, *vide* Art. 61; for short distances, the most convenient means are wooden Ts; the cross piece is about an inch and a half long, and is fixed by a small nail to the upright piece, which is about 8 inches long and $\frac{1}{2}$ inch thick; two of these Ts are dropped near the hive sides into each space between the frames, and

the frames are pushed together and wedged up; it is obvious thus arranged the frames cannot swing together so as to crush the bees. For long journeys the combs should be tough; they should be tied into the frames with stout twine, the honey should be thick or crystallized in the cell, and water should be supplied by means of a bottle fixed inside, or a bottle or sponge outside. (*Vide* Arts. 54 and 61.) Candy may be given instead of honey. Queens should have 20 to 30 escort bees with them for short journeys; for long journeys and in cold weather this number should be increased; for a very long journey several hundred bees are necessary; young bees should be given, as far as practicable.

CHAPTER XI.

BREEDING.

84. Strong stocks being essential to profit, the bee-keeper must keep his stocks as strong as possible by rapid breeding. To breed rapidly it must be the proper season; unseasonable activity leads to a greater loss of life than the breeding can compensate for; hence breeding too late or too early, when there is a severe winter or rains, is to be avoided. Although the queen will lay for a long period, the forcing which is practised in apiculture soon diminishes her fecundity; hence the faster and more continuous the breeding, the sooner the queen must be changed. In Europe two or

three seasons is the usual limit, but when bees are carried down the slopes into the valleys, so as to make the breeding more continuous, or when in the plains it is found practicable to prolong the natural laying season, then queens may have to be changed oftener. Warm bright weather and an income of honey and pollen are essential conditions; bees breed so long as there is food procurable; they stop breeding as soon as the food-supply fails, notwithstanding that they may have plenty of food in the hive. Breeding requires a certain number of bees to carry on the work of attending to the brood and keeping it warm, and old bees do not appear to like the work of attending to the brood, their natural functions being working outside. There must be a certain total number and a proportion of young bees to admit of rapid breeding. With care, skill, and warm weather, a stock *may* be built up from a good queen and a few hundred bees, but this is slow and sucess not certain. A most important condition of rapid breeding is crowding the bees on to the brood combs they can cover, and only gradually expanding the hive and giving more comb as the bees are able to fill the space.

85. To stimulate breeding give only as many frames with a minimum of three as the bees can cover. If they cannot cover three frames, it is better to reduce the size of the combs by cutting away an inch or two at each side, or shorten them by cutting two inches from the bottom. If there is capped honey in the comb, uncap some of it as fast as it is removed, and

unless the bees are getting pollen readily, put a little suttoo, or wheat or pea flour, inside the hive near the entrance, noticing if the bees take it. If there is no uncapped honey nor honey to uncap, put on a feeder and feed with syrup slowly, so that what is taken is consumed, and avoid feeding so fast that the brood nest may be filled with syrup instead of brood. About every eight days shift the combs, placing a comb containing least honey in the place of one with capped brood, shifting the latter to one side; or if two combs have brood, put one of those without brood between two brood combs. After three or four weeks the bees will be hatching out, and another comb may be added, and so on until the hive is full of bees. Meal may be given outside the hive, which is the usual way; it should be placed in a shallow vessel and mixed with a little chaff, grass, leaves, shavings, or other material for the bees to stand on; it should be protected from birds, and a small piece of comb placed on it at first to attract the bees, or a cake of meal candy may be given; but this is inferior to the syrup and meal. Stimulative feeding should be with thin syrup or diluted honey, in small quantity, and continued without any intermission for a fortnight or more, the comb being emptied with the extractor, if necessary, to make room for brood.

86. Weak stocks should be assisted by giving combs of covered brood from strong stocks. Swarms should be assisted by giving them empty comb and by stimulative (slow) feeding. Weak stocks should be stimu-

lated by feeding slowly or uncapping their honey. At the beginning of the breeding season the stocks breeding slowly should be assisted by brood comb from those breeding rapidily.

87. It is not possible to prevent drone breeding altogether, nor is this probably desirable, but the number of drones bred is greatly reduced by giving only worker comb or worker foundation, and by cutting out drone comb when excessive. Drone comb may be used for store comb or supers; but if so used and there is insufficient in the brood nest, the queen is very likely to lay drone eggs in it. In putting in foundation or worker comb, a little room may be left for drone comb, and the use of young queens and limitation of drone comb are sufficient to prevent excess of drones. The use of foundation in full sheets has the great advantage of placing the quantity of drone comb quite sufficiently under control. Excessive drone brood is destroyed by cutting off the caps of the cells with a sharp knife, and so beheading the brood, or by chilling it by dashing cold water on the comb, replacing the comb in each case for the bees to clear it. Such measures should be seldom, if ever, necessary, drone brood comb may be placed outside the brood nest, where it will not receive eggs, but be used as store comb when the brood has hatched out. To breed workers proceed as described above, *i.e.*, crowd the bees, apply stimulative feeding, and spread the brood, using only worker comb. To breed drones proceed in the same manner, and when the number of workers

is considerable and the combs covered, insert drone comb in the brood nest and continue the stimulative feeding but somewhat more rapidly.

88. To breed queens it is merely necessary to remove the queen of a strong stock which has eggs and lavæ under three days old, when the bees will at once commence to build queen cells and rear queens. A strong stock is chosen, because the removal of the queen obviously stops the supply of eggs until a new queen can be reared and impregnated, about three weeks, and the stock rapidly decreases in number. Obviously queen-rearing is impracticable unless drones or drone brood is present to provide for impregnation of the young queens. On removing the queen, feed, and if necessary supply meal, until the queen cells are capped, unless honey and pollen are being brought in plentifully. As queens raised from eggs are greatly preferred to those raised from lavæ, cut holes in or cut off the edges of a comb containing eggs, so as to bring the eggs near an edge ; this comb being inserted in the centre of the brood nest, queen cells will be started at the cut edges, and in seven or eight days these will be capped over, when they will be available for removal to be placed in other hives or for furnishing to nuclei. If all but one be removed, the one remaining will furnish a new queen for the stock hive. If a large number of queens be required, then the first batch of queen cells may be removed, and a comb containing eggs taken from another hive may be treated as described above, and inserted for more

queen cells to be made on it. To remove a queen cell cut it from the comb with a small penknife, leaving attached to the upper part of the queen cell a triangular or wedge-shaped piece of comb, the base of the triangle being upwards; care must be taken to avoid squeezing the queen cell in any way. To insert a queen cell, cut from the comb a wedge-shaped piece corresponding to that attached to the queen cell, and insert the wedge-shaped piece of comb on the queen cell into an opening cut in the comb, cutting away comb if necessary, to make a space for the queen cell to hang free in. Queen cells are often simply pinned to the comb after being cut out as described above, the pin being passed through the piece of comb left attached to the queen cell; in any case pins may be used if necessary. Beginners should cut out one cell at a time, replace the comb, and dispose of the one cell before cutting out a second. The cells should not be exposed to the sun or chilled. (*Vide* Art. 93.)

