Beekeeping in Rural Development

Published by:
Commonwealth Secretariat
Marlborough House
Pall Mall
London SW1Y 5HX
England

Paper copies are 2.50 British pounds.

Available from:
Commonwealth Secretariat
Marlborough House
Pall Mall
London SW1Y 5HX
England

Beekeeping in Rural Development

Unexploited Beekeeping Potential in the Tropics: with particular reference to the Commonwealth

Commonwealth Secretariat

International Bee Research Association

Beekeeping in Rural Development

Unexploited Beekeeping Potential in the Tropics: with particular reference to the Commonwealth

Commonwealth Secretariat
International Bee Research Association

Food Production and Rural Development Division
Commonwealth Secretariat
Marlborough House, Pall Mall, London SW1Y 5HX

BEEKEEPING IN RURAL DEVELOPMENT

ADDENDUM AND ERRATA

p.23: AN EDITORIAL SUMMARY

pp.50, 51: the text on these two pages has been transposed.

p.79: *(Extract from "Honey...)*

pp.155, 157: add *(ORIGINAL CONTRIBUTION)*

Published by
The Commonwealth Secretariat

May be purchased from
Commonwealth Secretariat Publications
Marlborough House
London SW1Y 5HX

ISBN 0 85092 160 0

Price £2·50

CONTENTS

FOREWORD

The Food Production and Rural Development of the Commonwealth Secretariat is charged with the responsibility of facilitating increased and accelerated food production and rural development in the Commonwealth.

It seeks to fulfil this function in various ways, for example, by acting as a clearing house for pertinent information and giving assistance to governments in various fields such as project preparation, project management, the development and transfer of rural technology, the reduction of post-harvest losses, and livestock and fisheries development.

To a certain extent the Division responds to requests from governments. However, an equally important role is that of catalysing thought and, hopefully, practical action by governments and other organisations in specific subject areas where there appears to be potential for profitable endeavour.

A cardinal guiding principle adopted by the Division is that its endeavours should be concentrated on projects that stand a good chance of conferring recognizable benefit to the rural poor in the shortest possible time. Thus,while the Division recognizes the important role that large, multi-million and multifaceted projects play in increasing food production and accelerating rural development, it has also been conscious of the value of what may be called micro-projects, which often involve minimal government and imported inputs and are potentially capable of increasing rural earnings within a relatively short time, providing they are executed with the necessary dedication.

In its catalytic role, the Division circulated early in 1978, an offer of free bibliographies on beekeeping available from the International Bee Research Association and funded by the International Development Research Centre, Ottawa, to Governments and invited them to communicate with the Division if they were interested.

In circulating the offer the Division was of the view that apiculture could be a source of valuable food and rural earnings. Honey is a much prized food both locally and abroad. Beeswax is in good demand and well priced. Bees can aid the pollination (and, therefore, production levels) of crops. Apiculture can be undertaken as a rural family venture without significantly interfering with normal farming activities; and, it can create a demand for locally manufactured equipment and thus aid both the development of appropriate technology and the creation of off-farm rural employment. For countries with very

limited renewable resources it could be an important source of income.

One of the responses we received said among other things:

"We have found that one of the problems was scarcity of beeswax used as a mould in the process ..... the need to set up a bee-keeping industry ..... to assist these poor brass founders".

Another said:

"I understand ..... that your association (SIC) has published a book on beekeeping ..... May I know how I can study the art and act of beekeeping? God bless you".

The genesis of this publication may be found in such responses to our original circular. We believe that in bringing together this selection of articles on a wide range of experiences - from various parts of the tropics, with emphasis on the Commonwealth - successes, failures, and problems - interested individuals and organisations will be encouraged to examine the potential and value of apiculture more easily.

The Commonwealth is an ideal framework within which to circulate expertise on beekeeping, for beekeeping is practised at all levels - from the highly developed and mechanized systems used in developed Commonwealth countries, to the fledgling projects and wild honey gathering among its developing members. Thus, through a common language, persons and organisations with experience at all levels can share their knowledge and assist one another.

In this publication will be found examples of sensible endeavour from modest beginnings, backed by research, training, long-range perspectives, consistent application, and practical incentives to producers rather than mere exhortations. These examples may be found among others, in Belize, Kenya, Tanzania and India where substantial contributions are being made to the national economy in this way.

Also in this publication, may be found examples of the importance of training and co-operation between Commonwealth countries - by Australia, Canada, New Zealand, the United Kingdom, and in sharing training facilities in the developing Commonwealth itself such as in India and the Forest Training Institute at Olmotonyi in Arusha, Tanzania.

The Commonwealth Secretariat is keen on helping to collect and exchange information and in providing such training and advisory assistance as fall within its purview and would be happy to hear from interested readers. Communications should be addressed to:

The Director,
Food Production and Rural Development Division,
Commonwealth Secretariat,
Marlborough House,
Pall Mall,
London SW1Y 5HX

I wish to acknowledge, with gratitude, all the individuals who have been involved in one way or another in producing this publication. Tony Moody, Project Officer of this Division whose "extra project" among his other main duties this publication is; Dr Eva Crane, Director, International Bee Research Association, Hill House, Gerrards Cross, Bucks, who inspired us and who was our Consultant Editor; and the various authors who have allowed us to use their papers are all due for particular mention. I have no doubt that both they and the other contributors will consider it ample reward if their endeavours lead to a better understanding and application of knowledge on apiculture.

M.S.O. Nicholas,
Director,
Food Production & Rural Development Division,
Commonwealth Secretariat,
Marlborough House,
Pall Mall,
London SW1Y 5HX

BEES AND BEEKEEPING IN THE TROPICS, AND TRADE IN HONEY AND BEESWAX WITH SPECIAL REFERENCE TO THE COMMONWEALTH

by EVA CRANE
International Bee Research Association
Hill House, Gerrards Cross, Bucks, SL9 ONR, England

Introduction

Honey and beeswax have been valued since earliest times, and in many regions they are among the commodities mentioned in the earliest written records. A number of regions in the tropics and sub-tropics have a long tradition of beekeeping, which originated centuries before today's "countries" were defined. The climate and physical geography of an area helped to determine how the bees of the area evolved and which of them are capable of wider and better use today. On the other hand honey yields are largely determined by characteristics of the present vegetation. Beekeeping is likely to be at its most profitable if high-yielding bees can be used in areas selected for high nectar and pollen yields, if the bees are healthy, and if pesticides are not used in such a way that the foraging bees are killed.

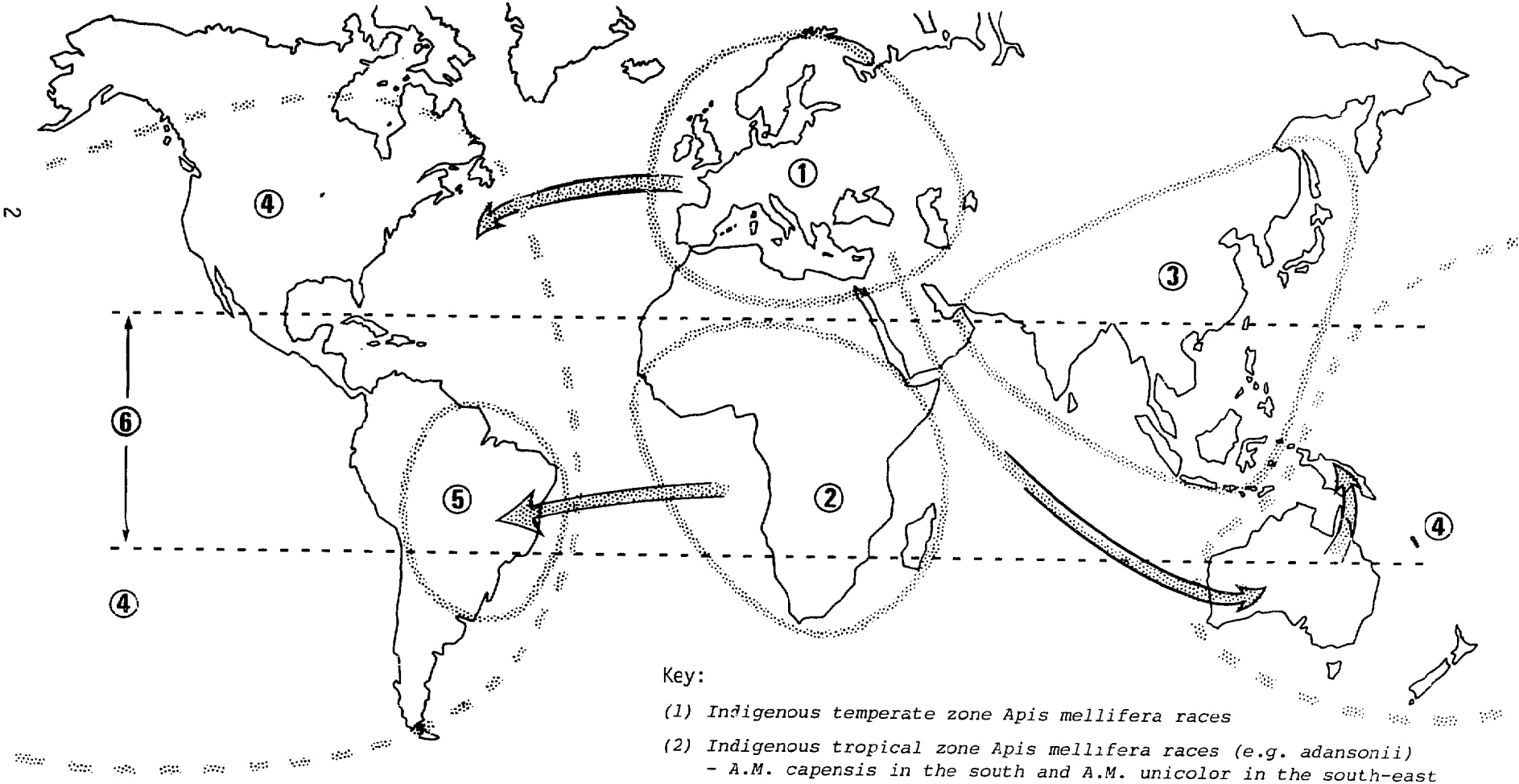
Tropical Honeybees

There are many thousands of species of bees in the tropics, but we are concerned here only with bees that form permanent colonies and store enough honey to be worth harvesting by man: the honeybees Apis and the so-called stingless bees of the Meliponidae. The indigenous European honeybee is Apis mellifera two of the best known races being Italian (A.m. ligustica) and Carniolan (A.m. carnica).

Three land masses (Africa, Asia, America) have tropical regions, which are well separated by oceans or deserts, and the Pacific islands form a large fourth scattered tropical region. Each of these regions has its own distinct characteristics with regard to honey-producing bees (Fig. 1).

Africa, with its offshore islands, is the only region with native tropical subspecies of Apis mellifera, of which A.m. adansonii is the best known, and this is the subject of most of the papers on Africa. On the other hand Asia, with its offshore islands, has three native tropical species of Apis: cerana, dorsata and florea. The first is like a rather smaller version of A.mellifera, but the other two cannot be kept in hives because their nest is a single comb in the open air. Articles which follow on India and Sri Lanka describe beekeeping with Apis cerana.

The Americas and the Caribbean islands have native tropical stingless bees, but no native Apis. Beekeeping there is now based on Apis mellifera from Europe. Hives of bees were taken to New England in North America in the early 1600s, but none arrived in Central or South America for another 200 years. Further information is found in the articles on Central America.



Key:

(1) Indigenous temperate zone Apis mellifera races

(2) Indigenous tropical zone Apis mellifera races (e.g. adansonii) - A.M. capensis in the south and A.M. unicolor in the south-east

(3) Indigenous Apis cerana, also Apis dorsata and Apis Florea in the tropics; introduced Apis mellifera in some parts

(4) Introduced temperate zone Apis mellifera races from Europe

(5) Introduced tropical zone Apis mellifera races from Africa

(6) Stingless bees occur in many areas between the Tropics.

N.B. Actual desert and mountain boundaries between (1), (2) and (3) are not yet known, and no attempt is made to define them.

Fig. 1

APPROXIMATE DISTRIBUTION OF THE DIFFERENT HONEY-PRODUCING BEES

Finally there are the Pacific islands, with no native honey-storing bees at all, except stingless bees in one small area. European Apis mellifera has been taken to most of the groups of islands in the last hundred years or so, and the remainder are still without them. Articles in this volume on Papua New Guinea and the Pacific describe some of the introductions.

At various times European mellifera has been introduced by man into all four of the tropical regions; they often thrive in sub-tropical climates, or where there are no native Apis species (as in Pacific islands) but not in general where these are present. The introduction of the tropical Apis mellifera adansonii from Africa to America is discussed later.

Of the four tropical regions, Africa has the oldest tradition of beekeeping, and the one that survives most vigorously, in the main still with primitive hives. There are probably more colonies of bees in tropical Africa than in the other three regions together. Until recently the beekeeping problems and possibilities of tropical Africa have been more discussed than those of any other region, but the results of importing African bees into South America have led to much vocalization in that continent.

Tropical America also has a long tradition of beekeeping, but with stingless bees. The extensive Precolombian production of gold castings by the lost-wax method must have used the wax of these bees. The deliberate shift to beekeeping with more productive imported temperate-zone honeybees is not complete even now, and neither is the change to modern hives. We shall discuss later a second shift, to tropical honeybees from Africa, that has not been voluntary is most areas where it has occurred.(7)

In some parts of tropical Asia the tradition has been honey hunting rather than beekeeping. The most productive bee, Apis dorsata, nests in the open, and so does the smallest honeybee, Apis florea, whose honey is especially prized; nevertheless a form of beekeeping with this bee exists in Oman, and is now being developed there.(6) In general the Asiatic hive bee Apis cerana produces less honey per hive than dorsata or mellifera, but it has valuable characteristics in exploiting its native flora, and thrives where Apis mellifera cannot.

