

BEES AND BEEKEEPING IN SOUTH INDIA*

Introduction.—Among insects, in fact, among the numerous lower animals, the honey bee occupies a unique position. It has been man's associate practically from prehistoric days. In view of the honey it yields and in consideration of the various virtues displayed by the creature in its social life this creature was not only held by the ancients in high esteem but was even endowed with divine powers and became the centre of many myths and superstitions. It was probably due to such ideas that the bee was added as an insignia by great men; it is said to appear on the crowns of the Egyptian kings, on the arms of the Pope and on the imperial robes of Napoleon! Honey and wax were attributed divine properties and in Christian rituals honey was given to babies in baptism and the Church candles were to be of pure wax! In India, the existence of bees and the usefulness of the products we get from them are facts well known to almost every layman. But very few among us possess any clear and definite ideas regarding the natural history of bees or about the aetiology and purpose of the useful products man gets from them. There is of course, reference in different Indian literary and medical works to honey as Madhu and to the honey bee as Madhu makshika (literally honey fly) the exact term by which it is known in the vernaculars, though it is scientifically incorrect to call it a fly. The little that is known of them may be more or less summed up in these statements (1) that bees abound in forests, (2) they give us some very valuable and useful products, (3) they are a proverbially hard-working and industrious lot, and (4) that they sting. All the rest regarding them has been practically a sealed book to most of us. The honey bee is, therefore, one of our familiar creatures and yet one about which we really know very little!!!

The primary object of this paper is to present in a very compact and popular form a very brief account of the honey bees we have in South India and the native methods now in vogue in the different tracts in artificial beekeeping and honey gathering, and secondly, to give a very short summary of the attempts now being made by the Entomological section at the Coimbatore Agricultural Research Institute to carry on investigations in this line with a view to demonstrate and popularise the modern methods of beekeeping as is practised in many of the Western Countries. One important excuse for publishing this paper with all its inevitable imperfections is the fact that we have absolutely no previous records of a connected form relating to bees in South India and that there is a demand from many people nowadays for a publication of this kind.

II. *General Facts Regarding Bees and Honey Bees.*—Before we enter into the main theme of beekeeping it will be advantageous to get some clear ideas regarding the position of the honey bees in the animal

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kingdom, their nearest relatives and some general facts regarding their natural history. Though popularly the term 'Bee' has been understood to refer to the domesticated honey bee, because of its long and intimate association with man, the name can be applied without mistake to a number of other insects; in fact, over four thousand different insects are known which come under this designation and all of them including the honey bee being classified as a group called *Apidae* (Bee family). The various bees, numerous wasps and different kinds of ants constitute the three important sub-divisions of the well-known insect order *Hymenoptera*. Very familiar examples of bees other than the honey bee are the carpenter bees and the leaf cutting bees. A common example of the former is the stout bluish black insect (*Xylocopa*) found flying about houses and gardens with a strong buzzing noise and frequently seen boring into wood work (hence its name); the leaf cutter bees (*Megachile*) are generally smaller than the carpenter bees and these have the habit of cutting and removing away portions of leaves from rose and other garden plants. Most of the members of the bee family share some common features, the most important of them being the habit of visiting flowers to collect pollen and nectar (hence called *anthophila*), the possession of a long tongue which helps them in probing into flowers and the presence of plumose branched hairs on the body. In the matter of growth and development also they are similar—the pregnant female lays a number of single eggs; these hatch into helpless fleshy grubs which have to be fed by others until they pupate and from the pupa the adult bee emerges. Thus every bee passes through a complete metamorphosis during development as in beetles or butterflies. As against these similarities numerous differences are noted between different kinds of bees especially in their habits which enable us to classify them into such groups as underground nesting, surface nesting, tree nesting, parasitic, solitary and social bees. The honey bees come under the last group.