89. In common with all animals, bees differ in many respects from each other; the bee-keeper endeavours to obtain and perpetuate those varieties having the most desirable qualities: the progeny of one queen may be more beautiful, industrious, or better tempered than those of another, or one queen may be more prolific than another; in general, some stocks may prove better than others, and the bee-keeper does well to select drones and queens bred from his best stocks to be the parents of future generations. He may introduce new varieties for their excellent

qualities or to infuse new blood into the race long cultivated, and he should avoid having young queens impregnated by drones from their own hive. But the bee-keeper has two points to consider in which bees differ from other domestic animals,—he cannot control impregnation directly, because it takes place in the air, and as impregnation does not affect the drone progeny, a queen may be the mother of hybrid workers, but her drone progeny will be quite pure; *e.g.*, an Italian queen impregnated by a black drone lays hybrid worker eggs, but pure Italian drone eggs. To breed from two selected stocks stimulate breeding as described in Article 85, and breed drones in one stock as early as practicable before the other stocks have drones, then remove the queen from the other stock and breed queens in that stock; the queens will be necessarily impregnated by the drones of the first stock, as these are the only drones flying. In introducing a new variety into an apiary, the course generally followed is to obtain impregnated queens of the new variety and introduce them into stocks of the old variety (Art. 79); as the old bees die off they are replaced by young bees of the new variety. By this means much information, such as the longevity of workers, &c., has been gained. If a fertile queen of a new variety be introduced to a stock, and young queens, her progeny, be fertilized by drones of the old variety, their drone progeny will be pure of the new variety, their workers hybrids. Queens bred from the eggs of the first queen may be impregnated by

drones, the progeny of the young queens, and the progeny will be pure of the new variety, although related to hybrid workers. It should be noted that the term hybrid used by bee-keepers has not the ordinary meaning; it means simply a cross between any two distinct varieties. It remains to be tried whether a cross between *A. indica* and *A. mellifica* is possible.

CHAPTER XII.

MULTIPLYING STOCKS.

90. As strong stocks are essential it is necessary to avoid over-multiplication of stocks. A considerable increase of stocks and a large yield of honey cannot both be obtained the same season. The rate of multiplication of stocks will depend on whether the required number of stocks has been obtained or not; in the former case the additional stocks required will be merely those necessary to make up for accidental losses, as accidents to queens, &c. If rapid increase of stocks be required, then very little or no honey can be taken, and the bees may even require feeding. The exact rate of increase practicable with a profitable honey yield differs with the richness of the locality and season from 50 per cent. upwards. It is obvious from the above that a great difficulty the bee-keeper has to contend with, is the prevention of swarming, or rather keeping it within very narrow limits. There is no infallible means for preventing swarming, but it may in a great measure be prevented, and natural

swarming, which is uncertain and demands watchfulness, patience, and trouble, may be either anticipated by artificial swarming, which is certain, quite under control, and entails very little trouble, or prevented by such expedients as doubling, using the extractor, giving room in the hive in advance of requirements, keeping the hives shaded, &c., para. 91. If natural swarming should take place when increase of stocks is not required, the swarms may be united to stocks or to each other. In America it is a common practice to clip the queen's wings to prevent her flying with the swarm; as she then cannot go far from the hive, the bees return, and the swarm is captured with little difficulty; one of the larger wings is clipped with a pair of fine scissors while the queen is walking or standing on any convenient surface (*vide* Arts. 39, 40, 41). During the swarming season if one or two bottomless boxes with a number of augor holes in the sides are hung up in the neighbourhood of the hives, and if empty hives are present, swarms will often take possession of such; a piece of comb inside is an additional attraction. When the swarm issues, it should be allowed to cluster and then be hived as soon as possible, as the longer the bees are left the more difficult they become to handle. In capturing and hiving swarms some ingenuity is often necessary, and only general instructions can be given. If hived at once the bees being filled are easily handled, but later they become prone to sting. The swarm may be put directly into the hive if possible, or captured in a light

box or basket, and then placed in the hive. A light ladder and a bamboo or two may be useful, and a common iron bucket or a small basket may be used if necessary to shake the swarm into. A body box with frames of comb, if possible, or if comb be not available of foundation, should be in readiness, the frames kept from swinging together by Ts (Art. 83) and wedged up. When the swarm has clustered, the hive may be placed above the cluster, and the bees driven upwards with a little smoke; when they have gone up, the hive may be removed to its stand. If clustered on a bough, a basket or bucket may be held close underneath, and by a sharp jerk of the bough the bees are shaken into the receptacle and removed. If they have clustered near the ground, the hive may be placed near them on a mat, one side of the hive being raised an inch or more, the bees are shaken on to the mat, and they will crawl into the hive. If on a small bough which can be cut, the bough may be sawn off with as little jarring as practicable, and the swarm either put into the hive from the top, or from below as already described. If they are so clustered that the hive cannot be used, a light box, basket, or bucket may be used to shake or sweep the cluster into, and then it may be hived in either way described above; or the bees may be driven by smoke into the basket placed above them, and then put into the hive as described. With the vertical hive the swarm must be captured in a basket, bucket, or light box, and then poured into the hive at the back, or put in front of the

entrance on a mat or board. When hiving at the bottom, the quilt or a board should be on; when hiving at the top, the bees are simply shaken or poured into the hive, a few frames being removed to make room for them, when they have clustered the frames removed are gently replaced; if the frames are introduced very slowly, the bees on the hive side will move out of the way and not be crushed. The hive may be ventilated and additional entrance way left for the flying bees by propping up the body box below, or by leaving an edge of the quilt open; when the bees are in, set down the body box or arrange the quilt, put on a feeder and close the hive. In raising one edge of a hive containing frames, raise one side so that the frames do not swing. As swarms have to build their combs, there is great gain in giving them combs in which the queen can lay at once, and in feeding them. If the swarms are not required to form separate stocks, unite them (*vide* Art. 79) with each other or with stocks. To prevent after-swarms, cut out at once all queen cells but one, from the parent stock. A brood comb if available should be put in the hive, as sometimes swarms leave the hive and they are less likely to leave the brood. Having put on the feeder and closed the hive, it is better to leave the bees undisturbed for two or three days, as if disturbed they may abscond; after this period superfluous combs should be removed, the hive contracted, the swarm fed, and treated generally so as to stimulate breeding (Art. 85).