Anywhere in the world, if beekeeping is less productive than it could be, the causes are likely to be shared among the following factors:

a. climate

b. food resources for the bees (plants yielding nectar and pollen)

c. the honeybees used

d. hives and other equipment

e. method of bee management

f. pests, diseases and poisoning

g. human attitudes

There are many interactions, e.g. of disease incidence with

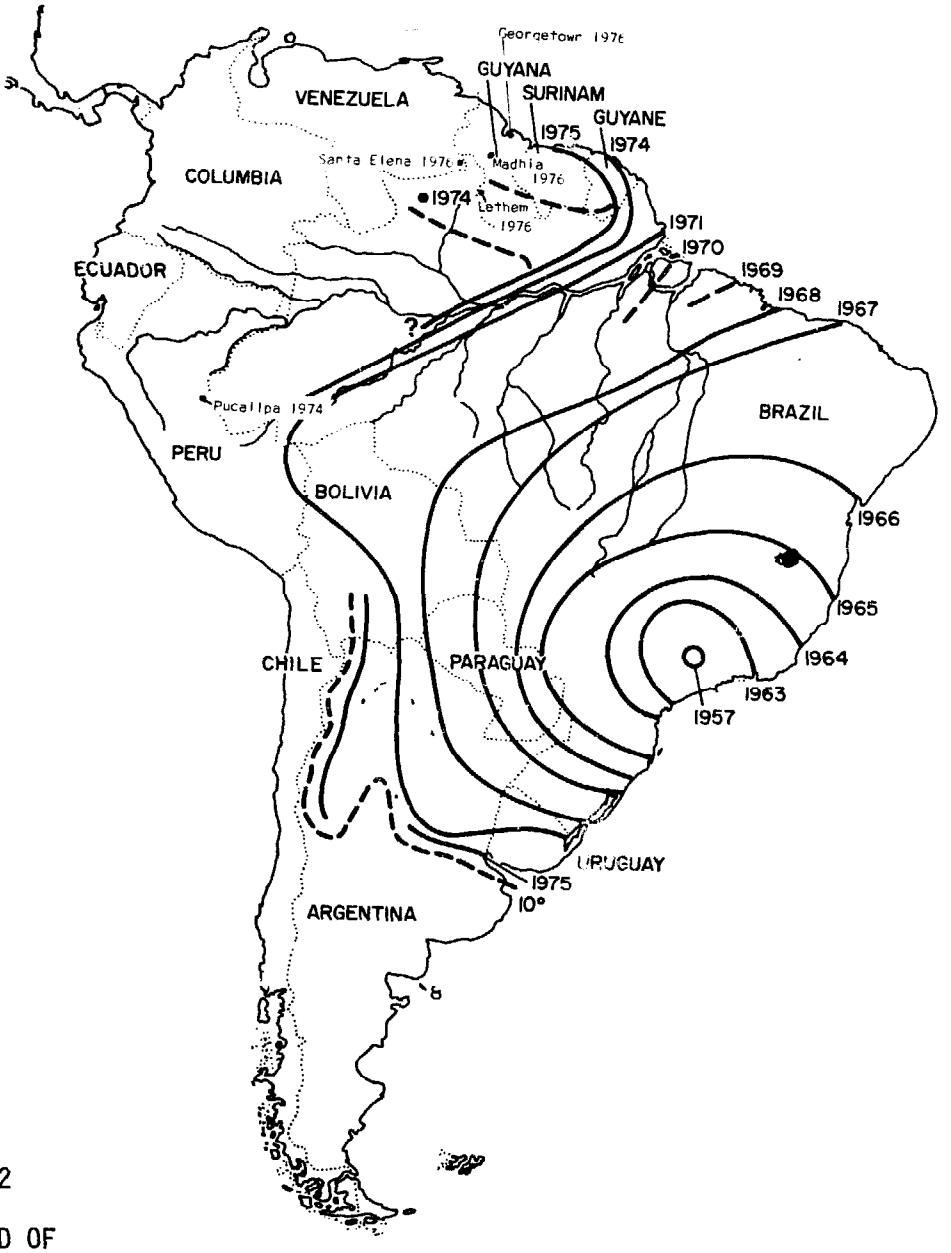


Fig. 2

SPREAD OF AFRICANIZED HONEY-BEES IN SOUTH AMERICA 1956-1976

(from O.R.Taylor)

climate and with lack of adequate food resources; and of bee management with both bees and hives.

Importing Exotic Bees

In the latter part of the last century, beekeeping was developed to a highly productive level in some of the countries with temperate climates, led largely by the USA, through the use of movable-frame hives (see below). The bees used were of European origin, and the methods of management were devised to suit them.

In some circumstances imported European bees, managed by these methods, have survived and thrived in subtropical regions, so that new honey industries have been developed: Mexico, Israel and the People's Republic of China provide examples. But transferring the same methods to tropical bees, or transferring both methods and bees to the full tropics, is often quite unsuccessful, for biological reasons that have not so far been overcome. The tropical bees cannot be managed by the same methods as temperate-zone bees: they may migrate, or be quite unamenable to handling, or fail to amass large honey stores. Imported temperate-zone bees die out: because of pests and enemies they cannot combat, because of mating problems, or because their foraging habits are out of tune with the food available - they may fly in the mid-day heat instead of at dawn and dusk when the flowers produce nectar and pollen.

Bees imported into a country can bring with them lethal pests and diseases that were previously absent but can never again be exterminated.[5] Alternatively, if successful, the imported bees may compete with local bees until these are exterminated.

Full enquiries from competent authorities should therefore be made before introducing foreign stock: such an introduction is likely to be an irreversible step, and may be a disastrous one. The most publicized introduction in recent years has been the import of queens of tropical African bees (Apis mellifera adansonii) from Pretoria in South Africa to Sao Paulo in Brazil in 1956. Twenty-six absconding swarms escaped, headed by African queens, and Fig. 2 shows their successful spread through most of South America. The phenomenal rate of spread, involving advances of 300 or even 500 km in a year, has been achieved with the help of this bee's very rapid swarming cycle. Under favourable conditions a 1-kg swarm can produce another swarm in 48-50 days, and swarming can occur in nearly all months of the year. Also, the swarms probably make several temporary stops before they finally occupy a nesting site where they build combs and rear brood, many kilometres from the parent colony.

Almost all areas in South America where the Africanized bees have advanced strongly seem to be rather dry, with less than about 1000-1500mm rainfall a year. In Africa A.m. adansonii occurs in a wide range of habitats but seems to be most abundant in Central African plateaux at 1000-1500m, with annual rainfall of 500-1500mm. Dr. O.R. Taylor says that "basically A.m. adansonii belongs to semi-arid regions, and it would not be surprising if its greatest population densities and highest productivity in South America are attained in a similar habitat such as north-east Brazil".[7] From the bee's distribution in South Africa he estimates its probable tolerance to cold as

follows:

1. short intervals with temperatures as low as -10°C;
2. 6-8 weeks with mean temperature of +10°C and mean maxima and minima of 17° and 4°;
3. up to (and perhaps more than) 60 days a year with temperatures below 0°;
4. up to (and perhaps more than) 150 days between the first and last frosts (a 215-day growing season).

Certainly its spread southwards into Argentina has been slower, and it seems to have got no further south and west than around the 10°C mean temperature isotherm, in the coldest month of the year.

There is plenty of evidence that in areas of Brazil where beekeepers have adopted new and satisfactory methods of managing these bees, honey yields have soared, and in many areas surplus honey has been produced for export for the first time in history. But there have been difficulties when the Africanized bees arrive in an area, which affect more people than just the beekeepers; the bees can easily become alerted to sting on masse.

Exploitation of Bees

It is entirely probable that man has exploited bees for their honey ever since he first existed as a species, and that his primate predecessors did so in even earlier times . exploitation of wild bees' nests is still practised in the tropics and also in forested regions of the north temperature zone. Honey harvested from the giant bee Apis dorsata in the tropics of Asia must still be taken from wild colonies, since this bee will not nest in a cavity such as a hive. With this exception, the honey and beeswax that comes on the market is from colonies kept in hives, and the term beekeeping or apiculture is applied to the husbandry of such colonies. The hives may be grouped in an apiary near the owner's dwelling or in suitably sited out-apiaries some distance away or they may be scattered, as when they are hung in trees (front cover).

Keeping Bees In Hives

Traditional hives are simple containers made of whatever material is used locally for other containers; hollowed logs, bark, woven twigs or reeds, coiled straw, baked or unbaked clay, plant stems and leaves, or fruits such as gourds tropics and subtropics almost all these hives lie or hang horizontally. In the most primitive form of beekeeping the bees are killed or driven out once or twice a year when the honey and wax are taken, the colony being destroyed in the process. Some examples of traditional beekeeping are given in the first two articles.

One of the better forms of husbandry, widely practised with cylindrical hives, is to leave the brood combs, with the queen and some bees, when the honey is taken. The simplest way of ensuring this is to use hives longer than the reach of a man's arm, so that when he reaches in from one end he cannot take out all the combs.* Tropical bees swarm readily, and empty hives

* *The IBRA Collection of Historical and Contemporary Beekeeping Material has cylindrical hives from widely separated parts of Africa, and most have a very similar length (110-110cm) which satisfies this condition.*

can be put out to be occupied by new swarms.

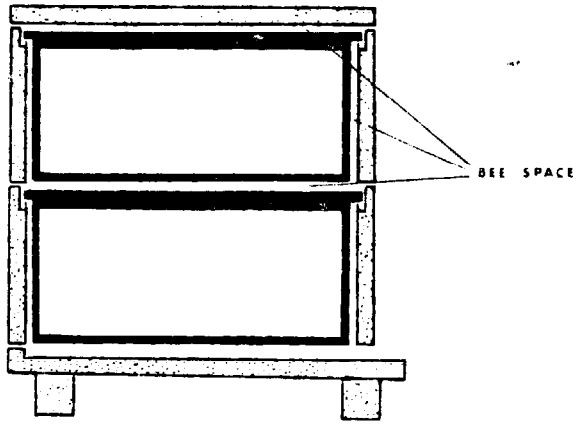


FIG. 3

DIAGRAMMATIC SECTION THROUGH A MOVABLE-FRAME LANGSTROTH HIVE WITH TWO BOXES (G. M. Walton)

- The floor and the roof are shown, and the essential bee space indicated.

At the other end of the scale are the hives used in modern apiaries throughout the world, which consist of a tier of accurately manufactured wooden boxes, each fitted out like a suspension filing system. From the metal runners along the two long sides of each box wooden frames are suspended, each carrying a wax sheet which has been pressed into a pattern of hexagons of the size constructed by the bees themselves when building their combs. The bees accept this man-made contribution and build the cell walls out from the beginnings provided, using both wax from the foundation and wax they themselves secrete from wax glands on the under side of the abdomen. In order that the frames can be removed individually from the hive, the frames must be precisely positioned on all sides, by the runners and by spacers that fix the lateral distance between frames, so that a "bee space" (about 6mm) is left all round (Fig. 3), except where the frames make a line contact with the runners they rest on. Bees will close up any gap beyond a comb that is smaller than a bee space, attaching the comb to the adjacent surface. If a gap is left that is greater than this critical distance, the bees will use it to build extra comb.

A movable-frame hive allows frames to be removed for inspection replacement, or transfer to another hive, and for honey extraction. The most widely used pattern of movable-frame hive is the Langstroth with 10-frame boxes. Standard designs differ, however, from country to country in minor ways, and sometimes 8 or 12 frames are used. In Britain the British National or Modified National is standard, and the Langstroth hive has not

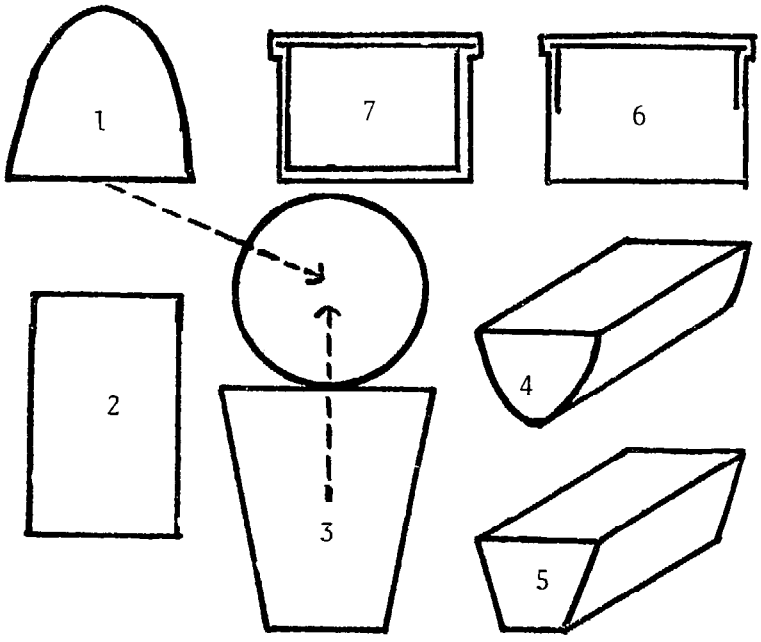


FIG. 4

SKETCHES OF DIFFERENT TYPES OF HIVE (not to scale)

Fixed Comb Hives

1. European-type straw or wicker skep.
2. Upright box or log-hive used in temperate regions.

Moveable-lamb Frameless Hives

3. Earliest known type of top-bar hive (Greek)
4. Zululand top-bar hive.
5. Kenya trough or trapezoidal top-bar hive.
6. Wide rectangular hive with top-bars and partial side-bars, but without foundation.

Moveable-Frame Hives

7. Long stroth and type with framed combs built from foundation (as Fig. 3)

been widely adopted. In parts of USA, and in French-speaking areas in Europe, variants of the Dadant hive which have larger frames, are usual, but the principle is the same.

The bottom box of a hive is the brood chamber, and a queen excluder can be used to separate it from the honey chambers above. These are often called supers, because they are superimposed (Fig.3). The queen excluder is a metal grid or flat sheet perforated with slots, the width of the holes being just too small for a queen to pass through, but large enough for the workers. In practice the brood chamber may consist of two or even three boxes, and any number of supers can be used, but normally some are removed full of honey before the pile becomes too tall to operate conveniently. The hives may stand on pallets for mechanical handling, and the size of an apiary is commonly determined by the number of hives that can be loaded (mechanically) on to a truck for moving to another site when the bee forage at the existing one has died away. Movable-frame hives are used widely in the American tropics and subtropics.

Between these two extremes - each irreplaceable in its appropriate context - there are various "intermediate" hives that provide some of the benefits of movable-frame beekeeping with a much reduced need for precision. Precision is always expensive, and unless it is used to full advantage its benefits are lost. In movable-comb frameless hives,[2] used successfully in development programmes in East Africa (see second article by Kigatiira on Kenya), the rectangular frame fitted with foundation wax is replaced by a top-bar only, rounded on the under side and smeared with wax (or perhaps supplied with a narrow strip of wax). The top-bars must be at the correct distance apart to give the bees' natural intercomb distance (bee space), but that is the only precision measurement. If boxes of the usual size for frame hives are used, the two long sides must be made to slope inwards towards the bottom, as the bees' naturally built combs do, and the bees will not then attach their combs to the sides of the hives. In fixed-comb hives, whether straw skeps, hollowed logs or clay water pots, the attachment of the combs to the inner surface is necessary for their support; in the transitional hives the long top-bars provide all that is necessary, even without a frame. Fig. 4 shows sketches of some different types of hive for comparison. Type 3, shaped like a waste-paper basket, is used in Greece, and is known to have been used there as early as 1680. Bars are placed across the round top at the correct spacing, and each supports a comb. These combs are however not interchangeable (as in hives 4 and 5) because their length is not uniform.