In India, we have over thirty genera included in the bee family (*Apidae*) including over two hundred known species of bees and the insects known as honey bees constitute but one of these genera (*Apis*) including three species. These three species which are the chief sources of honey in India and another minor insect the *Melipona* (Dammar or stingless bee) constitute the four genuine honey bees found all over the Indian region. All these bees are social insects and live in colonies. The three species of *Apis* and their fundamental features are (1) *Apis dorsata*, F., Rock Bee. This is the largest of the Indian honey bees and gathers plenty of honey; it builds long big open single combs which may often be four feet long on tall forest trees, along sides of precipitous cliffs and occasionally on the walls and other parts of buildings. The honey got from these hives in the forest forms the bulk of the material collected by hill people and sold in our bazaars. The irritable and ferocious temper of this bee and its confirmed nomadic habit of deserting its hives frequently have made it impossible to domesticate it: (2) *Apis florea*, F. This is the smallest of the three species and is known as the little bee. This also builds single combs which are, however, very small and often found hanging from bushes and corners of roofs, each comb usually gives but a few ounces of honey; (3) *Apis indica*, F. This is the common Indian honey bee, very commonly found both in the plains and the forests all over India. In size this is larger than *florea* and smaller than *dorsata*. This bee unlike the other two builds

several parallel combs generally in hollows of trees, caverns in rocks, on the walls inside wells and similar protected spots. This is the typical Indian honey bee and the only one which has so far been found to be capable of domestication. In the different hill tracts of South India the common bee found is a dark race of this *indica*. The only other known species of *Apis*, besides these three Indian forms, is the European bee *A. mellifica*, L., which is the honey bee domesticated and extensively reared all over Europe and America and this species, except in a few minor features, is very closely similar to *indica* in structure, size and habits and hybridises freely. With regard to the affinities and phylogeny of these honey bees, though many entomologists like Linnaeus, Friese and Buttel-Reepen regard *mellifica* as the original species and the other three as its descendants, recent workers consider that the Indian form *indica* is the real ancestor. Professor Wheeler of Harvard, an eminent authority on social insects, in arguing out this point, adds the following very interesting and noteworthy remarks in favour of *indica*. "Had a Hindoo entomologist preceded Linnaeus, *indica* would be the type of the species, and the Hindoo, aware of the existence of two other species of *Apis* in his own and the neighbouring countries and nowhere else in the world, would properly regard the genus as of South Asiatic origin and the species *indica* as having spread to Europe and Africa and produced the dark race *mellifica*."

III. *The Members of a Bee Colony*.—As stated before the honey bees live in colonies. In an average thriving colony of the common Indian bee (*indica*) there is generally found a population of about forty to fifty thousand bees. This large number is, however, made up of three different kinds of individuals inhabiting the colony. These are the Workers, the Drones and the Queen—the workers making up the great bulk of the population (over 90 per cent.). The worker bee is an immature female smaller in size than the queen or the drone; on her devolve most of the important domestic duties of the colony such as gathering of honey and pollen, building of the combs, rearing the brood, defending the colony from enemies, attending on the queen and keeping the home sanitary and warm. To perform these duties satisfactorily the workers are also provided with the necessary structural adaptations. The tongue is comparatively long, the hind legs have basket-like hairy structures to collect pollen, the abdomen has glands to secrete wax which is the material used for house building, and they have a powerful sting for defence at the tail end of the body. The drone is the male bee and comparatively heavier built than the worker; its eyes are very large and meet at the middle of the head (this is the feature found in many male insects). It has no pollen basket, wax producing structures or a sting. The duty of the drone simply consists in acting as the husband of the virgin female bees. Very few drones are generally found in a healthy and vigorous colony, and at times there may be no drones in the colony at all. In every colony, usually any one healthy mother insect or queen is found. It is a mature female and is bigger and longer than the worker; she has no pollen baskets or wax plates but has a conspicuous combined sting and ovipositor, the latter to deposit eggs. The only function of the queen in a colony is to lay eggs and thereby add to the population of the colony and keep it strong. This egg laying machine is known to deposit two to three thousand eggs a day and under satisfactory conditions lives for two or three years.