92. Artificial swarming is quite under control and

is far preferable to natural swarming; it is performed in many ways, of which the following are the best: To be successful the stocks should be so strong that natural swarming is anticipated; but as the value of a swarm depends on its being obtained early in the season, and as in no case should swarming take place so late as not to admit of the bees getting in and sealing their winter stores, natural swarms should be made as soon as the stocks are strong enough and have drones; sometimes artificial, is used to prevent natural, swarming. The conditions of success are—(1) that the swarmed stocks be strong; (2) if spare impregnated queens are not available, drones must be at least ready to hatch out; (3) that the artificial swarm is not depleted by the bees returning to the old stock; (4) that if a queen be given to the swarm, she be introduced with proper precautions for her safety. Obviously when there is a choice, the young bees should be given to the new queen, as they are more amiable and less likely to abscond. Artificial swarms interfering least with the honey harvest are made as follows: If there are a sufficient number of stocks, take one or two frames of brood from each of several stocks to the number of eight frames, shaking off the bees and leaving them behind; place this brood in an empty hive, and fill up all the hives with comb or foundation; now place the hive with the brood combs on the stand of a strong stock, moving the latter to a new stand, when the old bees of the strong stock will return from the fields, hatch the brood, and raise a young queen. A

better practice when a spare queen is available is to give the queen of the strong stock to the artificial swarm her own old bees, and introduce a fertile queen to the young bees of the stock on the new stand. Such methods as the above depending on separating the flying bees should be practised only on fine days, when most bees are out. To make three stocks out of two *A* and *B*: on a fine day, take four or five combs of brood from *A* without bees, place in an empty hive and fill up both hives with comb or foundation; now put the hive with the comb on the stand of *B*, and remove *B* to another stand. In this case *A* supplies the brood and *B* the bees. In the absence of spare queens to introduce, *C* will raise queens from the eggs of *A*. To make two stocks out of one without a spare queen, is obviously attended with more risk and a greater diminution of the honey yield than the above methods, but it is done on the same principle. The queen and one comb of bees are left on the old stand to receive the old bees flying; the old hive and all the brood and young bees are removed to a new stand, where they raise a queen, or the queen may be removed with the bees and a comb of brood be left for the old bees to raise a young queen. It should be noted that the young bees must be supplied with syrup and meal if necessary, as the outdoor labourers have been taken away; that care must be taken in dividing that sufficient bees remain in the swarm removed to keep the brood warm, and if during the period queens are being reared, the number of bees

dwindles or all the brood hatches out, the swarm should be assisted by brood from other stocks. The presence of brood will prevent absconding, and particularly prevent the bees leaving when a virgin queen goes out to meet the drones. When fertile queens are used in nuclei to make swarms, this is termed nucleus swarming. (See Art. 93.)

93. It is obviously very advantageous to the bee-keeper to have fertile queens ready against accidents, and to make artificial swarms; these are reared in a stock hive up to a certain point, and then kept in small stocks of two or three frames termed nuclei. Proceed as described in Article 88 to breed queens by removing the queen of a strong stock; take one or two frames of brood and a frame of honey and pollen with the bees on them, and place them in an empty hive contracted by means of a dummy; contract the entrance until it admits only one bee to prevent robbing; cover up to economize the heat, and this forms what is termed a nucleus. One full stock may be divided into a number of nuclei, or one nucleus may be made from each of a number of hives. If one stock is split up, the flying bees will form a separate stock with their own queen; but, as a rule, it is better not to break up one stock, but make up each nucleus from a separate stock. Nuclei are liable to be depleted by the old bees, leaving them for the parent hive, and they are liable to dwindle seriously from the fact that they at first only contain few bees and have no laying queen. The first may be met by

shaking the bees off two or three other combs into the nucleus when stocking it; the other case is met by inserting a comb of covered brood if the dwindling is such as to require it. The nuclei should be prepared eight or nine days after removal of the queen from the stock which is to furnish the queens; at the end of that period the queen cells started will be capped and may be cut out. (Art. 88.) The nuclei should be stocked 12 hours before the queen cells are cut out, and the cell is best introduced by cutting out a queen cell started in the nucleus, and inserting the queen cell in its place; with these precautions the bees are much less liable to tear down the queen cell introduced. Obviously only one capped queen cell is given to each nucleus being pinned into the comb; as soon as the queen is hatched and fertilized, the nucleus is ready for either building up to a full stock by gradually adding covered brood from strong stocks, or on a fine day the nucleus may be put on the stand of a strong stock, and the strong stock on the stand of the nucleus, the nucleus being filled up with empty comb or foundation and the queen caged (Art. 79). When queens are reared for sale, the queen is removed from the nucleus as soon as she commences to lay, and another cell introduced to rear another queen. A supply of queen cells is kept up by keeping the queen rearing stock queenless, and supplying it with brood comb necessary for each batch of queen cells. It is obvious by these means fertile queens can be bred continuously for a long period, provided there are

other stocks from which brood combs can be taken to keep up the numbers of the bees in the rearing stock and nuclei. A danger to which nuclei is exposed, is the absconding of the bees when the queen goes out to meet the drones; to prevent this, brood must be present in the nucleus at this time.

CHAPTER XIII.

FEEDING.

94. The neglect of certain precautions in feeding may lead to the destruction of stocks by robbing or disease. Only the bees being fed must be able to reach the food; if accessible to other bees robbing and fighting will be induced, and every stock in the apiary may be destroyed. When a feeder is put on a weak stock, the entrance should be contracted to admit one or two bees; the contracted entrance must be kept clear of dead bees, and the hive ventilated if necessary. The feeder must in every case be covered so that no bee can get at its contents excepting from inside the hive. Flour of peas, dhall, wheat, or other substitute for pollen, does not induce robbing; it may be fed inside or outside the hive; inside is less trouble. Both pollen and honey are necessary to breeding. If meal or flour candy be fed inside, then it is necessary to clean the floor board occasionally to remove the remains, which may otherwise encourage insect

vermin. Summer and spring feeding is with thin syrup usually and is slow, having the object of stimulating breeding; autumn feeding for winter stores is with thick syrup, fed quickly, and winter feeding is with candy, as the introduction of liquid food then would cool the hive and induce dysentery. Flour candy is used for spring stimulative feeding.

95. Necessary feeding is feeding to prevent starvation during the inactive season, or to feed up stocks so threatened at any time. It is of great importance to keep bees quiet during the inactive season, particularly where the winter is severe; they should therefore be fed up rapidly with honey or thick syrup early enough to admit of their capping all their stores before the weather becomes severe, and all uncapped stores should be extracted. The quantity of honey or syrup left in the hive had better be too much than too little, as the bees will only take just what is necessary. In Europe 10 to 20 lbs. is allowed for wintering, but roughly it is as much capped honey as the bees can cover on both sides. As soon as settled spring weather sets in, every stock should be examined and fed slowly, if necessary. In the spring, flour candy is useful to stimulate early breeding, but unseasonable activity either late or early should be avoided. If the bees are well wrapped up in cold weather and the hive properly contracted, the consumption of food is very trifling, and strong stocks consume relatively the least; the less the better, as a large consumption of food may induce disease. If necessary to feed very late or very

early in the season, then candy should be given, fluid food only being given during warm weather. During the rains in the plains the hives may be examined on fine days, and, when necessary, a cake of candy may be laid under the quilt over the cluster. Candy is better than syrup, as dampness is then to be avoided.