With tropical bees, hives are usually populated initially by flying swarms. Where bees of temperate-zone origin are used, as in much of Latin America, new hives will be started by dividing an existing colony, and either providing a queen for the queenless portion or letting it rear one itself.

The seasonal cycle of work depends on the flowering seasons of the year. After a dearth period, whether caused by drought, heavy rains, heat or cold, plant development starts again and, with the first flowers, pollen and nectar become available. The pollen provides protein which the colonies need for rearing

brood, and population increases rapidly until there are enough bees in a colony to forage and collect more nectar than is needed for the immediate energy (carbohydrate) requirements of the colony. The surplus is made into honey by the bees, which the beekeeper can harvest - usually at the end of a major "nectar flow", and in any case before the active season ends. Enough stores must of course be left to last the colony through the next dearth period. The bees seal mature honey in cells of the honey-comb, and it has a sugar content around 80%

Harvesting the honey from movable-frame hives involves three basic operations:

(a) removing the honey supers bee-free from the hive;

(b) taking off the cell cappings with a knife or other implement;

(c) spinning the honey out of the frames in a centrifuge (extractor).

The honey is then usually strained to remove particles of wax, etc. The fact that the frames can be removed from the hive singly facilitates (a) and (b), and the frames provide support for the combs so that these can be spun at quite a high speed.

With intermediate hives that have no separate honey chamber, combs must be removed singly instead of in boxes, and combs could be broken by (c), so honey is usually separated from the wax by straining and/or pressing. An article in this book describes honey processing in East Africa.

With traditional fixed-comb hives operations (a) and (b) are more awkward, and (c) is normally impossible. But since the centrifugal extractor is comparatively expensive, it is likely to be ruled out on the grounds of cost where money is short. The simplest way to harvest honey, needing minimal equipment, is to use smoke to drive the bees off the combs to be harvested, to cut these out of the hive, and to put them into a container that can be covered quickly (otherwise the bees will find them), then to take the container to a bee-free place and crush and strain the combs in a bag of cotton, woven grass, or other porous material whose holes are not too large. The strained honey is sold, the wax comb (still wet with honey) is often mixed with water and fermented to make beer. Finally the wax is melted, and strained into containers, in which it sets and from which blocks of solid wax can be removed.

The price of beeswax is several times higher than that of honey, but the yield per hive is smaller (often around one-twelfth). One important factor, however, is that the movable-frame hive is designed for producing honey, minimizing any diversion of the bees' energy into wax production. So the world's requirements of beeswax are largely produced in the tropics, where many hives do not have movable frames.

Honey Production

Honey is made by bees from plant materials, and nearly all the world's supply of honey is from nectar produced in the nectaries of flowers. A smaller amount comes from plants which have nectaries elsewhere (extra-floral nectaries), and from honeydew

which also does not involve flowers.

In many plants, nectar and pollen are produced by flowers that can be pollinated only if they are visited by an insect, and bees are by far the most important pollinating insects. The annual value of world crops produced with the aid of insect pollination is probably considerably more than £1000m, much higher than that of the honey produced from bees, which is perhaps £20 - £30m.

The performance of bees is truly astonishing. The fuel consumption of a flying bee is about ½ mg honey per kilometre, or 3 million km to the litre. In providing one kilogram of surplus honey for the market, the colony has had to consume something like a further 8 kg to keep itself going, and the foraging has probably covered a total flight path equal to six orbits round the earth - at a fuel consumption of about 25 g of honey for each orbit. In English units, this means 7 million miles to the gallon; a pound of honey on the breakfast table necessitates a total flight path equivalent to three orbits round the earth, each orbit using up an ounce of honey as fuel![3]

The major part of the honey made by bees is also used by them, and the beekeeper's harvest can only be the surplus they do not require. It has been estimated[3] that this surplus varies from around one-tenth of the total amount in poor honey-producing areas to one-third in the richest areas.

Uses of Honey

Honey is produced in almost every country, and 90% of the world's production is eaten directly as honey. The remaining 10% is used in baking, confectionery, fermentation to alcoholic drinks, tobacco curing, and the manufacture of pharmaceuticals and cosmetics.

In the past also, honey was produced very widely, and much more widely than sugar cane, "the honey from reeds". But sweetness was not at all a common characteristic of foods until the sugar industry was developed during the last 150 years; the annual world production of sugar rose from 1½ million tons in 1850 to cover 70 million tons in 1972 - 50 times as much.

In many parts of the developing Commonwealth honey is a valued food, as an occasional treat or as a standby in times of famine. In some other areas it is so highly regarded that it is used as medicine rather than as food, and in other regions, especially parts of tropical Africa such as Ethiopia, it is used largely for making beer (tej).

Because honey is universally valued it can usually be sold as a cash crop; it can also be kept for future use, for it need not be used quickly like meat and many fruits and vegetables. Beeswax is even more durable, and being solid it needs no container. Pollen is another hive product that could be collected and utilized where it is plentiful. A "pollen trap" fitted across the entrance to a hive incorporates a grid that removes the pellets from the hind legs of the bees as they scramble through it, and the pellets accumulate in a tray below.[1] Pollen contains up to 20% or more of protein, and is richer than many plant materials in vitamins B_2. B_3, B_5, B_6, C, E, H. Would

pollen benefit people not receiving an adequate diet? The answer is surely yes, provided the pollen contains substances that are lacking in the diet. Whether the use of pollen as an additive is feasible, economic and acceptable are separate questions. It is, however, worth bearing in mind that pollen is produced in almost all inhabited parts of the world, and is largely unharvested. In primitive honey-hunting days the whole combs from bees' nests were eaten, the honey, pollen and bee brood together constituting a nutritious and acceptable food.

Trade in Honey

World trade in honey is characterized by three dominant exporting countries and three dominant importing countries. The exporters, all in the subtropics, are Mexico, Argentina and the People's Republic of China. The importers, all in the temperate zone, are the German Federal Republic, the United Kingdom and Japan. Table 1 sets out a balance sheet for 41 countries over two recent periods for which figures are available, 1965-1969 and 1971-1975. It shows that in the Commonwealth only Australia, Canada and New Zealand have any significant share in supplying the world market, and that the major source of demand for honey imports comes from the countries of Western Europe, with Japan. These importing countries have well established and quite strict requirements for both quality control and flavour, and the trade is mostly in the hands of large importers.

Apart from the United Kingdom, all the countries of the Commonwealth that now import honey could be, and should be, self-sufficient; some should also be able to export honey. It is likely that the honey they now import has in fact travelled first from the subtropics to Europe, where it has been processed, packed and re-exported, travelling back to the tropics for consumption. There are two likely reasons: one is the efficiency of the sales organisation of European packers; the other is the guaranteed cleanliness and quality of the honey they sell. Honey produced and marketed locally may not be (or may not appear to be) clean, and its water content may be above 18%, in which case it is likely to ferment on storage.

The figures show that there is a clear case for extending beekeeping in these developing countries of the Commonwealth, at least to the stage where honey is not imported, and the presence of tropical exporting countries in Table 1 suggests that many other countries could in fact also export honey. But honey for export must satisfy standards laid down by European countries, whereas honey for home consumption need not meet requirements that are based on European preference for certain flavours and aromas. Local honeys are in fact often preferred locally, always providing they are clean, and have the keeping quality expected of honey. There is a widespread potential for honey production as a small but low-cost source of employment for rural societies. In general export and import figures (Table 1) are more closely related to fact than production figures such as those given in Table 2. Many are likely to be underestimates, for various reasons, but they give some idea as to what has already been achieved.

We should, however, be concerned that the fundamental potential of honey production should be more nearly fulfilled in countries

where sources of agricultural income and employment are limited, and this can be done through the promotion of beekeeping among agricultural populations. From reading many of the papers in this volume it will become apparent that, in those developing countries where honey has entered commercial markets, the development of the industry has often been based initially on primitive honey collection procedures, and has graduated into the use of improved hives. In other areas, especially the Pacific Islands, the introduction of honeybees is quite recent and has always been based on movable-frame hives. But almost everywhere in these countries production is in the hands of small-scale producers who may produce only 30 kg per year, whereas the annual output of an individual Australian honey producer might be 10 or 20 tons, and a large-scale operation in Australia or Canada might produce 1000 tons or more.

At an average price of one US dollar per kg, 30 kg would not seem to give a very high income. But if this comes from 3-10 hives that are home made and cost nothing, then in terms of the return of labour and scarce land resources it can compare favourably with the return to 1 acre of an agricultural export crop, at the same time not interfering with normal farming operations.

Comparing Table 1 and Table 2, we can group the countries of the developing Commonwealth according to the degree to which their beekeeping potential is at present exploited.

First there are countries with active beekeeping programmes and lively honey production: Tanzania, Kenya, Uganda, Belize, Jamaica, Trinidad, and to some extent Sri Lanka. At least half the honey produced is consumed internally and some countries have a surplus for export. Neither Kenya nor Trinidad is exporting honey - Kenya is even importing it, but Kenyan imports are falling sharply, and more rapidly than Tanzania's exports are increasing. Kenya may soon become a net exporter.

Secondly there are the small-island states of the South Pacific. It appears that the flora of some of these islands can give very high yields per hive. Largely due to assistance from New Zealand aid programmes, recent developments on some islands have seen spectular developments in production. In Niue and Tonga there are large-scale commercial beekeeping operations, each with about 1000 hives. Both islands are net exporters. A similar development is projected for the Gilbert Islands and Western Samoa. Both Western Samoa and Fiji already have a small-scale beekeeping production, and both show increasing imports of honey, indicating a demand in excess of supply.

Thirdly, and differing from the second group only in degree, are countries such as Malawi, Guyana and Papua New Guinea. Each has an established honey production, but also increasing honey imports, that could certainly be met by increased domestic production. In each country smallholder apiculture would offer employment to at least 400 rural families, merely to attain self-sufficiency, and it is likely that domestic production would further stimulate demand. Both Malawi and PNG have integrated rural development programmes, into which beekeeping could well be introduced.

Lastly, there is a group of countries in which beekeeping exists, but seems not to have led to any commercial marketing: Mauritius, Barbados, Ghana, Zambia and Nigeria. Yet there is a demonstrated domestic demand in such countries. It is not easy to assess the situation clearly, but there is quite a large traditional beekeeping industry in Nigeria, particularly in Benue State. The recently estimated annual production was over 2000 tons, yet Nigeria appears to be importing this amount of honey. So far as we have been able to ascertain, the local production is entirely used up locally, in the village economies where honey is produced; the methods used are still based on fixed-comb hives with low yields. In Zambia and Ghana also, honey is also produced by traditional methods, yet in neither country has any established beekeeping programme evolved. Both Mauritius and Barbados are densely populated island states which import significant quantities of honey. In 1967 I found a very active interest in honey production in Mauritius, and beekeeping might well be added to the limited range of potential sources of employment for landless families there.

There is potential for an expansion of beekeeping within all these groups of countries, although the type of programme would be different for each. Amongst the first group it would be important to monitor programmes that are already active, to check on the efficiency of marketing, and to consider whether deprived regions of these countries would benefit from extensions of national programmes. For the small Pacific islands of the second group, the proved productivity of beekeeping should be related to the need of rural families for participation in this potential source of income.

In the third group, demand and potential would probably support a larger scale of operations than exists at present; if so, there would be a strong case for increasing the level of development. The last group of countries perhaps needs the most immediate attention, to establish beekeeping on a scale that could be managed by smallholders, probably modelled on the experiences of the countries in the first group. After all, Nigeria could save nearly a million dollars of foreign exchange if it were self-sufficient in honey, with very little extra labour input and almost no extra cost in foreign exchange for equipment.

Trade in Beeswax

There is a continuing world shortage of beeswax, which still has no satisfactory substitute in various technologies, and in pharmaceuticals and cosmetics. The world's large-scale beekeeping industry, is based on the production of honey, not wax, and itself uses quite large amounts of beeswax for making new comb foundation. Tropical Africa has by tradition been the source of most of the beeswax marketed outside the beekeeping industry. The frequent swarms of native honeybees build new combs readily; temperatures are high which encourages wax secretion, and the wax yield is much higher in relation to the honey yield in hives without frames and foundation. In movable-frame hives wax production is deliberately surpressed in order to produce more honey,and the total wax yield is one-fiftieth or even less of the honey yield, whereas for frameless hives in Africa the proportion is likely to be around one-twelfth.

Beeswax commands a price several times as high as that of honey, and no containers are needed to transport it. Reliable statistics for beeswax production are,however, even more difficult to obtain than those for honey. The entries in Table 3 are derived from figures given to me by the late H.G. Clay of the United States Department of Agriculture. They are only partial; based on honey production, the total world product of beeswax must be at least 10,000 tons and could well be ,000 tons. Something like half this amount - including nearly all the beeswax that goes on to the world market - is produced in the tropics and sub-tropics. It is the fixed-comb (and movable-comb frameless) hives that provide a harvest of wax, in conditions where this is produced easily, as well as honey.

Conclusion

The fact and figures presented above show that bee husbandry at different levels already exists in virtually all developing countries, and that it still has a considerable unexploited potential. Existing methods can be made more effective, and improved methods can give higher yields. If hive products receive proper treatment and publicity, they will command higher prices, and there is a buoyant world market for both honey and beeswax. The minimal aim should be national self-sufficiency, for it is ludicrous that foreign exchange should be used to buy a commodity that is easily produced at home.

There is great scope also for broadening the base of beekeeping in developing countries, involving a greater number of individuals; however poor a man may be in land or money, it is quite likely that he could increase his income by keeping bees, at a level suited to his locality and his individual capacity. Beekeeping at its simplest require little time each year, and hives can be made when other work is slack, from materials that cost nothing.

The papers selected for this book present widely differing examples of achievement in various parts of the developing world, and they should encourage similar efforts elsewhere. In the past, one of the major obstacles faced by those involved in setting up a new beekeeping operation has been the virtual impossibility of finding out what had already been tried in similar areas, with or without success, and what pests or diseases might bring the operation to an untimely end. This situation is largely remedied, with the publication in 1978 of the Bibliography of Tropical Apiculture, funded by the International Development Research Centre, Ottawa. In 24 Parts, and with 14 further specialized Satellite Bibliographies, this work provides access to 4000 relevant publications that give information relating to different aspects of beekeeping in developing countries.