It is thus found that in a bee colony there are three kinds of individuals or castes with different functions which contribute to the welfare of the colony, and each one of these is specially adapted structurally also to attend to its respective duties. The workers as their name implies, attend to all the material needs of the colony and the queen and drone play the parts of wife and husband keeping up the strength of the colony. The following passage regarding the bee colony is therefore, quite apt "The bee colony is a wonderful republic with many kings and only one queen, the citizens do all the governing without voting; the kings are powerless and the queen works as hard as and longer than any of her subjects." A few words as to the way in which the three bee castes arise in the colony may be added. Starting with a young queen who has just emerged from a pupal cell, we find her one fine afternoon emerging out on her virgin flight. She very usually meets a drone and they mate. This nuptial ceremony which generally takes place outside a hive is unfortunately attended by a tragedy; in the act of union the queen carries with her the generative organs of the husband and he is killed; (it may be added by the way that among many lower organisms the husband shares this unfortunate fate as a result of mating). The pregnant queen returns to her hive very soon and as a result of this union she carries the spermatid fluid received from the male retained in her spermathecal bag. In a day or two after her return from the wedding trip she starts laying eggs, practically her only function for the rest of her life; in each empty cell of the hive she lays one egg and she is found capable of laying three to four thousand eggs per day. One very striking peculiarity with the queen bee is that she is able to lay either fertilised eggs which will produce workers or non-fertilised eggs which produce only drones. This is due to the peculiarity in her generative mechanism which gives a control to allow or not allow an egg which passes out through the oviduct, to get impregnated by allowing a particle of the sperm from the sperm sac. This is a very remarkable capacity in the queen and fortunately or unfortunately it is absent in the higher animals and man! There is no difference, however, in the nature of the egg that will produce a worker or a queen and it is only food and other conditions which determine the production of either. Generally the queen lays fertilised eggs out of which the numerous workers which are essential to the needs of the colony emerge after a development period of 21 days. When a queen has to be raised and not otherwise, the workers build a few large cells and feed the baby grubs in them with special food, and from among these grubs an adult queen emerges in about 16 days; this special food "royal jelly" and the provision of larger cells to the chosen grubs appear to make these otherwise worker grubs fully developed queens! The drone egg takes about 24 days to develop into an adult bee. The difference in the period to attain maturity in the three different individuals is apparently due to the quality of food supplied to each. Various and marvellous are the numerous activities of these individuals, especially of the workers which go to regulate and to maintain the multifarious normal and abnormal needs and the domestic economy of a colony. It is hardly possible in this short paper to deal with the numerous facts and theories connected with the sex relations, the development of the sexes and other allied phenomena connected with the multiplication and maintenance of the normal strength of a colony.

IV. *The Domestic Life and Activities of the Honey Bee—Beehive.*—

As stated at the beginning the common Indian honey bee in the natural haunts lives in what are called hives made of combs constructed by members of the colony in well protected places. Each hive is made up of a number of combs generally remaining parallel to each other. The combs which are made of wax, are divided up into thousands of hexagonal cells, each comb having a double set of them one on each surface; and these cells serve as receptacles for the storage of honey and pollen and as chambers for the developing brood. The beehive with its remarkable architectural and economic arrangement, is one of the wonders of the insect world. In the words of the great poet Maeterlinck "No living creature, not even man, has achieved in the centre of his sphere what the bee has achieved in her own; and were someone from another world to descend and ask of the earth the most perfect creation of the logic of life, we should needs have to offer the humble comb of honey." The mathematical accuracy with which the cells are arranged and the way in which the whole hive is constructed are features always evoking wonder and admiration. Adult bees of all the three different kinds when at home simply remain clustering to and moving along the surface of the combs and do not have any special lodgings. Usually the cells in the upper part of the combs are made use of for the storage of the honey and the lower ones are utilised for brood rearing. While the worker cells when closed are capped flat, those of the drone and the queen have different shapes; the drone cells which are usually found along the edges have a convex capping and the queen cells stand out from the margin as elongated conical projection. Wax which is the material with which these combs are built is a secretion which exudes as a semi-fluid substance, through some of the ventral plates of the abdomen of the workers and which solidifies into the plastic wax so ideal a material for constructing the comb. The best stone mason or brick-layer will simply marvel at the way in which the bee removes the wax from its belly, kneads it with the help of its mouth parts and uses it for comb building. During the busy season when cells have to be built at a rapid rate workers gorge themselves with honey and this stimulates wax production. It is said that to get a pound of wax, bees have to consume about 10 to 15 lbs of honey; as such, comb building and brood rearing go on vigorously when there is plenty of honey available.

Food of the Bee.—The food of bees, as stated before consists usually of nectar and pollen, from flowers. The adult bees chiefly feed on honey while the young ones have to be fed mainly on pollen, although it is often mixed with honey and water forming a paste called 'bee bread'. The developing grub in each of the brood cells is unable to find its food and has, therefore, to be fed with these materials by the nursing workers of the colony until they are full grown and about to pupate. Since the food of bees in all stages consists of materials from flowers of different kinds they generally thrive well in jungles, flower gardens and orchards where flowers of various kinds form their pasturage for both nectar and pollen. Occasionally, however, bees have been noted lapping up the honey dew of some plant bugs and it is said that they seek sugar in other places than flowers.