96. Stimulative or speculative feeding is feeding during the spring and summer to excite breeding. The bees may get quite enough food in the fields, but this supply may be intermittent; swarms having comb to build may be fed to assist them to secrete wax and to stimulate breeding. Bees regulate breeding according to the food-supply; a continuous food-supply induces them to keep up the breeding at the maximum rate, but to be effective the feeding must be continued for a fortnight or longer without intermission. The syrup should be thin, and one open hole $\frac{1}{16}''$ diameter in the bottle-feeder will be found sufficient, feeding at most a wineglassful a day. As when stimulating breeding, the combs and the space in the hive should be reduced to what the bees can occupy, care must be taken that the brood nest is not filled with syrup instead of eggs; and as a rule, feeding with meal will be found very useful. A tablespoonful of meal may be put inside the hive near the entrance, or a little may be put just inside the entrance as fast as the bees remove it, and so long as they seem to take it eagerly. A cake of flour candy under the quilt is also an excellent mode of spring feeding; large quantities should not be put on at a time, not more than

enough for eight or ten days' consumption, and when renewing it, if there is much meal from it left on the floor board, the floor board should be cleaned. Flour candy should not be fed in very damp weather.

97. Bees should be fed on white sugar or honey. Thin honey or honey of inferior flavor, bitter or very dark honey, are utilized as bee-food; the bees will also clean up combs containing honey left from the extractor, and will empty any combs containing honey which has been allowed to crystallize, or which is too thick to extract. Bees, which have gorged themselves and then rejected the honey, so that they are being suffocated, will be saved if the accident is discovered in time, by putting them into strong stocks to be cleaned by the bees; even the washing of utensils and drainings may be used to feed with, where there is much honey dealt with. Honey is the best food for bees; but as it has a characteristic smell it is very attractive, and no food must on any account whatever be fed, or the bees allowed to get at honey or syrup, outside the hive. Any food spilt about in transferring, &c., should be washed away as early as practicable. Bees' food should not contain molasses nor be burnt, as it is then injurious; crystallized sugar is too hard in the grain, and sugar should therefore be given as syrup or candy. A trace of salt in the drinking water, or a little in the syrup, is no doubt useful.

Syrup varies in strength consisting of from 3 lbs. of sugar to a quart of water for thin syrup, to 5 lbs. to the quart for thick. If simply made of sugar

and water, the syrup would crystallize, and clog up the feeder and combs with sugar. The sugar must be converted into a non-crystallizing sugar, and this takes place when a solution of sugar is subjected to a high temperature in the presence of an acid. The acid used may be citric, tartaric, or acetic ; the latter is commonly used in the form of vinegar, rather more than half a wineglass, or two tablespoonfuls of strong vinegar being used for every 10 lbs. of sugar, and $\frac{1}{4}$ oz. of table salt may be added to each quart of water. The sugar should be dissolved in hot water and placed on the fire ; when the syrup boils add the vinegar, and boil hard for five minutes, then remove it from the fire, cover it, and let it cool slowly ; if it crystallizes, the acid was insufficient. Candy is made by heating sugar with very little water, stirring it continuously to prevent burning ; about half a pint of water is added to every 4 lbs. of sugar ; this is boiled until a little dropped on a cold surface cools solid without being sticky ; it is then poured or rather ladled into saucers or other convenient vessels lined with paper. The paper should be left on, and the cake of candy is placed on the top of the frames with the paper upwards ; this prevents the quilt being sugared. In the moist climate of Lower Bengal, candy gets moist during the rains, and hence should be made in small quantities ; in dryer climates, if properly made, the candy keeps well. Flour candy is made as above, but wheat flour, pea flour, suttoo, or other available meal, *rich in nitrogen*, is added up to one-fourth the weight of sugar

when the candy is ready; this is well stirred in, and the mixture put out and applied as described above. When foul brood is in the neighhourhood, salicylic acid should be added to the syrup, as much as will cover an eight-anna piece heaped being added for every 4 lbs. of sugar, or the salicylic acid may be dissolved in a solution of borax. One ounce of a mixture of equal parts of borax and salicylic acid is added to a quart of water, and 1 per cent. of this solution may be added to syrup to prevent foul brood. The salicylic acid solution is also a most excellent remedy for disinfecting, by spraying infected combs, washing out hives, washing stands, the hands, utensils, &c., when the existence of foul brood has been detected, or is known to exist in the neighbourhood; it is also an excellent and cheap disinfectant for purifying hives before using them again.

CHAPTER XIV.

HONEY AND WAX.

98. Honey differs very widely with the source from which derived and its degree of ripeness. Some kinds are dark in colour, resembling treacle, or being even darker; the consistency and density vary from a watery syrup to a thick semi-solid which may not be removable from the cells with the extractor. The proportion of water is very variable; when it reaches 21 per cent. the honey is thin. Normal honey separates

after a time into two parts, a crystallized part (dextrose), and a non-crystallizable part (levulose); this separation is in a measure a proof of the honey being genuine; it is hindered by the honey being kept at a constant temperature like that of the interior of the hive, and honey kept in the comb does not so readily crystallize. In India molasses, and in America glucose, are added to honey ostensibly to prevent it crystallizing, but really as an adulterant; and flavoured glucose and syrup are sometimes sold as honey. The honey (?) placed so plentifully on the tables of Swiss hotels commonly contains no honey at all, but is a cheap imitation. When first collected, honey is often very thin; kept in the hive it is thickened by evaporation, and by the time it is capped over it is said to be ripe. Some kinds of honey thicken very rapidly, and should be extracted at short intervals without waiting for capping; but other kinds, if taken previous to capping, must be ripened artificially to prevent fermentation or mustiness, as unripe honey will not keep. It need scarcely be mentioned that honey should not contain the juices of crushed brood, nor be obtained by crushing comb containing pollen; the presence of such readily decomposing nitrogeneous impurities spoils appearance, flavour, and keeping qualities. Honey is difficult to filter unless very thin; it may be filtered through fine muslin or flannel, but if taken with the extractor it need only be strained from the larger particles of wax and then allowed to stand, when the finely divided wax it may contain will rise and may be skimmed off;

or, better still, the honey may be run into a deep vessel, allowed to stand, and the clear denser portion drawn off from below and bottled, the upper part being fed back to the bees. There is some difference of opinion as to whether artificially-ripened honey is as good as that ripened in the hive; many bee-keepers only take honey after it has been capped, others justly consider it more profitable to save the time and labour of ripening and capping; they take the uncapped honey and ripen it artificially. Whichever course is adopted, it should be distinctly remembered that if uncapped honey is extracted, it must be ripened artificially, or it will not keep. To ripen thin honey it is merely necessary to expose it during hot weather, so as to permit evaporation, a thin cloth being put over it to exclude dust. If the air is not dry or the honey very thin, then it is best ripened by standing the vessel in a second vessel of hot water, the object being to evaporate the excess of moisture before fermentation or mustiness sets in. It must not be boiled, and if evaporated at the hive temperature, so much the better. Thick honey may be thinned for extraction by warming it; some varieties, which cannot be extracted with the extractor, may be sold in the comb, or the comb may be cut up, put in a flannel bag, and drained out under the influence of heat. Comb honey should be kept in a warm room; the nearer the conditions of the interior of the hive are attained, the longer the honey will keep without crystallizing. It should be noted that fine honey which crystallizes to the consist-

ency of butter, is not deteriorated in any way by the change. In marketing honey it is of great importance it be offered in an attractive form; extracted honey should be put up in white wide-mouthed bottles with attractive labels in 1 or 2 lb. parcels, and the labels should distinctly state the honey is genuine, and may be expected to crystallize if kept. Tin cans may be used for honey, or barrels smeared inside with melted wax; probably earthern vessels used in India would make excellent receptacles for storing honey, if heated, well waxed inside, and well closed. In closing bottles an excellent practice is to pour a tea-spoonful of melted white wax on the honey before closing the bottle.