Details of the Bibliography, and of its availability free of charge to institutions in developing countries, can be obtained from the International Bee Research Association which has been in charge of the work, directly, or through the FPRD of the Commonwealth Secretariat when intermediate help is needed.

References

1. Bee World (1976) Pollen and its harvesting. IBRA Reprint M86; Bee World 56: 155-158 (1975), 57: 20-25 (1976)

2. Crane, E. (1971) Frameless movable-comb hives in beekeeping development programmes. IBRA Reprint M60; Bee World 52: 33-37

3. Crane, E. (1975) Honey: a comprehensive survey. London: Heinemann in co-operation with IBRA

4. Crane, E. (1977) The shape, construction and identification of traditional hives. IBRA Reprint M90; Bee World 58

5. Crane, E. (1979) Fresh News on Varroa, Bee World 60: 8 (1979)

6. Dutton, R.; Simpson, J. (1977) Producing honey with Apis florea in Oman. Bee World 58: 71-76

7. Taylor, O.R. (1977) The past and possible future spread of Africanized bees in the Americas. IBRA Reprint M89; Bee World 58: 19-30

8. Walton G.M. (1975) The metrication of beekeeping equipment. Bee World 56: 109-119

TABLE 1

Net balance of trade in honey: 5 year averages (in metric tons) for 1965-69 and 1971-75.

Names of Commonwealth countries are in capitals

Country	1965-69 avg.	1971-75 avg	1971-75 net exporters
People's Republic of China	+15,265	+28,000	
Mexico	+26,293	+25,175	
Argentina	+18,823	+17,396	
AUSTRALIA	+ 5,452	+ 8,136	
CANADA	+ 1,827	+ 5,796	
Soviet Union	+ 3,740	+ 5,620	
NEW ZEALAND	+ 627	+ 1,385	
TANZANIA	+ 356	+ 377	
BELIZE	n.a.	+ 97	
JAMAICA	+ 199	+ 51	
NIUE	nil	+ 33	
UGANDA	+ 24	+ 6	
TONGA	nil	+ 3	

			1971-75 net importers
WESTERN SAMOA	nil	- 2	
INDIA	- 5	- 3	
SRI LANKA	- 9	- 4	
MAURITIUS	- 11	- 8	
MALAWI	- 4	- 9	
GUYANA	- 10	- 9	
FIJI	- 9	- 12	
BARBADOS	- 4	- 15	
GHANA	- 11	- 18	
BAHAMAS	nil	- 21	
ZAMBIA	- 29	- 29	
Italy	1,169	- 62	
PAPUA NEW GUINEA	- 42	- 71	
KENYA	- 541	- 117	
MALAYSIA	- 81	- 164	
SINGAPORE	- 140	- 360	
Denmark	- 1,392	- 1,028	
NIGERIA	- 103	1,908	
Belgium	- 2,046	- 2,399	
Netherlands	- 2,806	- 2,589	
Austria	- 3,353	- 3,312	
France	- 4,348	- 3,397	
Switzerland	- 3,422	- 4,291	
United States	- 1,213	- 8,770	
German Democratic Republic	+ 2,414	- 9,185	
UNITED KINGDOM	-14,005	-15,554	
Japan	-10,832	-19,722	
Germany Fed.Republic	-45,877	-44,646	

Statistics for Swaziland, Botswana and Lesotho imports are not available separately; imports would be included with those of South Africa, because of the S.A. Customs Union

TABLE 2

Honey production in different countries, 1976

COUNTRY	HONEY PRODUCTION (metric tons)	APPROXIMATE PERCENT OF WORLD PRODUCTION
Developing Commonwealth		
Western Samoa	4 a	
Papua New Guinea	5 c	
Fiji	5 a	
Malta	10 d	
Tonga	10 a	
Sri Lanka	25 b	
Guyana	30 a	
Niue	45 a	2½%
Malawi	50 b	
Belize	140 a	
Cyprus	200 a	
Trinidad	240 a	
Jamaica	1,200 a	
India	1,400 b	
Uganda	124 a	
Nigeria	2,800 b	
Tanzania	7,500 a	
Kenya	8,000 a	
Developed Commonwealth		
United Kingdon	1,760 b	
New Zealand	4,919 a	6 %
Canada	24,693 a	
Australia	22,800 a	
All Commonwealth		8½%
Other Major World Producers		
People's Republic of China	236,630 a	
Argentina	22,700 a	
Mexico	38,000 a	
United States	86,300 a	
Soviet Union	200,000 a	63 %
Other Countries about	260,000	28½%
World Production	923,657 a	100 %

Based on: (a) *FAO production yearbook, 1976*

(b) *"Honey: a comprehensive survey" Ed. E. Crane*

(c) *Various articles*

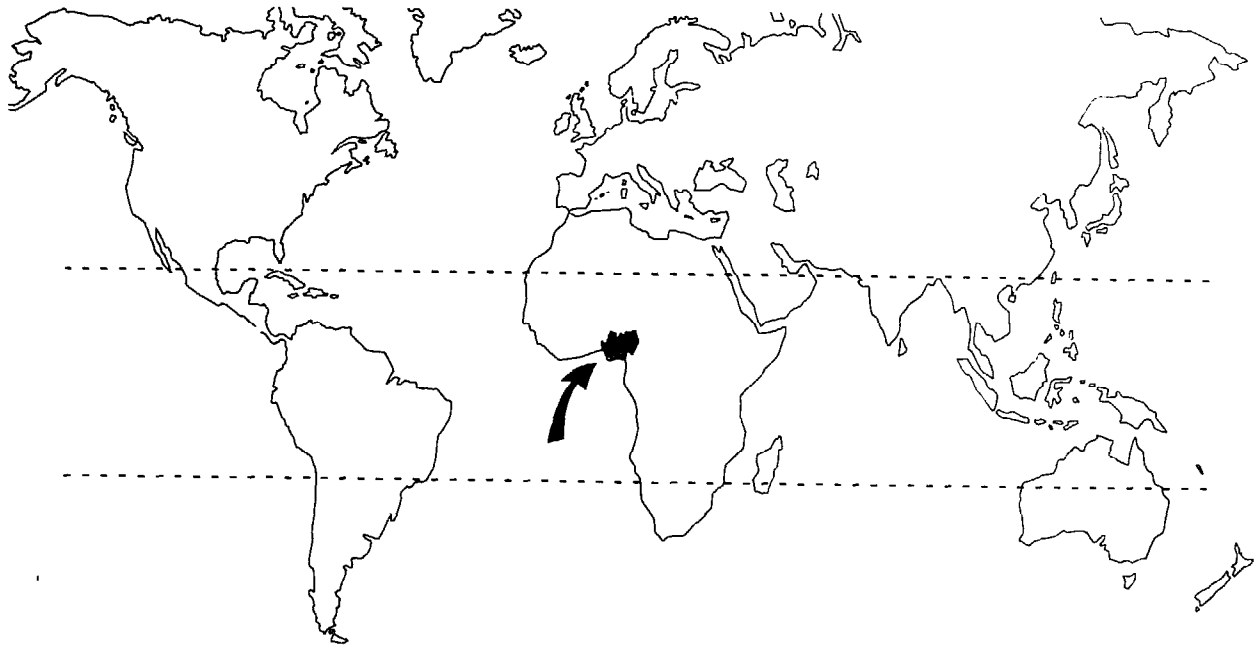
(d) *Estimate by T. Moody*

TABLE 3

Annual beeswax exports in metric tons in the late 1950s. (Estimates from H.G. Clay, US.Department of Agriculture; entries in brackets are exports to the USA only.)

AFRICA		
Tanzania	650	
Ethiopia	423	
Angola	(253)	
Egypt	(150)	
East Africa	(36)	
South Africa	(34)	
Mozambique	(15)	
Total for Africa		1561
CENTRAL/SOUTH AMERICA		
El Salvador	(353)	
Brazil	(346)	
Cuba	(342)	
Mexico	283	
Chile	(248)	
Costa Rica	207	
Haiti	(223)	
Guatemala	119	
Dominican Republic	47	
Argentina	(38)	
Puerto Rica	11	
Total for America		2217
OTHER CONTINENTS		
Europe (Portugal)	(134)	
Australia	118	
Total for Other Continents		252
Total from Countries Listed		4030

Note: Figures for total world exports from the various countries are not available, but the total beeswax production in tropical Africa is likely to have been around 4000 tons, and much of the amount exported would have been sent to the UK.



TRADITIONAL BEEKEEPING IN NIGERIA - A EDITORIAL SUMMARY FROM "BEEKEEPING AMONG THE TIV"

by J. A. A. AYOADE
University of Ibadan
(Nigerian Field, Vol.42 (1) pp.31-36, March (1977)

TRADITIONAL BEEKEEPING IN NIGERIA - A EDITORIAL SUMMARY FROM "BEEKEEPING AMONG THE TIV"

by J. A. A. AYOADE
University of Ibadan
(Nigerian Field, Vol.42 (1) pp.31-36, March (1977)

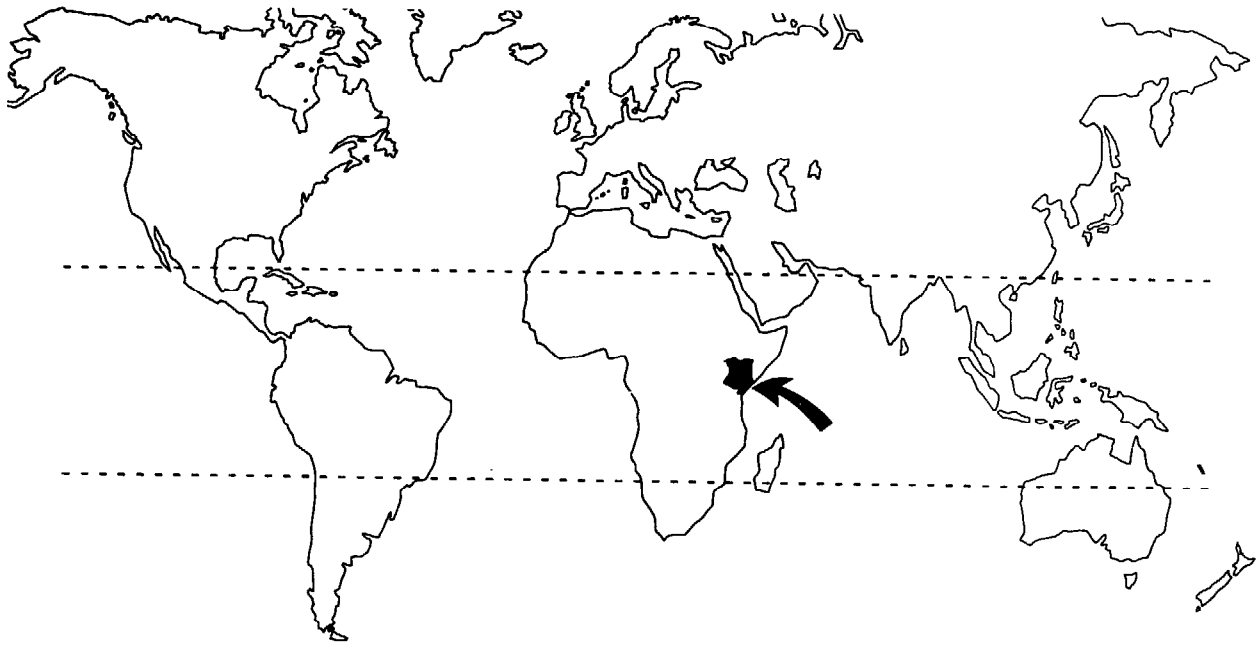
The Tiv people, who inhabit most of Benue State in Central Nigeria, have had an aggressive reputation for many years, and their traditional practice of beekeeping is associated with this. One of the uses to which they are reputed to have put bees was as a weapon against unfriendly incursions into their territory.

This use of bees was intricately connected with witchcraft, and the Tiv allegedly kept bees specially for use in warfare. The bees were put in horns containing powdered poison, which they carried into battle when they were released to attack the Tiv's enemies.

The more important uses of bees to the Tiv were, and are, more usual. Honey is a staple part of Tiv diets, and an ingredient of their medicines. Beeswax is an important soldering wax for repair of kitchen utensils. The Tiv are also aware of the importance of bees to the pollination of crops.

Beekeeping is treated as a skilled occupation amongst the Tiv, and experienced beekeepers can train others in the elementary skills of making simple hives and harvesting the honey. Tiv hives are made from a gourd or an earthenware pot, which is waxed and sweetened with cow-dung to encourage the bees to settle.

The Tiv do not apparently seek to locate their hives near particularly good nectar sources, but do make efforts to destroy trees that produce particularly bitter nectar. It normally takes 5-6 months for the bees in a hive to store enough honey to warrant harvesting the bees are then smoked out and the honey combs collected.



TRADITIONAL BEEKEEPING IN KENYA - FROM "TRADITIONAL BEEKEEPING AMONG KENYA TRIBES, AND METHODS PROPOSED FOR IMPROVEMENT AND MODERNIZATION" EXTRACTS

by J. M. NIGHTINGALE
(pp.15-22 from "Apiculture in Tropical Climates", IBRA, London 1976)

TRADITIONAL BEEKEEPING IN KENYA - FROM "TRADITIONAL BEEKEEPING AMONG KENYA TRIBES, AND METHODS PROPOSED FOR IMPROVEMENT AND MODERNIZATION" EXTRACTS

by J. M. NIGHTINGALE

(pp 15-22 from "Apiculture in Tropical Climates", IBRA, London 1976)

Kenya has many different altitude zones, each of which has a characteristic floral climax. In two zones at different altitudes (1200-1500m and 1500-1800m), where the climax vegetation still consists of indigenous species, traditional beekeeping is carried out. Particularly good honey crops in these zones are obtained from Labiatae and species of Acacia. Beekeeping is still an important traditional craft to some tribes, including the Wakamba, and the Kalenjin and Pokot.

1. The Wakamba

The Wakamba, together with their close neighbours, are the most progressive and knowledgeable on all aspects of apiculture, and know such things as the difference between queens, drones, and workers. They live in the large area east of Mount Kenya and Nairobi. The climate varies from pleasantly warm to intensely hot.