Honey.—Speaking of honey it may help us to have some clear ideas as to what it really is. The honey that we get from beehives is not the actual nectar which the insects collect from various flowers. This nectar collected by them from all sorts of flowers is swallowed by the creature and afterwards regurgitated into the honey cell. In the honey stomach of the bee in which the nectar remains before regurgitation, certain chemical changes take place and it is this changed stuff which is called honey. The bees knowing very well that pasturage may not be available during all the seasons in the year due to climatic variations, collect very briskly when there is plenty of pasturage and store quantities of honey which will serve them and the brood during the rainy or very chilly months when no pasturage is sufficiently available; during these months their outside activities are also very much curtailed. On the other hand during the spring and summer months when there is plenty of pasturage available the workers are found very industrious and busy, not only gathering stores of provisions but also actively engaged in comb building and brood rearing, the queen is also very active during this season of plenty and adds to the population of the hive by laying numerous eggs day after day. In view of the fact that the length of life of the worker bee is not more than three or four weeks and that many of them are liable to be killed in various ways, a proportionate increase in brood is thus quite necessary to keep up the normal strength of the colony. However, when due to very favourable conditions, the population of a colony increases enormously and there is a general feeling that there is not sufficient room or convenience for all the inmates, preparations for a family partition become evident. The reigning queen and a good number of workers from the hive fly out of the colony and start a fresh one in a new spot. This family partition is called *Swarming* and is often much more peaceful and harmonious in striking contrast to what often happens in human families. This appears to be a natural instinct on the part of all the members of the colony in helping the dispersal and distribution of the species. This habit is occasionally persistent in the bee; and has to be watched and proper precautions taken by the apiarist. There are numerous other points in the behaviour of bees which are the problems that will repay investigation.

Enemies of Bees.—Before we conclude this brief account of the remarkable family arrangement of the honey bee a few words may be added regarding some of the factors that often interrupt the machine like working and organisation of these remarkable insects. There are some enemies in the shape of diseases and pests. The Indian bee, unlike the European *mellifica* is so far free from the two notorious bee diseases—‘the Isle of White disease’ and ‘foul brood’. In the shape of active enemies we have the bee eater among birds; but it is among insects we come across some of the dreadful enemies of the bees. A few years ago, the senior author discovered in the Bababuddin hills in Mysore a wasp which behaves as a typical bee hunter—attacking and carrying away bees. †Some of the common hornets also occasionally attack bees. The common hawk moth* attacks the hives and feeds on the stored honey. An inveterate pest of the hive is the wax caterpillar† which often devours the wax combs

† Recently described as a new species—*Philanthus ramakrishnae*, T. * *Acherontia styx*. † *Galleria melonella*.

and causes very serious damage especially in weak colonies. The other enemies of bees are miscellaneous animals of different kinds which rob them of their provisions; under this category, of course, comes man. The workers that defend the colony from such robbers and trespassers have, of course, their defensive organ in the sharp and poison inoculating sting. The writers believe that, but for the possession of a such protective weapon, man and other animals would have by now made the honey bee a creature of the past like the Dodo or the Mammoth!