99. Cappings cut off when extracting are almost pure wax, so are clean white combs, and it is best to melt such separately from old combs which contain much refuse. All cappings, cuttings, and waste pieces of comb should be melted as early as practicable, or they should be squeezed into balls, and put away in a closed vessel, where the wax moth cannot get at them. Good comb, even in small pieces, should be carefully preserved for use; a number of small pieces may be fixed together by means of fixers, or small pieces may be stuck on the frames as starters. The primary object of the bee-keeper is the production of honey; wax may be considered almost a bye-product. Wax differs very much in colour, some being almost or quite as white as bleached wax, and worth the highest price; other specimens are dark orange, and have a strong

resinous smell. The greater quantity is light yellow in colour, and has a distinctive aromatic smell; it melts at about 142° F. When an old comb is boiled in water, the water becomes dark brown in colour, the comb breaks up into separate cells of cocoons, and resinous matter, which do not melt, and this *débris* is seen to be mixed with bright-yellow wax. As the *débris* has about the same specific gravity as the wax, mere boiling in water is insufficient to effect the separation. If the mixture be merely strained through a cloth, much of the wax remains with the *débris*, and the cloth is rapidly rendered impervious. The wax may be separated by boiling the comb in a coarse cloth, pressing and kneading the material under water, or removing the mass from the boiling water, and quickly putting it under some simple form of press, and pressing out quickly the hot water and wax. If the mass be kept under the boiling water by a weight and well kneaded, the wax rises, and may be skimmed off. Another method is to place the combs broken up in a wire gauze, or perforated tin or zinc basket, or cylinder, and suspending this in a vessel open below, closed above, and fitted over a vessel of boiling water, the steam from which melts down the wax, and it falls through the bottom of the basket, leaving the waste behind. In Gerster's wax-extractor on this principle, the basket is stood over a shallow tray into which the wax falls, and it passes through a hole in the bottom of the tray through a tube ending outside the steam vessel, so that as each basketful

is cleared, the basket can be emptied and replenished, and the wax as melted is run into moulds without the trouble of skimming. Any ingenious person could fit up a convenient apparatus from earthern vessels readily obtainable in Indian bazars, or the appliances already in use may, no doubt, be improved at trifling cost. The solar wax-extractor is an appliance for applying the sun's heat to this purpose; it is simply like a small garden frame, lined with zinc, and glazed above. Any very shallow blacked box glazed above, exposed to the sun, may be used to melt combs down, but steaming would be found more satisfactory. The use of a well-closed thin sheet-iron box blacked outside, and exposed to the sun, may prove an efficient wax-extractor: the author will try it; the solar extractor is said to succeed in Italy. It is a recent invention not yet in general use. The requirements are that the comb be heated to about 145° F., and the melted wax be drained from the *débris* with which it is mixed. Wax may be purified by melting it with water, and then allowing it to cool, when the impurities will be found below. Sometimes the water is acidulated to improve the appearance of wax for sale, 20 per cent. of strong vinegar or about 1 per cent. nitric acid being added to the water. Wax is adulterated with paraffin, tallow, and spermaceti, all of which render it unsuitable for comb foundation, as although it is worked out, it is exceedingly liable to melt down in the summer. Meal and earth are used as adulterants; they may be strained out of the melted wax: other impurities are also found

rendering it necessary generally to purify the specimen before deciding on its commercial value.

CHAPTER XV.

GENERAL MANAGEMENT.

100. The objects of bee-keeping are the production of honey, wax, and bees, for sale. The majority of bee-keepers produce honey in large quantities, small quantities of wax, and they only sell bees occasionally; others breed queens and bees for sale and produce very little or no surplus honey. The latter branch of apiculture is not pursued in India; itw ill no doubt arise and prove remunerative when apiculture is more general, European methods are understood, the best varieties of indigenous bees have been distinguished, and varieties of *Apis mellifica* distributed. *All stocks must be kept strong;* weak stocks give no surplus, are unprofitable, liable to grave accidents, and have frequently to be fed. This is the first principle to which all others are subservient. Every stock must have a fertile queen. A considerable increase of stocks and a large yield of honey are not possible the same year. The bees should be saved all unnecessary labour, *e.g.*, they should have clean water near, comb building should be rendered unnecessary as far as practicable by supplying old comb or foundation, hives should be cleaned out, &c., and when the bees are few, food should be given so as to economize their labour

for brood-rearing. Their nest should be protected from the inclemencies of the seasons, and they should be protected as far as practicable from their enemies, particularly those of their own species. The bee-keeper should not grudge his workers stimulating and necessary food at any time of year; judicious liberality in this respect is repaid ten-fold, and bees do not consume more than they actually need for themselves and brood. The best stocks should be applied to multiply stocks so as to perpetuate the best qualities. As the large stocks obtained by doubling are exceedingly profitable, the natural increase of stocks if not required should be checked by doubling and adding swarms together and to stocks, so as to greatly increase the yield. A paper should be kept in the roof of each hive, on which may be noted everything of importance observed—as age of queen, date of swarming, &c.—and an account or note-book should be kept for the apiary, giving full account of cost and yield, each stock being entered on a separate page, and an abstract or balance sheet made periodically. During the inactive season, bees require no attention if the hives have been properly contracted and provisioned. In Germany it is considered 40 stocks may be attended to by a teacher, clergyman, or similar person in his leisure time without assistance. The labour of looking after bees is greatly reduced in the case of the experienced by the ability to conclude how matters are progressing inside the hive from what may be observed at and near the entrance; if the hives are so placed that the bee-

keeper passes them daily, a glance at them informs him if all is progressing well. If the extractor be relied on as recommended, and doubling, artificial swarming, &c., be practised to combat the tendency to natural swarming, the time, trouble, and skill demanded will be far less than when comb honey is arranged for by supering, &c.; but under these circumstances, there is no reason why some comb honey may not be obtained from a frame or two filled with sections placed inside the body box, or from an upper body box. The time of the bees may be taken up when not collecting honey early in the season in working out foundation for giving to swarms; the foundation is simply placed in the middle of the brood nest of a strong stock. In the autumn after the honey harvest is over, they may be employed storing and capping honey or thick syrup for winter. It will be found that the combs are sometimes worked out very unevenly, and in some cases may be crooked and joined together; to remedy these defects, slice the faces of the combs even, after extracting, and crooked combs may be warmed and pressed flat; the bees will repair any cracks and refix the combs. Full sheets of foundation and full frames of old comb compel the bees to keep their combs straighter than they otherwise would. The best combs are built from foundation.