For the manufacture of hives they use a great variety of trees, but it seems that the source of supply of suitable timber will soon be exhausted, and that an African beehive uses a vast amount of wood for what it achieves, as there is much waste in hollowing out a log. Most of the hives are made of logs cut to roughly 3-3½ft. long (1m). Before working on the log, the operator buries one end at an approximate 45° angle in the ground to give it good support,while the other end is supported by crossed sticks. The hive maker then proceeds to hollow out one end of the log, using a long handled chisel. This handle is about 5ft (1.5m) long, and it is quite astonishing how skilfully this tool works. They also use a somewhat longer chisel for smoothing off the outside of the log hive. The manufacturer is able to produce an amazingly smooth finish by using a planing action with this long chisel. Having hollowed out one end of the log, it is then reversed, and the other end is worked on. When the hive is near completion the carpenter allows it to season somewhat before completing a good finish. He tries to get the walls of the hive as thin as possible without destroying the strength, as weight is considered to be an important factor. A small adze is used to fashion the split boards enclosing the end of the hive. Most hives have a larger diameter at one end than the other, and the entrance holes are always drilled at the narrow end using a red hot poker-like device. A curved metal bar, thin at the end, is used red hot to put owner markings on hives.

Hives are hung in high trees by means of a hooked pole, which is attached to the hive in such a way that the hive hangs at an angle, with the smaller end pointing downwards. This is the

end with the bee entrances. Wakamba beekeepers hang their hives at this angle in order to prevent any water condensation from lying in the bottom of the hive. They also hang their hives as nearly as possible with the entrance facing away from the strong prevailing wind, as bees become dissatisfied if there is a strong draught blowing in at the entrance and will often abscond for this reason.

The main honey flow in Ukambani (the area where the Wakamba live) occurs in June and July. Then there is another honey flow just before the November rains when a lot of the acacias anticipate the coming of the rain by flowering extensively. The honey is of a good flavour and, if sold in a clean state, should fetch a top price on the market.

The beekeepers work their hives usually in the late evening, as they find the bees are far too fierce during the day. Bee keepers there confirm very strongly that there are colonies of many differing characteristics - some being incredibly fierce and others fairly tractable in comparison. Bees kept around homesteads and near much human and animal activity get used to this situation and are far less likely to become stingers than those in isolated situations. The Wakamba beekeepers work their hives on the ground. One man will shin up the tree and attach a long strap made of cow hide to the fork by which the hive is hung in the tree. The other end is thrown over a higher branch, and the man on the ground then takes the strain while the operator up in the tree will lift the fork off its branch. The hive is then lowered to the ground. One benefit of working the hive on the ground is that the flying bees tend to go up to the high site in the tree. When the honey has been removed, the hive is hauled back up and hung in the old place. Great is the excitement felt by the man up in the tree when he lifts the hive off its branch and discovers that it is extremely heavy, which means a good crop of honey is about to be removed. The bees usually build their brood nest at the bottom end of the hive, near the entrance, and then work gradually up towards the higher, wider end, and finally start storing honey at the top portion, so this is the end that the beekeeper opens to remove the crop. Smoke is used quite extensively.

When a beekeeper finds it necessary to move a hive of bees from its existing site to a new location, he will cover both ends of the hive with thin calico and then carry the hive to the new site, hang it up, and remove the calico from either end. In the meantime he will hang a half gourd at the old site so that any bees returning the next day will use this gourd to settle on. That evening the gourd with bees is taken to the new site and shaken on the ground below the hive. It is usually sufficient to do this just once.

All tribes place their hives as high as possible, as it has been found that bees much prefer this situation. It is likely that the bees' instinct also tells them this is the safest place from attack by safari ants or honey badgers (ratels), and that there is less temperature variation than nearer the ground. Where there are many swarms competing for limited accommodation, they will set up home anywhere available, such as, holes

in the ground, buildings, old tyres or aircraft wings, but where swarms are scarce and accommodation is plentiful they can be most choosy.

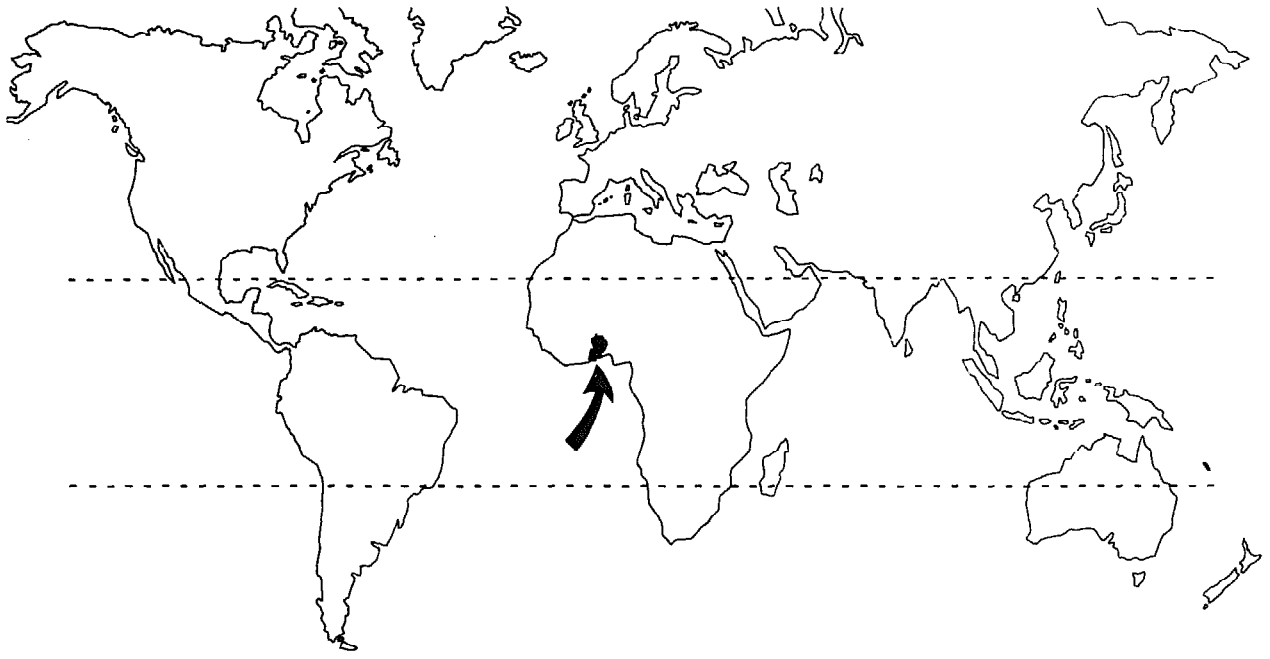
2. The Kalenjin and Pokot

The Kalenjin group of tribes live in the Rift Valley, north of Nakuru. A large part of the area is dry and hot, and the people rely on a goat economy. They are therefore short of ready cash, so beekeeping can make a useful addition to their meagre earnings.

To make a hive, the Tugen beekeeper splits his log lengthwise and then hollows out both sections into troughs, which he varnishes inside with the liquid contents of a goat's stomach. As the varnish dries he runs his fingers through the troughs leaving slight depressions in the varnish to induce the bees to build their combs parallel to the round of the hive. Having fitted the two sections together,the hive is placed level in the top of a thorn tree in such a way that the operator has a convenient perch to stand on. If one is not available, he will make it by tying a cross pole in the tree. The hive is opened by levering it apart along one of the split edges and inserting a suitably sized stone or block of wood to hold it open until the removal of honey has been completed. In this hive all the combs can be easily observed. Up to about 20 miles (30 km) from the sisal plantations the Tugen hives are fully stocked, but further away bees become scarce due to the failure of the seasonal migrations from the hills.

Close cousins of the Tugen are the Elgeyo Marakwet, who live over a range of hills in the Kerio Valley, an extremely hot area where the bees will only forage for two hours before sunrise and for a similar period in the evening, although they will go out during the day to collect water.

Further down the valley are the Pokot, who are not truly Kalenjin people and whose language and customs are quite different. The Pokot are worthy of mention as, although they also work in the tree tops, they do so somewhat differently. Their hives are far neater than others' and are bound with grass or reeds as a protection against both weather and the intense heat. There is a window about 6 x 4 inches (15 x 10 cm) in the centre of the side of the hive, and sometimes below it, which is closed with a cushion of bark fibres. The author himself has been out all day harvesting with these people without getting stung. The bee-man up the tree will spend up to ten minutes waving his smoke torch around the hive. Having removed the cushion, he then blows smoke through the window until the bees are driven out as two clusters at both ends of the hive. He then scoops out the honey by hand into a skin bag hanging at a convenient height from his neck. By custom he will work only one end of the hive from the window, to preserve the brood. If by chance he scoops out any brood he discards it. The Pokot also complain bitterly about the lack of swarms migrating back from the high altitudes, as they once did.



THE BEEKEEPING POTENTIAL IN GHANA - 1962-5

by DR. AUGUST M. GORENZ
Horticultural Advisor
US Aid/Ghana Mission

THE BEEKEEPING POTENTIAL IN GHANA - 1962- 65

by DR. AUGUST M. GORENZ
Horticultural Advisor
US Aid/Ghana Mission

(This chapter combines two papers. In the first written in 1962, the author speculates on the beekeeping potential of Ghana. In the second he summarizes his experiences three years later, after attempting beekeeping in S.W. Ghana.)

(i - The possibilities for beekeeping in Ghana, The Ghana Farmer, 6(4), 149-150 (1962)
ii - A start in Beekeeping in Ghana, The Ghana Farmer, vol.8, No. 4, 108-114 (1965))

The possibilities for Beekeeping in Ghana

A wild honeybee is indigenous to most parts of Ghana. The bees are most common in the North, and their nests are generally located in cavities in trees. The honey is much relished by the local inhabitants and any bee trees that are found are cut down, using fire to kill the bees, and chopped open to obtain it. No attempt is made to hive the bees so as to have more honey in the future.

This wild honey bee, which is well adapted to local conditions, is very similar to and a close relative of the commercial honey bee of the USA and Europe.

In Ghana, flowers of certain trees and shrubs, for the most part wild, are the major sources of nectar. The flowering of most of these plants is seasonal, and the honeybee stores a surplus of food in the form of honey to carry it through the periods when flowers are scarce. Major flowering periods occur principally at the end and beginning of the rainy season. Extended rainy periods, and conversely long dry periods are unfavourable for beekeeping. If there are two to three months without (or with only few) flowers, the bees use up all their available stores and reach the point of starvation.

What then are the possibilities for beekeeping in Ghana? Due to marked differences in rainfall and vegetation some regions will be much better than others. There is a general correlation between the abundance of wild bee colonies and the suitability of the area for bees. This can be found out by observation but, in the end, there is no substitute for actual beekeeping experience in the particular area.

Past experience in many countries with similar climatic conditions to those in Ghana has indicated that modern, large-scale commercial beekeeping which requires a high capital investment would not be profitable. There is no question that a beekeeping industry would be useful in Ghana. However, it would have to be mainly of the side-line, cottage-type, part-time and

small-scale beekeeping, and be practised by large numbers of people throughout the country. Most of the equipment needed could be produced locally.

Beeswax has a ready international market at a good price, approximately four shillings per pound*, and could be readily exported if the quality was kept high. Much beeswax goes to waste when wild bees are robbed for their honey and the wax discarded. A scheme to collect it would necessitate training in extraction of the wax and a marketing service. This would not be worthwhile to set up for the wax from wild bees alone, but would have to await the time when the production from a few thousand beekeepers is available. About one pound of wax from each hive could probably be obtained in a year.

Many problems remain to be solved before there can be established an extensive beekeeping industry in Ghana, and Ghana could usefully draw on the experiences of Tanzania (1962 ed.).

The wild honeybee indigenous to Ghana is a vigorous bee that defends its home with the utmost valour. Once aroused, the bees will persist for the remainder of the day in attacking and stinging everyone that moves in the vicinity of the colony, and will continue to follow and harass their victim for long distances. The amount of protective clothing needed to be secure from their attack make its use impractical. To a limited extent, the bees can be handled after dark using a light, as they prefer to stay in the hive after sundown.

This sensitivity and instant reaction to any disturbance make this bee unsuited for modern beekeeping practices and manipulation. The commercial bee of the USA and Europe has often been imported into tropical Africa, but has never been able to survive local conditions. What is needed is a hybrid bee combining the ability to survive local conditions of the indigenous bee with the receptiveness to handling and manipulations of the European bee. Hybridization of these bees has already been done successfully in Brazil. Hybrids could easily be produced in Ghana within a short time, although selection of the best strains for industry and gentleness would take years of experience.

Another major problem is the lack of trained people with practical experience in beekeeping. Beekeepers have to be of a certain temperament, and the fear of being stung makes most people unsuited for the purpose. However, training in understanding of bee behaviour could make many of these lose their fear. In the end, selection of genuinely interested students for advance training could rather easily be effected by "baptism under fire", so as to speak, that is by actual willingness to handle and work with bees.

Another fundamental problem is that there have been no successful attempts at beekeeping in Ghana. Experience will have to be obtained on a regional and local level throughout Ghana.

Editorial Note

* This was in 1962. It was reported in Kumasi in early 1978 that beeswax cost over 100 times that amount. (Equal to approximately ¢ 96 or £45 per kilo in 1979).

Beekeeping practices follow local conditions and these would be considerably different in say the Western Division and the Northern Region. Such experience, which is necessary before specific bee-keeping instructions can be given in any region will take many years to obtain.

A Start in Beekeeping in Ghana

Obtaining the Bees

Considerable difficulties confronted us in establishing the first colonies of bees. Early in 1963 four attempts were made to transfer bees from trees to modern hives. It was found that, if the bees were smoked thoroughly and driven off the combs before they could become aroused, no protective veil or clothing was necessary. The bees would cluster like a swarm, and could be shaken or brushed into the hive. In every case it proved useless to transfer combs, as is the universal recommendation, to the new hive. The bees would not go back on to them. The uncapped brood was allowed to starve, and in a few days the combs were completely infested with hive beetle larvae and had to be removed. All four attempts eventually ended in failure. In two of them the queen was lost, in one the queen did not lay eggs, and so the bees could not reproduce themselves. They died off in a few months. One colony appeared to be established and remained in the hive for a week, making a small amount of comb, and the queen laying a few eggs, but it swarmed and left without clustering.

In another attempt, a five-foot section of tree trunk containing a colony was cut off and set up by the writer's house. The bees left after three days. On opening, the combs were found infested with a red centipede and hive beetle larvae. The combs had become disarranged during cutting and transporting the log; so the bees could not patrol them and thus deserted them when they became infested.