V. *Bees and Man*.—We have so far gathered some information regarding the natural history of bees. Let us now come to the relations between bees and man. Man's association with the honey bees dates from time immemorial and the primary object of this relation has evidently been to take advantage of their labours and appropriate the honey from the bee colony for his use. We will just survey briefly how these products have been and are still being gathered by man in different parts of India and in what way these could be considerably improved with advantage. Since bees are more abundant in the jungles it is the people in the forest tracts that are more familiar with their activities and conversant with the methods adopted to procure these products. In spite of the fact that these honey mongers of the hills are very familiar with bees and their products, they have absolutely no knowledge of the elementary facts in the natural history of bees. All they know is that there are certain seasons when bee colonies increase in numbers and when beehives get filled with honey which they have to appropriate promptly. The methods adopted to get honey are crude, wasteful and barbarous and these apply to gathering of honey from both the rock bee (*dorsata*) and the common bee (*indica*). During night when the bees are inactive and generally remain clustered on the surface of the hive, burning torches are applied to the hive and in this process most of the bees are killed and many of them badly suffocated; in order to save himself from possible stings during the operation, the man covers his body with a thick sheeting and closes his face with a veil or smears it with ashes to make the sting ineffective. When the bees are thus killed or disabled, the combs are removed and the process of honey gathering starts. This consists in cutting the combs into pieces and then pressing and squeezing every bit of them with the hands and securing the juice thus obtained as honey. Any one with a smattering of insect lore can easily form some idea as to what the components of this liquid are and the degree of its purity. In addition to honey it contains, among other things, the body juices of the developing grubs in the brood cells, lumps of pollen and pieces of wax from the crushed combs. This stuff constitutes the great bulk of what we get from our bazaar grocers as pure honey, though there are worse substitutes often sold as honey. Gradually as half civilised man realised the value and good properties of honey, it occurred to some that, instead of searching and locating bees for honey in the different parts of the hills, the bees may be attracted into some trap chambers and made to build their combs and store honey in them. With this idea the crude pot hives, log hives, straw hives (*skeps*), beer casks and other improvised contrivances came into vogue to breed the bees and this was the beginning of what may be called beekeeping by man; but the methods of gathering the honey continued in the same old crude ways, sacrificing the bees and their combs. It was not until the middle of the last century that some beekeepers in the West realised the

cruelty, the economic loss and the impurity caused by the inhuman methods of obtaining honey from the combs. Robbing the honey bee of their stores of honey, which is never intended for man's use, is never a commendable act, but by getting the stuff without smoking and crushing the bees is certainly more humane and the better evil of the two. As a result of the gradual realisation that the existing methods of honey gathering were more or less like killing the goose that lays the golden eggs, hives with movable frames were devised by the use of which the beekeeper could gather honey in a pure state and without sacrificing the bees. The introduction of the hive with movable frames is chiefly associated with the name of a clergyman Langstroth the inventor of the well-known standard hive known after him; and if only the bees could talk, they would with one voice express to him their external vocal gratitude for rescuing them from practical extinction. Since the introduction of different kinds of hives with movable frames the crude methods of honey gathering have almost disappeared in the Western countries. In South India, on the other hand, wherever anything like beekeeping has been existing, the primitive methods still prevail as in the hill districts of Coorg, Mysore and Wynad. Hollow logs or earthen pots smeared with wax are used as artificial hives and when these are colonised by the bees and sufficient honey becomes stored the bees are smoked out and the honey squeezed out in the same old way. Interesting accounts of such methods that have been in vogue in the different hill districts of India and samples of colossal ignorance displayed by revenue and forest officers regarding the natural history of bees could be found in a Government of India publication on the subject. Within the past two or three decades, however, attempts have been made here and there to rear Indian bees on modern scientific lines. The Jesuit fathers of Trichinopoly have done some very valuable pioneering work with *indica* and Father Newton's paper on this work contains some valuable information. The bulletin and another paper on beekeeping by Ghosh though mainly compilations from works dealing on the European bee *mellifica* also deal with the *indica* bee adding to our knowledge of this local species; the author does not, however, seem to encourage the keeping of the indigenous bees! A few enthusiasts here and there in recent years have tried importing colonies of the European bee *mellifica*, but the success so far attained by such attempts do not appear to be very encouraging. While on this subject of trials with the European bee, two or three important points have to be noted. In the first place it is not an easy task to transfer a species acclimatised to a temperate region to the plains of tropical India; of course, trials may be made on the hills. Secondly, the European bee is subject to two or three destructive bee diseases called 'foul brood' while our *indica* has been found susceptible to any such maladies. From this aspect it is not at all advisable to import the exotic bee and stand the chance of infection being carried to India. In the third place the cost of transferring a colony from a European country is prohibitive and can never be within the reach of the ordinary farmer. Who can say that the exotic bees, with all their original superiority, will not deteriorate like European univoltine silkworm, when introduced into the warm tropics; that they will is the opinion of Maeterlinck. In this connection it will not be inappropriate if I had the following unanimous resolution passed at an All-India Entomologists' meeting at Pusa in 1919 on this subject—"This meeting considers that there is considerable danger of the

introduction into India of bee diseases by the unrestricted importation of bees, beeswax and honey from countries infected with such diseases and that such importation should therefore only be permitted under necessary restrictions". In the opinion of the writers, therefore, the best thing to do is to try the local indigenous bee *indica* and effect all possible improvements by research and experiments in various directions. This is quite in consonance with the views experienced by two apiarists who have each had a long experience of over two decades with *indica*, viz., Father Newton of Trichinopoly and Lieut. Cousins of the Punjab. The following remarks of the former are worth quoting:

"It would be regrettable if people in the plains of India where *Apis mellifica* does not thrive were to be for ever deprived of such a fascinating pursuit as beekeeping from a mistaken notion that the Indian bee is not worth cultivating. I firmly believe that, given a good locality where honey yielding trees and crops are to be found in sufficient quantity, with proper hives and modern methods, the Indian bee in spite of its small size might prove sufficiently productive to justify its cultivation." As early as 1926, the junior author, out of curiosity, was having a few hives of *indica* under observation for some time and had opportunities to gather some practical knowledge of the art and this little start has stood him in good stead since 1931 when agricultural work was started by the Entomologist, and he was put in charge of the work. Besides the work at Coimbatore, trials with the Indian bee are going on in different parts of South India, and the Y.M.C.A. authorities have encouraged this industry as a part of their rural reconstruction scheme and actual rearing work has been going on in their important centre, Ramanathapuram, near Coimbatore since the year 1926. Such trials are also carried out at present in the Mysore and Travancore States not to speak of many private educated parties who have taken to this hobby in different places in South India.

VI. *Work at the Coimbatore Farm.*—The more important ideas with which work on rearing the Indian bee (*indica*) was started at the Coimbatore College were, in the first place, to definitely ascertain by experiments and research in various ways as to whether the common bee of the Indian plains (*A. indica*) can be successfully domesticated, secondly to work out all possible means which would improve the quality of the bees and the yield of honey, thirdly to work out thoroughly the economic side of beekeeping and finally to recommend keeping of this bee and give the necessary instructions and advice to those who are interested in the industry and who intend starting beekeeping either as a hobby or as a cottage industry. With these basic objects, work was started in 1931 with 12 colonies hived from local wild swarms. In 1932 the hives increased in number to about 35 and now we have 25 hives in flourishing condition excluding a good many sold out. It is generally found that the general health and prosperity of the bees depend on a good many factors, the most important of which are (1) availability in the vicinity of sufficient pasturage for gathering honey and pollen, (2) the climatic conditions prevailing and (3) absence of enemies like the wax moth. We have hardly any previous records on these points with regard to South Indian conditions.

Pasturage.—On the Coimbatore farm we found that, during the South-West monsoon months July to October, the pasturage becomes rather scanty and the activities of the bees become considerably minimised; on the other hand from January to June plenty of pasture becomes available and this period may be considered the 'honey season' in this area. Among pollen yielders in this locality, cholam and maize are found the best; next in the order of their value come cumbu, castor, garden Zinnia, *Peltophorum* and others. Regarding the nectar bearing plants, Cambodia cotton and tamarind have been found to be the best in the locality; the former appears to be a very good honey yielder and on a rough estimate an acre of this crop is found capable of giving nectar production of ten pounds honey during a season. Tamarind also appears to be almost as good as cotton. Further investigations are made in this line with regard to the suitability of other trees like nim, citrus, plantains and field crops like lucerne, coriander etc. Bees are found to use considerable degrees of discrimination in the selection of pasture and it appears that there are many factors which guide them besides smell, colour, shape etc., of flowers. *Strobilanthus* flowers are considered to be the best honey yielder in the sholas of the Nilgiris and it is intended to try these in due course. Investigations are being made and some data have also been collected as to the time of the day when the bees visit the different flowers and their preferences.

Honey.—As regards the quality of the honey gathered from the different main sources, cotton, tamarind and nim, each has its special taste, colour, aroma and degree of sweetness, and the apiarist after some experience is able to easily detect the special quality by its appearance and aroma. Nim honey, though not available in large quantities, is regarded to possess high medicinal properties. As to the yields of honey, our experience has shown that during an average year of normal seasonal conditions favouring good pasturage, and with sufficient care, one can get from a healthy hive from 10 to 12 pounds of good honey. It is not the honey value alone of these hives that one has to consider. Such a healthy hive gives out swarms periodically and if these latter are properly hived, these also begin to yield their quota in a few months. Thus a good deal of the success depends upon the practical skill of the apiarist in taking advantage of the proper opportunities in various ways. Some of the various items that are now engaging our attention in the matter of honey production are—studies on comparative food value of the different kinds of honey by analysis, fermenting and ripening of honey, the proper season for honey gathering, temporarily moving bees to better pasturage, swarming and various phenomena connected with them, artificial queen rearing, artificial partition of colonies, different methods of hiving wild colonies and various incidental details in connection with bees.