101. The active season commences as soon as the weather becomes mild or the rains are about to cease; the bees are then eager to go out. If the winter was cold as in the hills and the bees have been kept quiet,

as soon as the weather becomes mild enough to admit of their being disturbed without danger of their being chilled, each hive should be opened and inspected, the floor board should be changed for a clean one, the stores remaining should be inspected, uncovered empty combs removed, and the hive contracted by moving the dummy. The vertical hive may be opened on a mild day, the floor board scraped clean, and all dead bees, &c., removed. The object of the bee-keeper now is to fill his hives with bees as quickly as he can, so as to have a great host of labourers to bring in his harvest; he does this by stimulating breeding, by putting on a cake of flour candy, or giving pollen and slow feeding with syrup, or uncapping some of the honey in the hive at short intervals, and when this is low, feeding with syrup. The brood rapidly spreads through the hive, and in six or eight weeks perhaps the hives have large populations and an immense busy throng is working early and late for their protector's profit. One caution is necessary,—breeding having been so stimulated, the hives are full of brood much earlier than they would be naturally, and irrespective of the natural food-supply, the bees relying on the continuance of the bounty have filled their combs with brood demanding a continuance of the food-supply; but there are sometimes intervals between the blossoming of the different classes of plants, particularly in cultivated districts; it is necessary to consider this fact, and when the natural food-supply fails, to keep up the supply artificially but very slowly,

so as to keep the breeding at its maximum for the next honey glut. The extractor also may remove necessary stores. As the season advances, the swarming time comes, and the bee-keeper must decide to make artificial swarms early, must select his best stocks to multiply stocks from and breed drones early; he has during this season to carry out doubling and supering, to combat the tendency to swarm, and take the honey. As soon as the honey season is over, he must feed up his stocks to let them cap their necessary stores before they are confined to their hives by the weather.

102. During the inactive season bees should be kept as quiet as possible, their stores should be all capped, the hive contracted, and superfluous comb removed and stored for the next season. The entrance should be contracted and the hive packed with chaff, straw, paper, or other non-conductor, between the walls, and on top of the quilt and behind the dummy. The sealed stores should be as much as the bees can cover on both sides, and if any deficiency is noted, put on a cake of candy under the quilt. All unsealed stores should be removed with the extractor, and in each comb one or two 1-inch holes should be cut as winter passages, or several sticks may be laid across the tops of the frames, so that the bees may pass above under the quilt. The top should, however, be well closed to prevent escape of the heated air, but the covering should be of straw, chaff, or other material, allowing dampness to escape through it, and the upper part

should be ventilated. These precautions being observed, it is only necessary to avoid any disturbance of the stock by mice or other vermin, or by shocks from outside. If there is snow on the ground, or the bees show any disposition to come out and get chilled, the entrance should be shaded from the glare of the sun or snow by a piece of wood, as the light allures the bees to dangerous flights. In the plains probably rest during the inactive season is just as necessary, and the same precautions should be observed ; there is not the same absolute necessity for giving full stores during the rainy season as during a severe winter, but the less the bees are disturbed the better. Even if disturbance did no other mischief, it would cause the bees to go out when they might be beaten down by heavy rain ; and as breeding ceases and honey cannot be collected, the less bees go out the better. The comb should be reduced, the hive contracted, and if stores are necessary at any time, a cake of candy may be laid under the quilt, the entrance should be reduced and darkened, and the bees protected from all unnecessary disturbance. Wintering bees so that they shall be vigorous and relatively numerous in the spring, is considered in Europe a proof of considerable skill ; a great number of stocks are lost through bad wintering, either dying during the winter, getting diseased, or dwindling away in the spring. A most important point is, stocks must be strong to winter well, so that weak stocks should be united in the autumn sufficiently early to admit of their getting their stores

sealed before the weather becomes severe. Breeding is also kept up till late, and then when the brood hatches out of the centre of the combs, the bees cluster between and in the empty brood cells and in the centre of their honey, and the young bees form an important addition to the stock.

103. Bee-keeping is not by any means a difficult art; expertness and success are attainable by any intelligent person who chooses to take the trouble to master its practice and understand its theory. It is a branch of rural industry peculiarly well adapted to the conditions presented in India; its general introduction would be a valuable contribution to the means of many classes of the population, and it is a pursuit in which women readily find pleasure and profitable occupation, many having been very successful in Europe and America. Many fear the stings which punish the awkwardness of the novice; but, although at first persons often suffer much from stings, practice reduces their number to a minimum, and the disagreeable symptoms, beyond some pain at the moment, cease to appear. It is not an uncommon occurrence for a person to buy a hive and bees, take no trouble to acquire and apply the knowledge and skill necessary to success, and then complain that "bees do not pay." It should be remembered that the business in which success is certain in the utter absence of experience, knowledge, and application has yet to be discovered. This book contains a large proportion of theoretical matter, in order that the

reader many understand what he sees, for in many cases a little ingenuity is called for, and practical details cannot therefore be given to anticipate every case. The description of many varieties of hives and appliances has been avoided, and only those described which are sure to be useful, which have been actually used, and which experience has shown to be suited to Indian conditions; in some cases several appliances of the same class have been described, as one may be available where the others are not. The beginner is advised to first try the appliances described, and not attempt to invent new, until he is thoroughly experienced in the use of the old; those described are not put forward as the best that can be: the Indian bee-keeper of the future will no doubt improve upon them, but having been devised with special reference to Indian requirements, having been carefully tried, and being therefore known to be efficient, it will be found safer for the novice to be guided until he ceases to be a novice. It appeared to the author necessary not only to describe, but to place within reach of the would-be bee-keeper, approved hives and bee furniture; he therefore devised hives and appliances of cheap but serviceable kinds for use in India, and has arranged with native contractors to supply these articles direct on payment in advance. Those who would benefit their poorer neighbours by introducing bee-keeping in their neighbourhood, will be saved the trouble of getting the articles made from descriptions; they can obtain them ready-made of

approved patterns, for use direct, or as patterns to make others by locally. In Europe and America the supply of bee-keeping appliances is pursued as a business, in India this industry has yet to arise; as the spread of bee-keeping is greatly promoted by appliances being readily obtainable, it is of importance to obtain patterns and have them copied. It should be remembered that expensive European appliances, however excellent, are not suited to the poorer natives of India, an extractor costing Rs. 30, or even one costing Rs. 6, the cheapest article sold in England, is too dear for use by an Indian ryot keeping, say, ten stocks; the rougher appliance demands more labour perhaps, but labour is cheap, and the extractor costing 8 annas to Re. 1-8 would be preferred. The appliances proposed are very inexpensive, and in many cases could no doubt be made up locally for less than the prices quoted in the list attached to this book. It is hoped that Italian bees will shortly be offered for sale in India, as they have been introduced and done very well in Calcutta. The reader is recommended to obtain the British Bee-keeper's Guide Book, by T. W. Cowan, published by Houlston and Sons, Paternoster Square, London, price 1*s.* 6*d.*, and to take in the British Bee Journal, published by Kent and Co., 23, Paternoster Row, E.C., London. Probably the best works on the subject are in the German language, but recently a translation of Dr. Dzerzon's Rational Bee Culture has appeared in English. There are several American books of great practical value; Mr. Root's A.B.C. of Bee-cul-