On 1 August 1963, a small swarm in a young coconut tree was brought to the writer's attention. It was hived, and the precaution was taken to use an entrance guard that would allow the workers to pass but not the queen. The bees left the hive twice the first day and once the next day, but since the queen could not accompany them they soon returned. They were fed on sugar syrup and finally settled down in their new home. The feeding was continued for two months at the rate of three pints of sugar syrup (50 per cent by small case volume) per week. In September 1963, two combs of brood with some eggs and adhering bees were taken from this colony; they reared a new queen, and being fed sugar syrup they soon became a strong colony. The original colony was again divided on 14 October 1964, thus giving after one year a total of nine colonies from the original small swarm. This number could easily have been doubled if the three colonies had been used for increase only. Instead they were also run for honey production. No more feeding was done after the original three colonies were established.

In May 1964, a colony was found in a rotten stump by station workers at Aiyinasi (Western Region). They smoked out the bees and took the honey. A hive baited with a small comb of honey was brought, and most of the bees brushed inside it. It was then put on the stump with the entrance in the approximate

location of the old one. A piece of the old entrance was placed on the new entrance to attract the bees. Within a few weeks the bees were well established, and the hive was moved to the writer's house one evening after temporarily closing the entrance. In September this colony was divided into three parts. No feeding was necessary as this took place during a period of honeyflows.

The major swarming season is in June and July after the main honeyflows. When swarming, the bees lose their aggressiveness and do not attack, except that occasionally a few bees may try to sting. In June 1964, five swarms were captured within a quarter of a mile of the writer's house. The cluster of bees was shaken or brushed into a net-bag; the bag was placed in the new hive, quickly untied and the cover of the hive quickly replaced. The frames in the hive were furnished with starter strips of foundation only.

In every case an entrance guard was used to keep the queen from leaving if the bees swarmed again. This was found to be an absolutely necessary precaution even if a well monopolized hive was used. The bees always left the hive several times before finally settling down, after two to three days. One of the above swarms left and did not return,thus abandoning their queen. In July a small swarm was captured and added to a weak colony through a queen excluder. The entire colony swarmed the next day, abandoning combs of brood and honey. As the queen's wings had been clipped she could follow the swarm, and the bees returned.

Two types of entrance guards were used; one was of galvanized screen,5 meshes per inch, covering the entrance, the full width of the hive, the other was made of three parallel wires, spaced 0.16 inches apart. This proved best, as the bees could carry pollen through it, while the galvanized screen acts as a pollen trap. The guards were removed in about five days after the bees had become resigned to their new home. The guards must not be left on permanently as they can become clogged with drones, and virgin queens cannot get out to mate.

While swarms are not dangerous to handle, they do not take readily to confinement. If they decide to take wing after the cluster is placed in the net or hive, and they invariably do, it is impossible to quieten them with darkness, wetting them or feeding syrup. They will keep on trying to escape until all the bees are exhausted or dead.

It was found best to release the bees as soon as possible inside a hive with an entrance guard. The guard slows down the exit of the swarm so that the bees can remember the spot and can return when they miss the queen.

Thus by November 1964, twenty-four colonies of bees had been established. Although it was difficult to achieve the initial start, subsequent divisions have been made easily and rapidly.

Location of Hives and Apiary

Most of the colonies are on strong stands about two feet high under the overhanging eaves on the north and east sides of the writer's house. No special precautions have been found

necessary against ants. On two occasions safari or driver ants have passed over the bee stands without touching the hive; on a third occasion the ants overwhelmed and destroyed a one-frame nucleus of bees. A stream of boiling hot water was poured on several hundred feet of their column, and they have not been seen since. Small sugar ants were a nuisance at first when using the entrance feeder, but a change to the friction-top tin feeder placed on the top bars in the centre of the cluster eliminated this trouble completely. Cobwebs have been swept down occasionally. When lizards become too numberous and start bothering the bees they are eliminated by shooting them with a pellet air gun.

Three of the colonies are inside a small building with entrances facing the outside. These hives can be opened and examined at any time without the danger of persistent attack from large numbers of bees.

This is the best way for anyone to start keeping bees. Up to forty colonies could be kept in one building 9 feet wide and 30 feet long.

The bees do not tend to be vicious; and they mind their own business until disturbed. However, once aroused it is impossible to stay in the open. Colonies have been completely aroused on three occasions in the past year. There was the roar of thousands of bees in the air ready to sting anything and everything in the vicinity. They started hitting door knobs, and any objects they encountered. The bees hit against the window screens in an attempt to get at people inside the room. It took two or more hours for them to calm down. Anyone attempting to approach the house at this time would be seriously stung. Dogs beat a hasty retreat letting out a yelp with each new sting. So as not to risk arousing the bees, the hives are not opened in the day time except for weak colonies or newly hived swarms.

Because of this possibility of the bees becoming angry, they should not be kept near a house or pathways. They should be about two hundred yards away and isolated by a hedge. If bee houses are not used, the recommendation from the Bee-keeping Division of Tanzania is that they should be placed individually on two-foot high stands separated from one another by a distance of about 5 feet.

A good location should be well ventilated but not windy, and should have access to early morning sun and afternoon shade for the hives.

Of course a major factor in selecting an apiary site is the relative abundance of good nectar-producing plants. Often a few miles difference in location can mean a big difference in the amount of honey obtained. A location with all-year-round nectar sources will include nearby swamps (freshwater and/or mangrove) and streams that never get dried up. Some very good locations will be on the northern fringes of the new Volta Lake.

Hives and Equipment

The beekeeper can make his own equipment. Almost all of the hives and equipment used by the writer are homemade. Hives are of standard Langstroth dimensions, except that top bars of the frames are reduced to 1 inch and end bars to 1¼ inches wide. The hive then takes eleven frames instead of the usual ten. Modified Dadant depth supers (6¼ inch deep frames) are used for honey, and often two of these are used for the brood chamber. Floor boards are made to provide ¼ or ⅜ inch entrances only. This entrance is left open the full width of the hive for strong colonies, but it is reduced to 4 inches or less for weak colonies.

If a deep and wide entrance is left at the bottom of the hive, which is a common practice in temperate climates during the summer, a large inside area near the entrance will often not be used by the bees. Comb will not be built in this area and, if introduced, it is gradually torn out, resulting in up to 20 per cent loss in brood chamber space.

A single flat cover, that is essentially an inner cover filled with newspaper and covered with aluminium sheet bent over the sides and tacked in place is used. During honey flows extra ventilation is provided to strong colonies on top by pushing the cover forward about ⅝ inch giving a ¼ inch opening the full width of the hive. For outside hives the covers are made 1 inch longer than the hive. Strips of wood ⅜ inch thick are nailed underneath it along the sides. A strip 1¾ inches wide and ⅜ inch thick is nailed under the front edge and one ½ inch wide under the rear edge. When pushed back, this cover provided top ventilation as well as protection from rain.

It is important that all hives be rot and termite proofed by dipping them in a saturated solution of pentachlorophenol in kerosene. This is allowed to dry, and the hives can be painted in the traditional white colour.

Galvanized wire-mesh screening with 5 meshes to the inch is used for queen excluders. This also tends to keep the bees from storing pollen in the supers.

A honey extractor, and a 15-gallon settling tank and bottle filler, were made with the help of the station blacksmith. The smoker, an absolutely essential item, was made in the writer's own workshop.

Hive stands are of heavy, rough lumber treated with solignum (creosote) against rot and termites. Concrete blocks are also used.

Good protective clothing is necessary for daytime work. This consists of veil, bee gloves, boots, and thick cotton shirts and pants of light colour. For utmost security heavy zippered overalls are needed.

Frames for the hives are wired and fitted with full sheets of wax foundation (factory made) when available. As an alternative a thick line of wax, made by pouring melted beeswax along a soaped wood bar placed along the centre of the top bar, has proved very satisfactory. In fact, this has been more effective

than starter strips of foundation.

Hives and frames, although home made, are made carefully to close tolerances of standard dimensions so as to be interchangeable.

Honey Flows of the Western Region

The amount of honey produced will depend on the nectar-producing flowers available to the bees within a mile or two of the hive. Sources of pollen for feeding the brood are never lacking. The area in which the writer's bees are located has large plantings of oil palm, coconut, rubber, citrus, large areas of essentially virgin jungle and swamp, large areas of secondary bush fallow, interspersed with small farms of maize, cassava, plantains, groundnuts, pepper and other crops. Water is present throughout the year in numerous small streams. It is to be expected that there will be a variation in honey production from year to year, depending on the rainfall. Too much rain and conversely too little rain are both unfavourable.

The main honey flow is at the beginning of the rainy season in March or April and continues to May and June. There is no flow during the heavy rains in July.

The months of August, September and October in 1964 have been drier than normal. Thus there has been a series of small flows during this period that have enabled the bees to build up rapidly and store some surplus honey.

A graph of the honey flows for the year is based on constant observation of honey storage and new comb construction. A hive will be placed on a scale for daily weight measurements to get a more quantitative graph for next year.

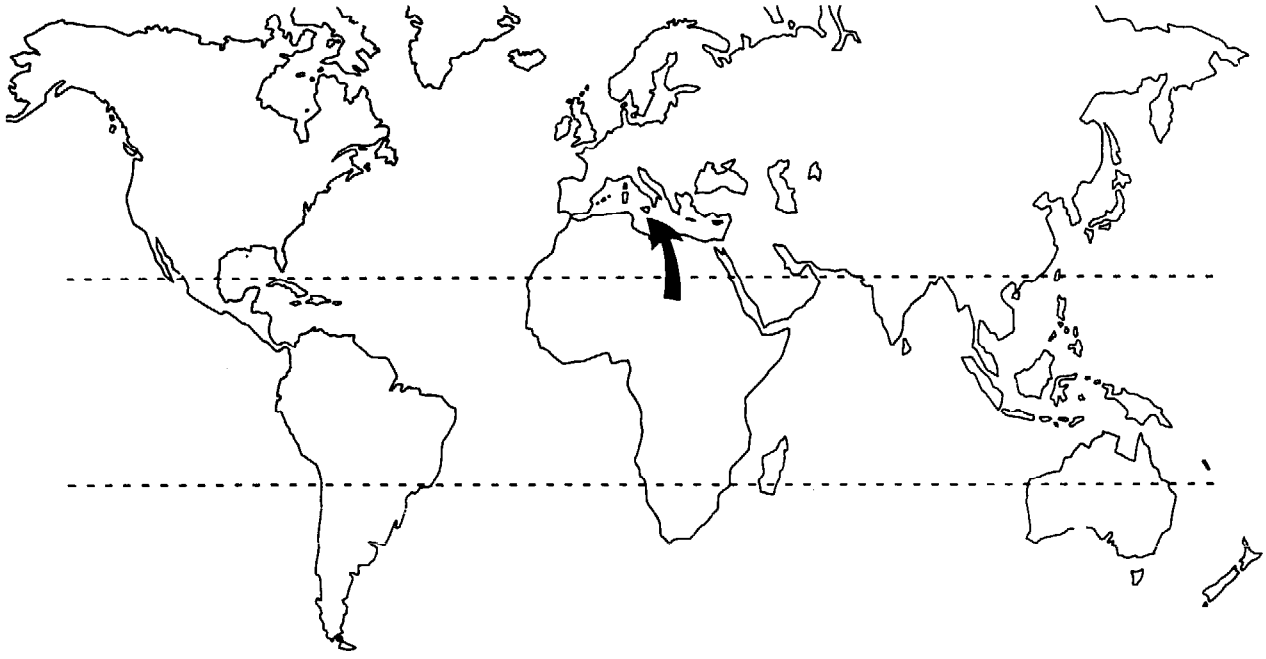
Approximately 36 pounds (3 gallons) of honey were obtained from each of two hives in May and June, and 24 pounds (2 gallons) in October, for a total of 60 pounds per colony. This is considered a fair yield, but it is expected that double or triple this amount can be obtained from strong, well established colonies furnished with about three M.D. supers of empty combs.

Plenty of empty comb space enables the bees to take full advantage of short but heavy flows which they could not make full use of if storage space was lacking. It is the writer's opinion, based on previous tropical experience with intermittent flows, that three times as much honey can be obtained from hives if the comb is extracted and returned as if the honey is obtained by cutting out and crushing the comb. Another very marked advantage is that swarming is greatly reduced.

The flavour and quality of the honey depend primarily on the flowers from which it is obtained. The wide range of floral sources in the Western Region gives a number of different flavours of honey from mild to strong to very bitter, and in colour from light to dark. The first honey in March was mild and light coloured, the next was light amber and very bitter, while that of June was dark amber and of a strong but not unpleasant flavour. Even bitter honey, when mixed with some of the other, is satisfactory and one can develop a taste for it, as for beer

or tonic water. The honeys of the late flows of August, September and October were amber and of a strong but pleasant flavour.

Only a small start has been made for identification of the honey plants. The most important ones for surplus honey will be some of the wild trees and shrubs. Bees have been seen working on coconut, oil palm, raffia palm, royal palm, citrus, cassava, Poinsettia, Bidens sp., cucumber and Casuarina (for pollen). During times of shortage bees have been seen collecting from cut ends of sugar cane, ripe pawpaw (papaya) fruits that have fallen to the ground and broken, and the fermenting juice from oil and raffia palms when palm wine is being made from them.



BEEKEEPING IN THE MALTESE ISLANDS

by VICTOR FARRUGIA, HNDH
(Original Manuscript)

BEEKEEPING IN THE MALTESE ISLANDS

by VICTOR FARRUGIA, HNDH
(Original Manuscript)

History

Beekeeping has been practised in Malta for thousands of years, and although this Island is not a comparatively large producer of honey, it has been noted world-wide for the quality of its honey. The name Malta is derived from Melita, the name by which the island was known some 2000 years ago. Melita in turn is derived from a Greek word, Μελι meaning honey. One of the larger valleys in Malta has been aptly called Honey Valley from time immemorial.

In 1915 Professor John Borg linked beekeeping in the Maltese Islands to the dawn of their history, when the Phoenicians settled in Malta some 4000 years ago. He concluded that IMGIEBAH, renowned for the abundance of wild thyme, is derived from a Phoenician word for clay hives; the same word in Maltese now has the same meaning.

Geographical Position

Although Malta covers only about 100 square miles, crops mature earlier in the southern part and the bees start storing honey earlier there than in the north, where the temperature is lower. Also the land is more fertile (and irrigated) in the south and more rocky in the north. So with Red Clover (Hedisarum coronarium) mainly in the south and Mediterranean wild thyme (Coridothymus capitatus) in the rocky areas of the north, migratory beekeeping is practised for these two honey flows. The active beekeeping season in Malta is a month or two earlier than in the south of England.