Appliances.—A few brief remarks may be added regarding the appliances we use in the work. The hives used by us are of the pattern advocated by Father Newton with one brood chamber and one or two supers, and we have been able to get it made locally at Rs. 4/- each and there

has been a very good demand for these hives during the past two years. Regarding the honey extractor also it may be added that after some trials we have been able to devise a fairly cheap and efficient honey extractor costing about Rs. 6/-. Trials are also proceeding in the matter of reducing the cost of all such outfit so that we may bring it to the lowest possible minimum for suggestion to poor ryots. The proper use of these appliances and the careful handling of the bees in the combs will considerably add to the health and safety of the bees? Our work in Coimbatore has now spread into the districts and some of our men are carrying on trials in this work under our guidance in the mofussil research stations at Anakapalle, Samalkota, Taliparamba and Coonoor, and it is hoped that in course of time this industry will become very popular in South India.

VII. *Economics of Beekeeping*.—Before concluding, some definite data may be added on the economics of beekeeping as far as our experience has shown. During one year, from eleven healthy hives we got 118 lb. of honey which at Rs. 1/4/- per lb. comes to Rs. 148/-. As stated before, each of these hives gave out a swarm which, in turn yielded about Rs. 77/- worth of honey. Thus in a year out of eleven hives we were able to get Rs. 225/-. These 22 hives at Rs. 4/8/- each and the honey extractor costing Rs. 6/- come to Rs. 105/-. The initial cost of hiving the original eleven wild colonies comes to Rs. 22/-. Thus the outlay comes to Rs. 127/-. The interest on this outlay at $7\frac{1}{2}$ per cent. comes to Rs. 9/12/-; the hives and the extractor are expected to be useful for at least 15 years and as such the depreciation on these will be about Rs. 7/-. The labour charges which are practically nothing, since the keeper is expected to attend to the work, may however be put down to Rs. 10/- for the year. The total annual expenditure therefore, comes to Rs. 307/- roughly and deducting this amount from the outturn the profit realised comes to Rs. 195/-, thus making an average net profit of nearly Rs. 20/- on each hive.

A farmer with some initial training and experience and particularly with the aptitude and enthusiasm really necessary for this kind of work, can easily manage about 20 hives provided pasturage and other conditions are satisfactory. But, for an amateur it is advisable to start with a few hives which would effect considerable saving in the initial outlay and from the experience and profits gained from these, he can expand his work. Further trials are being made in these various directions.

Other aspects of great importance in connection with the honey bees are their different relations to numerous plants and their economic importance in orchards, etc., as pollinators of different kinds of flowers. Observations and investigations in this direction on these habits of the bee have not been sufficiently made in India and as such would offer unexplored fields for study.

VIII.—*Conclusion*.—In concluding this necessarily brief account of this interesting subject we may add that, with some propaganda and advertisement, the demand for pure honey, as an article of daily consumption, is bound to increase. The Indian, with his proverbially spiritual

mentality, and aversion to taking life, will surely appreciate the modern methods of honey gathering and as he gets sufficient and correct information regarding the natural history of the bees, beekeeping on modern scientific lines in South India is sure to have a bright future. But it must be mentioned here that keeping bees is certainly not a short cut to fortune, but as a cottage industry, coupled with other items such as poultry keeping, silkworm rearing, etc., it would go a long way to supplement the ryot's scanty income from agriculture.

Apart from the material benefits we can secure by keeping bees it is needless to add how educative and inspiring the life activities of the bees are in various ways. Their sense of duty and co-operation for the common good, their unceasing diligence and industry, their wonderful architectural and sanitary instincts and their marvellous sense of domestic economy and forethought, bordering on intelligence, are some of the many features which have, from time to time, been pointed out by poets and philosophers as worthy of imitation by many an erring and wayward man.