ture is particularly useful. A Universal Bibliography of Apiculture has been compiled by order of A. DeKeller, Director of the International Museum of Apiculture at Milan, and published by Ulrich Hoepli of Mila The beginner should first obtain experience; this is essential without which many masters will only co fuse and place him in the position of the amate farmer whose farm was expected to pay as soon his expenditure on books ceased. Nor is the begi ner in a position to judge which articles in a lon trade list are really necessary or likely to prove usefu many such articles are superfluous, others needless expensive; three or four guineas may be paid for bee-hive to ornament a lawn, but such hives are n used by those who make bee-keeping pay. Th reader, generally speaking, should not listen to th notions of natives on the habits of bees; it is a strang fact that ridiculous superstitions and ideas are held o this subject everywhere by uneducated persons, an India is no exception. If any difficulties presen themselves, as they may do at first, the reader ma safely assume he has probably gone wrong in som detail, and he should seek advice if possible, as difficul ties sometimes arise from very trifling oversights, an what appears at first impracticable is seen ultimatel to be readily attainable by the simplest means. Diffi culties of this kind have, as far as possible, been antici pated and provided against in this book, which wil explain why the instructions may appear in many places unnecessarily minute. Beginners requiring

advice may address their queries to the author; the questions should be written distinctly with spaces left for the answers, and a stamped and addressed envelope enclosed for the reply.

Prepared somewhat hastily, in scanty leisure, this book is not put forward as being exhaustive; it is a mere hand-book for beginners, an attempt to convey the essentials of bee-culture, and it may no doubt be greatly improved should it ever reach a second, and more leisurely revised, edition.

The author suggests that those who take up bee-culture make notes of the habits of the indigenous bees. Already a dozen or more persons have taken up the subject, including two native gentlemen and one English lady; with simple instructions and proper appliances available, there can be no doubt the number will rapidly increase, and India may have its Bee-keepers' Association and its journal of bee-culture. At agricultural, and by special, shows, apiculture may be represented, and prove that culture of the honey-bee under the favourable conditions presented in India may prove a notable addition to the wealth of the country and to its food-supply. Bee-culture in India should not be regarded as an experiment of which the success is doubtful; its ultimate success is certain. Mr. Frank Benton, a gentleman of the widest experience, an importer of foreign bees, who visited Ceylon to obtain bees, writes in the British Bee Journal:—

"I look forward to the time when bee-culture in India will be a source of no inconsiderable revenue; in fact, I fear the

time will come when 'Brother Jonathan' across the water will find his tons of delicious nectar will have to compete in the English market with tons of sweets gathered on India's 'coral strand.'"

It will probably be in supplying the Indian demand that the principal market for Indian honey will be found, and the existence of so great and near a market is an additional argument in favour of the pursuit of Indian Apiculture. Honey and wax are products which will bear considerable loading with cost of carriage if only their purity be properly assured, but it is obvious that adulterated, dirty, or watery honey, which will not keep, must be a drug on limited local markets; hence where wild honey is procured in large quantities, the use of the extractor and ripening should be introduced, quite apart from the cultivation of the hive-bee. The simplest extractor described herein, when seen and tried, will suggest even cheaper appliances on the same principle. Wax from wild bees is commonly sent to market exceedingly impure and adulterated with meal and earth; it should be melted from the comb by steaming or other method described, and sent to market pure; it would have a higher value, a readier market, and pay the producer better. This book has been written, appliances devised, and *Apis ligustica* introduced by the author, with the object of spreading apiculture among the natives of India; an appeal for co-operation is confidently made to the many Anglo-Indians favourably situated.

A phrase much used had its origin in a refer-

ence to the bee-hive: applied to the spread of apiculture in India this phrase is in every sense pertinent, for the practice of apiculture would indeed conduce to the production of "sweetness and light."

APPENDIX.

Priced List of Hives and Appliances obtainable in India and designed with special reference to Indian requirements.

No.		*R*	*a.*	*p.*
1.	Double-walled horizontal hive, unpainted . .	7	8	0
	Ditto ditto, painted . .	8	4	0
2.	Spare body-box for above	1	0	0
3.	Single-walled hive	5	0	0
4.	Quilt of gunny, and sheet necessary for use with above hives	0	3	0
5.	Frames, per dozen . . . . . One dozen are necessary for each hive of *A. indica*, 10 for *A. mellifica*.	1	0	0
6.	Dummy, one necessary for each hive . .	0	2	0
7.	Smoker. This burns paper bagging, old rope, decayed wood, or other similar material, which must be dry; it is fed from above, lighted from below, and if kept upright will not go out. It has a hook for hanging it on the hive side, and the smoke is projected on to the bees by blowing through the hole in the bottom . .	0	12	0
8.	Tin can feeder	0	3	0
9.	Feeder stage on which a pickle bottle should be inverted, the mouth of the bottle being covered with any very *coarse open* cloth . . .	0	2	0
10.	Fountain feeder. This is for feeding in the hive and is suitable for vertical hives . . .	0	5	0
11.	Queen cages for caging the queen to prevent absconding, and in introducing queens . .	0	1	6
12.	Extractor. A tray on which the comb is laid with strings to swing it	0	12	0

No.		₹	a.	p.
13.	Extractor with bamboo handle as figured. The extractor should be used in extracting from wild bees' combs. A cheap double comb-extractor is being devised, as these extractors are laborious to use where the honey is very thick or considerable in quantity . . .	1	6	0
14.	Comb-fixers for fixing comb in frames in transferring, per dozen.	0	15	0
15.	Spray-diffuser for spraying bees with thin syrup, and combs and hives with disinfectant solutions as salicylic acid solution. The side hole is stopped by the finger and the horizontal tube is blown through	0	6	0
16.	Wax foundation, 5 cells to the inch, per lb. .	1	6	0
17.	,, ,, 6 ,, ,, ,, ,, .	1	6	0
	The price of foundation will be reduced if the demand is sufficient to admit of this; the impure wax costs 12 annas a pound, and there is considerable loss in refining.			
18.	1 lb. section boxes, per dozen	0	12	0
19.	2 lbs. ,, ,, ,, ...	1	6	0
20.	Section crate with glass ends	0	13	0
21.	Zinc separators, per dozen	0	12	0
22.	Section frame for working 3 sections inside hive with separators, tin	0	5	0
	Section frame for working 3 sections inside hive with separators, wood	0	4	6
23.	Packing No. 1 in crate, &c.	3	0	0
24.	,, ,, 2 ,, ,, ...	2	0	0

Only one pattern of extractor and one pattern of feeder are necessary, but one form may be preferred to another, and the cost of the extra patterns is trifling. Pieces of comb should be preferred to foundation when procurable, and small pieces of comb form the best starters. The beginner is advised to work for extracted honey only and not try to obtain comb or super honey. The section frames are expensive, but if section honey be produced in sufficient quantity-machine, made sections at about one fourth the price would be used.