Climatic Conditions

The climate is sub-tropical, the temperature very rarely falling to freezing point, but often reaching 104°F (40°C) in the shade during a hot summer. Bees can forage for practically twelve months a year, but the hot dry summers are a drawback, and the bees must be provided with a permanent source of water near the apiary. Shade and adequate ventilation for the hives are also essential during this period.

The hives are usually painted white, and their roofs covered during the summer months with fleshy leaves of the prickly pear (Opuntia ficus-indica) or palm fronds (Phoenix canariensis), or a makeshift awning of wild reeds (Arundo donax) collected locally.

The high summer temperatures are advantageous in queen rearing, in that the developmental period of the queen is 2-3 days shorter than in northern countries.

In deciding where to site a new apiary, wind is an important

factor. The Islands are subject to frequent north-westerly winds which can reach gale force. Valleys are therefore much sought after, and a southerly aspect is usually chosen. As a result of the winds, many bees are lost during foraging, and there is much drifting to other hives, which can lead to robbing and the spread of disease. Windy days also reduce the number of foraging hours for the bees; when the wind reaches Force 5, the bees usually remain in the hives.

Maltese Flora

The native wild flora of the Maltese Islands provide useful bee forage between the main flows; the most important are listed in the floral Appendix. Pollen loads range from black from the Bristly poppy, through yellow and orange (Cape sorrell and common vetch) to white from the White wall-rocket. The Bee orchid (Ophrys apifera) is occasionally found in Malta.

Honey Types

The main honey, usually extracted in July-August, is from Mediterranean wild thyme. It is reddish-brown, and has the best flavour. Flowering may last from may to the end of July, depending on the season.

Red clover honey is extracted in large quantities in May, but its flavour is not quite as good; it has a yellowish colour. Red clover (Hedysarum coronarium) may be in flower from February to May.

Small quantities of other honeys are extracted by specialists: carob honey from the locust tree (Ceratonia siliqua), and citrus honey mainly from oranges, lemon and tangerine blossoms. There are only small local fruit growers, who do not hire bees for pollination. There is some indiscriminate spraying of insecticides on trees at blossom time, with resultant bee mortality.

Traditional Hives

The traditional Maltese hive is a bottle-shaped earthenware jar open at both ends. At one end is a neck about 3 inches in diameter; the main part is about 10 inches in diameter. to the open end of which is fitted an open-ended clay cylinder of the same diameter, about 18 inches long, which serves as a honey chamber. More than one open cylinder may be used; the open end at the back of the hive is usually closed with a piece of cardboard or wood, held firmly in place with a stone or other heavy object. The neck of the brood chamber serves as the hive entrance; its size can be adjusted by stuffing in a piece of sack cloth.

These earthenware jars, which are still used by some beekeepers have the advantage of an equable temperature inside them (about $75^{o}F$, $24^{o}C$) day and night, and they are relatively cheap. The combs are securely attached to their rough inner surface. Honey is usually extracted by removing the honey combs and pressing them by hand or with a mechanical press, and then straining. Honeys from different flows are all dealt with together. Their disadvantages are many: (a) no queen excluder is used, so brood is usually mixed with honey in the supers; (b) the progress of the colony cannot be assessed by inspection of the combs; (c) control of pests and diseases is difficult; (d) the bees have to rebuild combs after the honey is harvested.

Modern Hives

Wooden frame hives were introduced towards the middle of the present century. Today they are constructed locally, from red or white deal. Most hives are Modified Dadant, Langstroth, British National, or British Modified Commercial. Relatively little space is needed for winter stores, so a large brood chamber is not needed. For this reason the Modified Commercial hive is preferred to the Dadant: two shallow brood chambers provide adequate space during the build-up period, and the brood chamber can be reduced later to single shallow, to get more honey into the supers during the flow.

The transfer of a colony fron an earthenware jar to a frame hive is a messy job, requiring skill and patience,. It is best tackled in the winter months when the wax combs are harder and less likely to be damaged.

Beekeepers

Most of the larger towns in Malta have little in the way of open green areas, and bees cannot be kept in them. Hence, the art and skill of beekeeping has always been the prerogative of rural people, and among these, mainly land tenants. In days gone by, beekeeping was only a sideline to the local farmer: hives were placed in the least-used part of a field, and handled only once a year, to harvest whatever honey could be taken from them. The older rural generation had little money or time to educate themselves prior to the last World War, when education had to be paid for by the individual. Many of the old country folk are illiterate or partly so. Up to a few decades ago, beekeeping practice in the Maltese Islands was practically isolated from the mainstream of development in the rest of the world. The techniques of beekeeping in Malta have thus been passed on from one generation to the next by word of mouth, each generation adding its own observations and innovations.

The characteristics of Maltese beekeeping include the knowledge by beekeepers of the special relationship between the life history of the local bees and the Maltese flora, and the native enemies such as the blue rock thrush (il-merill), the national bird, the bee-eater, and the death's head hawk moth.

Moreover, local remedies have been developed for easing the pain of stings and the prevention of swelling, including the use of spirits, oils, onions and other local herbs. The use of beeswax for polishing marble and wood, and of honey to cure sundry ailments according to local folk medicine, must have evolved here as in other countries.

Swarming

The only way an old-time beekeeper could increase his stock was by encouraging his colonies to swarm, which they usually do between mid-March and mid-April. Swarming before mid-March, though welcomed, is very rare, and any swarms after mid-April, are not worth taking. To attract swarms to establish themselves in a prepared earthenware jar, the inner surface is rubber with balm extract from cultivated plants (Melissa officinalis), then some comb honey or sugar syrup is left inside the jar. If this lure fails, the beekeeper - who usually spends every day at swarming time watching his hives - is always ready to hive any swarm that becomes available. If broad beans which are normally in flower at the time of swarming are planted near the hives, and almond trees grown around the apiary, it is said that swarms

will be attracted to cluster on them.

Bee races

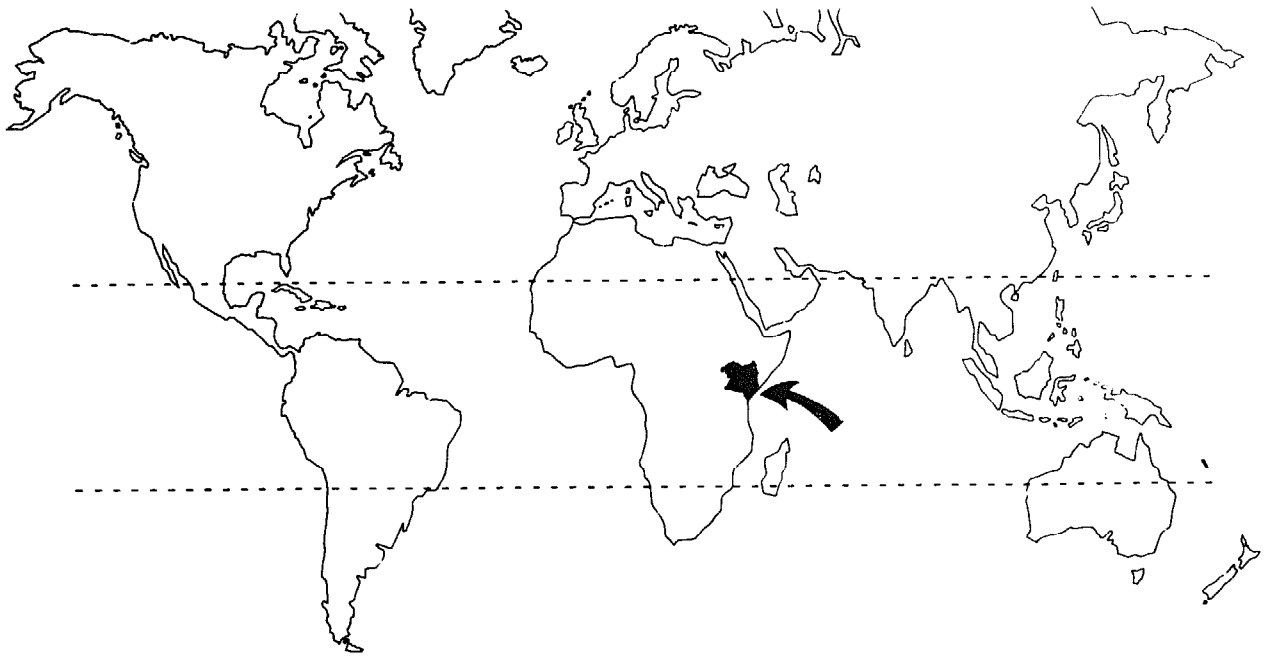
It has not been established that a pure Maltese race of bees existed at any time in the island's long history of beekeeping, but the possibility is not excluded, because Malta must have been isolated for a long period.

The present interbred strains of bees are black and rather small; some beekeepers claim that their queens manage to pass through a queen excluder, but, I cannot confirm this. The local bees have a tendency to sting the operator and other living things within a considerable distance. The swarming habits of the local strains are greatly influenced by the fact that local beekeepers still encourage swarming. Thus, if the local bees have been bred for anything, they have surely been bred to swarm.

Over the last few decades, bees of yellow races have been introduced in large numbers and they have interbred with the all-black strains. The local dark bee may or may not be best suited to the islands, but careful comparative experiments should be carried out before the wholesale importation of foreign bees which may, in time, cause the local dark bee to become extinct.

Pests and Diseases

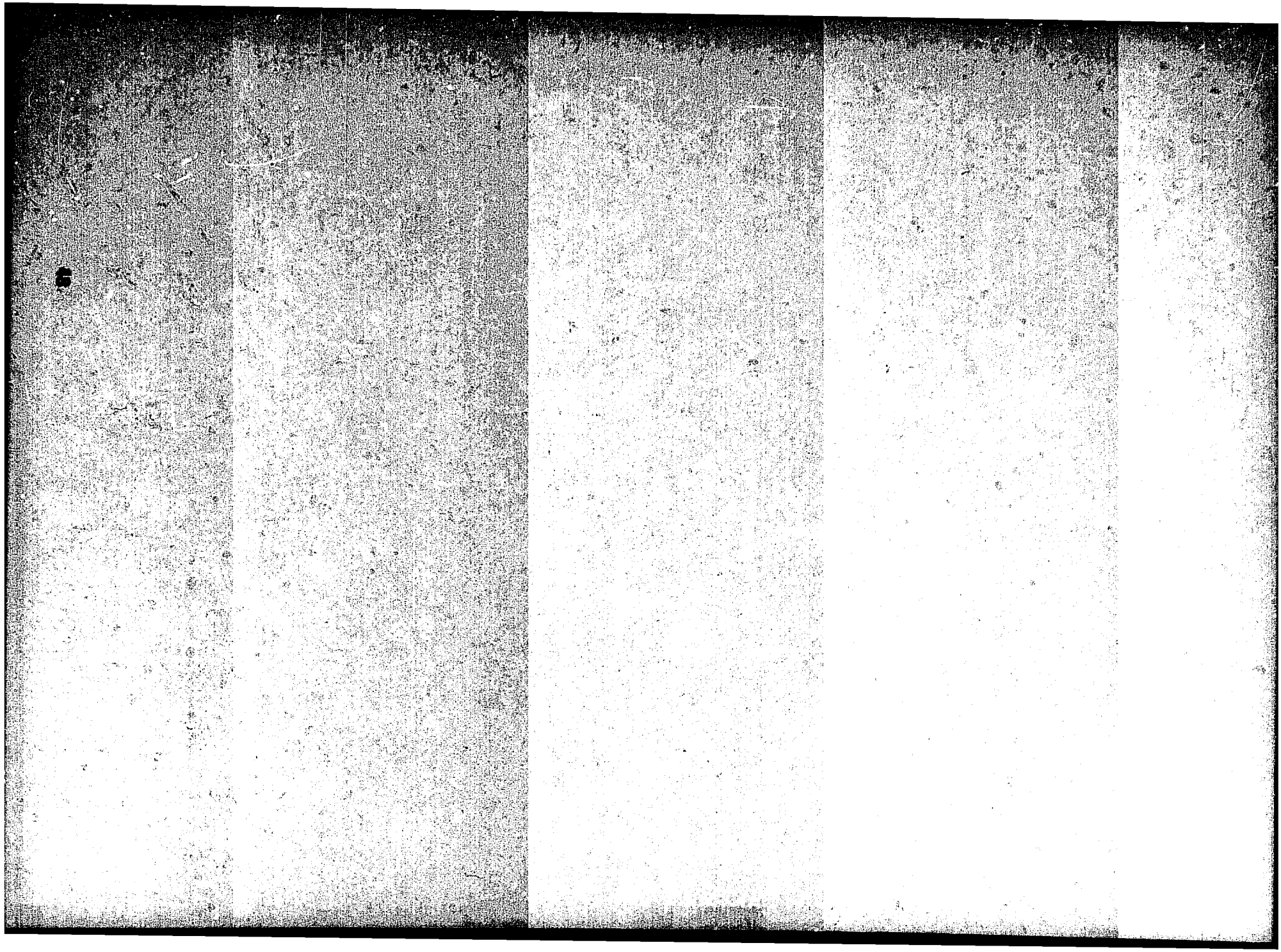
Nosema and foul brood diseases are not common in the Maltese Islands, but dysentery and acarine disease occur. Due to lack of inspection of hives, and the weakening of colonies after a long dry spell, beekeepers often complain that their hives have been overrun by wax moths. Other pests include ants, which usually invade the hive at night, and some birds as already mentioned. APIMYIASIS, due to a red parasitic mite, is also found, but is neither common nor lethal.



BEEKEEPING DEVELOPMENT PROGRAMMES IN KENYA

by KIREA I. KIGATIIRA
(Beekeeping Section, National Agricultural Laboratories Nairobi, Kenya)

(Reprinted from "Apiculture in Tropical Climates", IBRA, London 1976, Pages 143-146)



BEEKEEPING DEVELOPMENT PROGRAMMES IN KENYA

by KIREA I. KIGATIIRA
(Beekeeping Section, National Agricultural Laboratories Nairobi, Kenya)

(Reprinted from "Apiculture in Tropical Climates", IBRA, London 1976, Pages 143-146)

The Basis

The beekeeping industry in Kenya is worth many millions of shillings and plays an important part in the economy of arid areas. Beekeeping is a traditional practice, developed and tried for thousands of years, and virtually all honey in Kenya is produced by traditional methods. It was felt that, in order to increase the output of honey in the country, improved beekeeping practices should be tried.