The articles in the foregoing list may probably be made locally from a pattern cheaper than the prices quoted.

A stock of indigenous bees with the combs in frames should sell for from 5 to 10 rupees.

The author would be glad to hear from gentlemen who would supply bees, hives, and appliances and other practicable assistance to persons in their neighbourhood, until such time as the requisites of bee culture become articles of regular trade.

Letters and remittances relating to the supply of articles should be addressed to

GUNESHAM NATH MISTRY,
NUSHKARPORE,
BEHALLA POST OFFICE,
near CALCUTTA;

or

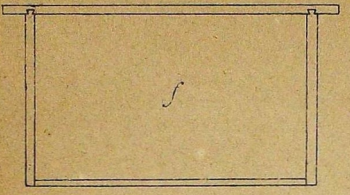
OOMESH DOSS MISTRY,
MONSA TOLLAH,
KIDDERPORE,
near CALCUTTA;

or through the author, Calcutta, who will hand them over to the contractors. The numbers in this list should be quoted, as the contractors do not understand English and know the articles by their numbers. The author wishes it to be understood that he makes no profit whatever on the sale of either this book or bees or appliances; the prices are the bare cost of the articles, excluding cost of foundation machine, patterns, experiments, &c. The author will issue as available Italian bees for acclimatization; they will be issued free to experienced bee-keepers, and at 30 rupees a small stock to others, the former class having the preference.

From observation of the indigenous bees up to date, it appears they may be successfully cultivated in Calcutta; they readily fill their frame-hives with comb and breed very rapidly and early; two hives the author has under observation at this date (March 18th) have exceeded his expectations, as they were very weak after the rains. They have built all their comb from starters.

The author will endeavour to improve and cheapen the appliances in the foregoing list, particularly the extractors.

Govt. of India Central Printing Office.—No. 522 R. & A.—1-4-84.—500.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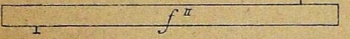
f I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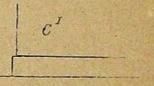
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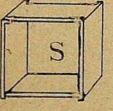
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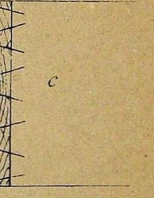
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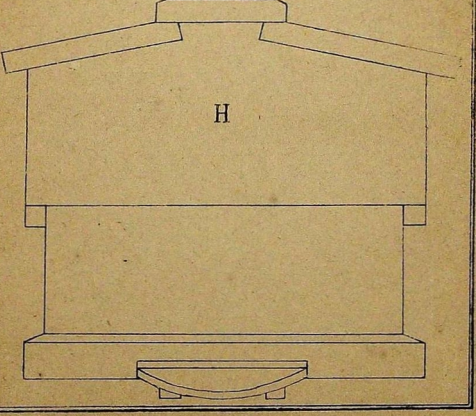
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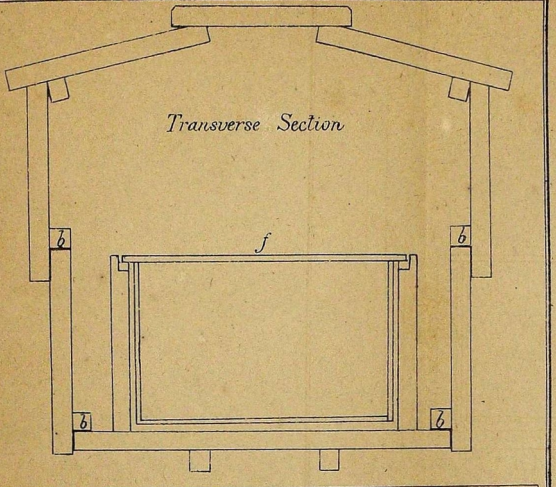
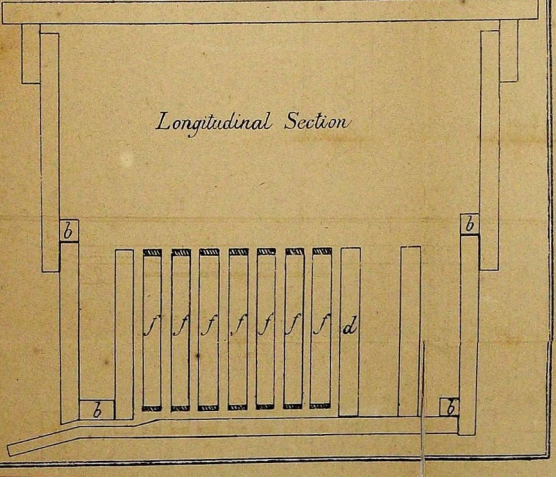

Transverse Section
f
b
b
b
b


Longitudinal Section
b
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d
b
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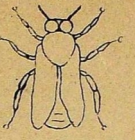
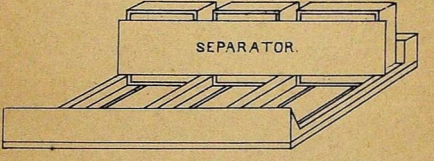
— Queen.



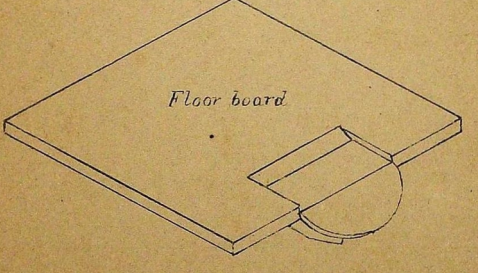
—Drone.

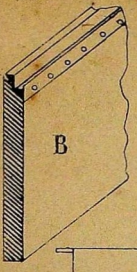


—Worker.



Section rack partly filled.

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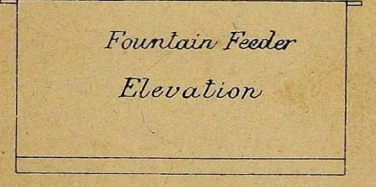
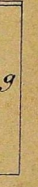
Wire fixer




Fountain Feeder
Elevation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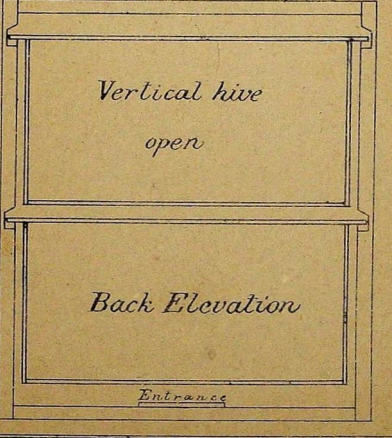
Vertical hive
open
Back Elevation
Entrance

Tin section frame

F

for 3 section boxes

Side Elevation

Bamboo

Extractor Front Elevation

A

B

C

1 Top Lid

2 Section

3 Section

4 Bottom