In view of the difficulties in achieving economic development in these areas, Oxfam (through "Freedom from Hunger") granted Kenya in 1967 £8000 over two years for a pilot project, with the hope that a more involved project might then be considered should development prove possible. The object of this pilot project was to gather information and to start any scheme that might be of value in achieving the objects of the project. An application was lodged in 1967, for the continuatuon of the two-year beekeeping pilot project for a further year, by which time it was thought it would be possible to establish the beekeeping industry on a commercial footing.

At the expiry of the Oxfam exploratory project in 1970, the Kenya Government requested the Canadian Government to provide technical assistance, in the form of apicultural experts to help establish a Bee Section in the Ministry of Agriculture. Also funds for the building of a small laboratory, supply of equipment, and fellowships for overseas training, were requested. The Kenya Government was to provide counterpart personnel and support services.

The basic phase 1 objectives of the Canadian projects were to assist the Kenya Government to establish a permenant Apicultural Section in the Ministry of Agriculture, by means of a co-operative programme of training, extension and research, in particular the following :-

1. To continue the development of primary honey and wax collection centres, and of central refinery and marketing centres, in Kenya. These first efforts were adopted in 1950 by the Animal Industry Section of the Veterinary Department.

2. To undertake general extension and promotion work, through mass media such as radio, pamphlets, and participation in Agricultural Shows.

could be used to advantage, then adapting it to local needs and conditions, and finally - possibly the most difficult task - educating farmers to use it.

1. Extension

Precisely to the above end, the Canadian team maintained posts of technical specialists who brought education and service, in many instances, down to the subsistence farmer. A hive intermediate between traditional hives and movable-frame hives, which was fitted with standardised movable bars, was made available. The hive was simple enough for the farmer to use safely and economically with methods he employs traditionally. Training programmes in many areas were conducted on using the hive in ways which cost little in terms of human effort.

As awareness continued to increase, it became apparent that a significant production increase could be achieved only as the team, which now included reliable Kenyan officers, helped the farmer to improve all major aspects of his operation. He must have help to acquire understanding of (and often be helped to finance) improved hives, and also modern practices in bee culture, management, pest and disease control, and the handling of hive products.

2. Training

In 1972 the first Kenyan left for Canada for eight months' training. At the completion of his course in 1973, the second Kenyan left for Canada to undertake a two-year MSc course in Apiculture. In August 1975 a third Kenyan completed his eight month diploma in Apiculture. These Kenyans have been sponsored under the auspices of the project. There is, however, need to train more Kenyans so that the Section can be manned by fully trained research and extension personnel. Courses on beekeeping are held regularly at Ngong FTC for farmers and extension officers. Trainees taking Animal Husbandry courses at AHITI in Embu and Bukura receive a complete course in all aspects of beekeeping. Most of the Village Polytechnics have a compulsory beekeeping course, and sometimes students receive hives on completion of the course.

3. Research

A small field research laboratory and a bee house were established at Ngong Farmers Training Centre. An apiculture research laboratory has been constructed at the National Agricultural Laboratories, Kabete, and though not yet fully equipped, it is satisfactory for the present stage of our research, and considerable knowledge of bee behaviour has been gained. However, research has been dominated by the extension programme, and achievements have fallen short of hoped-for goals.

Hives, hive accessories, and beekeeping equipment such as swarm catcher boxes, smokers, veil and gloves, have been produced and improved from time to time.

4. Beekeeping Centres

The need was felt for a strong central marketing organisation, with more sophisticated machinery for both honey refining and hive construction, and with the necessary supervision of technical operation. Thika Farmers Training Centre was selected, and machines were installed. This central system was fed with honey from satellite collecting centres in Marimanti (Meru), Kitui, Wamba (Samburu) and Makueni (Machakos), these centres partially cleaned their products and forward them to Thika for

3. To advise on, and to assist in, organisation of local courses of training in beekeeping.

4. To undertake research relevant to Kenyan conditions, and to the requirements of the traditional Kenyan beekeeping industry, in such spheres and activities as improved hives, bee management, honey handling and marketing, use of bees for pollination.

5. To undertake habitat study surveys, to determine characteristics of honey types and honey flows, and to develop vegetation and pollen reference libraries.

6. To select apiculturalists and to train them in Canada, ready to take over the project on behalf of Kenya Governmnet after the completion of the programme.

The project Director, Prof. G. F. Townsend (Canada), was in charge of the overall operation of the project, including the planning and periodic review of the programme of teaching, extension and development, and the general appointment, supervision and co-ordination of the activities of the Canadian team, in consultation with the Head of Animal Production Division of the Ministry of Agriculture (Kenya) and with CIDA.

The appointed Team Leader (Canadian) was always the overall director of the programme on the spot, assisted by a Canadian Extension Officer appointed for four years. The Canadian officers, Kenyan counterparts, and field staff formed a Beekeeping Team which was ready to fill the many gaps in the ideal of beekeeping, aimed at the positive participation of the public.

An early decision of the team was to respond to the interest expressed by individuals and groups, rather than to sell the programme and its purpose aggressively. It was recognised that the speed of adaption to improved bee management was influenced by the following:-

1. The communicability of the idea, explained in simple general terms that are understood with ease.

2. The relative advantages of the idea, such as easy manipulation, low cost in terms of material investment or of human effort and future benefits.

3. The compatibility of the idea: it was realized that a technology that is contrary to commonly held values, interests and beliefs of the community is not likely to receive the support of the people.

4. Divisibility: complex ideas were divided up into small parts for the purpose of trying them out.

Achievements

It was realized that with beekeeping, as with other agricultural inputs, the question in Kenya (and other developing countries) is not one of seeking new knowledge only, but rather one of improving and implementing what exists already. In this country, where food production falls behind needs, the first task called for determining what existing technology

finishing and packing. Thika continues to be the centre for bee supplies for the country.

The Future

The Government of Kenya wishes to extend the project into a second phase, 1967-1977 to 1979-8. This will enable the project to consolidate its achievements so far, and will permit a smooth handing over of all the major operations from Canadian to Kenyan management. Already a Kenyan has been appointed Director of the project, with a Canadian (Professor Townsend) as an advisor.

THE CONSTRUCTION, DIMENSIONS AND SITING OF LOG HIVES NEAR NAIROBI, KENYA

by KIREA I. KIGATIIRA
(Officer-in-Charge, Beekeeping Station, National Agricultural Laboratories, Nairobi, Kenya)

and ROGER A. MORSE
(Department of Entomology, Cornell University, Ithaca, New York, USA) *(Original Manuscript)*

Beekeeping in Africa is an ancient art. Honey was an important part of early man's diet and even today provides him with a base for an alcoholic beverage. Brood was often eaten and provided a good source of protein. Trade along the east African coast predates present history: beeswax was an important commodity in early trade as it is today.

Methods of keeping bees are now changing rapidly in Kenya. Movable frame hives and movable-comb frameless hives are now widely used, and their success suggests that ancient methods of keeping bees will soon pass. We have observed that beekeepers in both rural and urban areas are substituting discarded metal and cardboard drums and shipping boxes for the traditional log hives, and these makeshift hives are attractive to swarms. Because a major change in beekeeping methods and equipment is taking place, we thought it important to record some facts about them.

We visited 8 apiaries in which traditional beekeeping was undertaken, and one maker of traditional hives. Records were made where possible of hive type, volume, height above ground, wood type, treatment of hive interior, and entrance size and position. The proportion of hives that were occupied by bees varied according to the care given in the apiary, and only general notes on this were made,

Apiary Sites

The 8 apiaries had from 3 to 49 hives, 145 hives were seen altogether. In no apiary did we observe only a single hive. in 2 apiaries the hives were on stands, not suspended from trees.

One beekeeper kept 17 traditional hives (6 occupied) on stands about 1 m above the ground. Trees for suspending hives were available, but this beekeeper did not think it was necessary; he also said it was inconvenient. This same beekeeper had several of the new Kenya top-bar hives, which he considered superior, and he planned to use these exclusively in the future.

A second beekeeper had 49 hives on stands, all but 3 at 1 m. The area was heavily farmed and overgrazed, and no large trees from which hives might be suspended were in the vicinity. The 3 hives at more than 1 m were in small trees at heights up to about 3 m.

In the remaining 6 apiaries the hives were suspended by wire

Fig. 1

Fig. 2

or with the traditional forked stick about 1 m long. Two of the sites were on hillsides so measurement of the height of the hives above ground was not useful. Of 48 hives in 4 apiaries not on hillsides, the height above ground varied from 1.2 to 12 m, measured at the hive's lowest point: the average was 4.7 m. However, beekeepers expressed no preference for a particular height (see below).

Hive exposures is important. Fig 1 is a mango tree (Mangifera indica) with heavy foliage in which suspended hives would be obscured. Fig 2 is a tree with thin foliage, in which hives suspended at any level would be visible. The height of the hives is therefore limited by the trees available and the density of their foliage.

Beekeepers we questioned did not think that the height of hives was important. Hives were placed high in trees to protect them from ants, honey badgers and fire, and to deter robbing by men. Ants can be prevented from entering hives close to the ground by greasing the wires with which they are suspended; apparently ants will not crawl very high into trees to rob hives. Badgers also will not climb trees to rob hives; we notice two modern apiaries of Langstroth hives protected by high woven-wire fences to keep out honey badgers.

Hives and Their Size

The typical traditional hive in the vicinity of Nairobi is made by hollowing out a section of tree trunk with a home made chisel about 2 m long - (Fig 3). Mweria (meru), Pygeum africanum, is preferred for the hive; we were told that the work takes 1 to 3 days. The man shown in Fig. 4 and Fig. 5 said he had made several thousand hives; hive making was his full-time occupation. In one apiary we saw hollowed sisal and palm tree trunks used as hives.

In several apiaries, especially near Nairobi, beekeepers were using wooden boxes and metal and cardboard drums for hives, which varied greatly in volume, but only a few were slightly larger than the largest log hive measured.

Log hives in three locations could be measured with reasonable accuracy: 3 under construction, all 6 in the apiary where the hives were about 1 m above the ground, and the 10 hives nearest the road in the apiary of 49 hives. Only a few of the hives were perfectly round. The maximum and minimum interior diameters were measured for each hive, and the values averaged. The internal measurements of the smallest hive were: diameter 23 cm, length 61 cm, volume 25 litres. For the largest hive: diameter 41 cm, length 107 cm, volume, 138 litres. The average volume for 19 log hives was 73 litres: the largest had a volume 5.5 times as great as the smallest.

The hives with smaller diameters were also shorter (Fig 6). We presume that this is so because of the physical difficulties of hollowing a small-diameter log with hand tools, but it suggests that volume is not a major concern in the minds of beekeepers in the area. Nevertheless, owners of the apiaries studied may well believe that larger hives produce larger crops of honey.

FIG. 3

A hivemaker using his sharp chisel to make a hive.

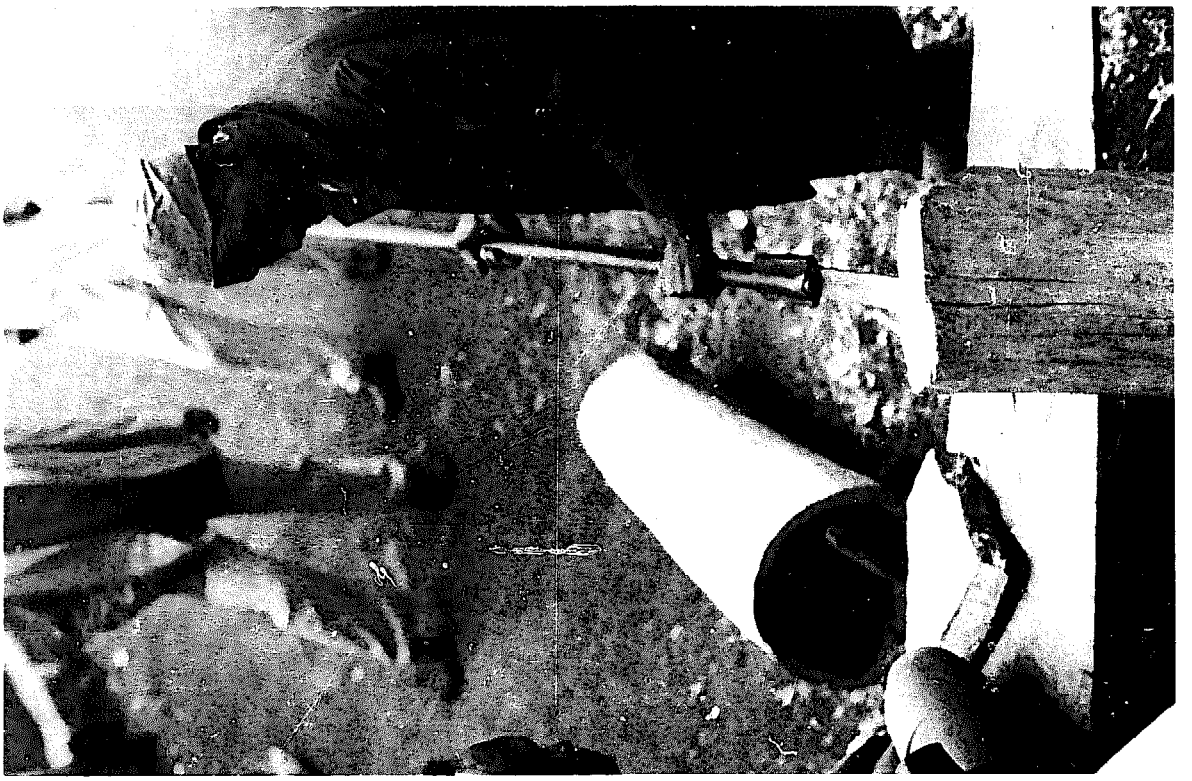


FIG. 4

The hivemaker with two finished hives and one unfinished (centre) Each end of the hive is closed with a wooden plug (left).

The exterior bark had been removed from the hives, and their outer shell was remarkably uniform in thickness (2.2 to 2.8 cm). The inner surface was quite smooth, not unlike wood planed with a hand plane. The single cutting tool we studied was kept sharp.

Many variations were seen in closures over the ends of the hives, and in the number of entrances (this was also true of the hives made from boxes and drums). We were told that different tribes often used different types of hive entrance. However, all hives were closed at the ends, and beekeeper indicated that this was important.

A very small number of log hives were marked with a special brand, burned into the surface, which identified the owner, his clan, and his tribe; the practice appears to be less common now than many years ago.

Beekeepers agreed that used hives were more attractive to swarms than new hives, and that the interior of new hives should be coated with hot beeswax/propolis to make it more attractive. No one mentioned that inserting comb might serve the same purpose, but black hive interiors were preferred.

FIG. 5

Suspension of the hive, using a forked stick attached with two wires

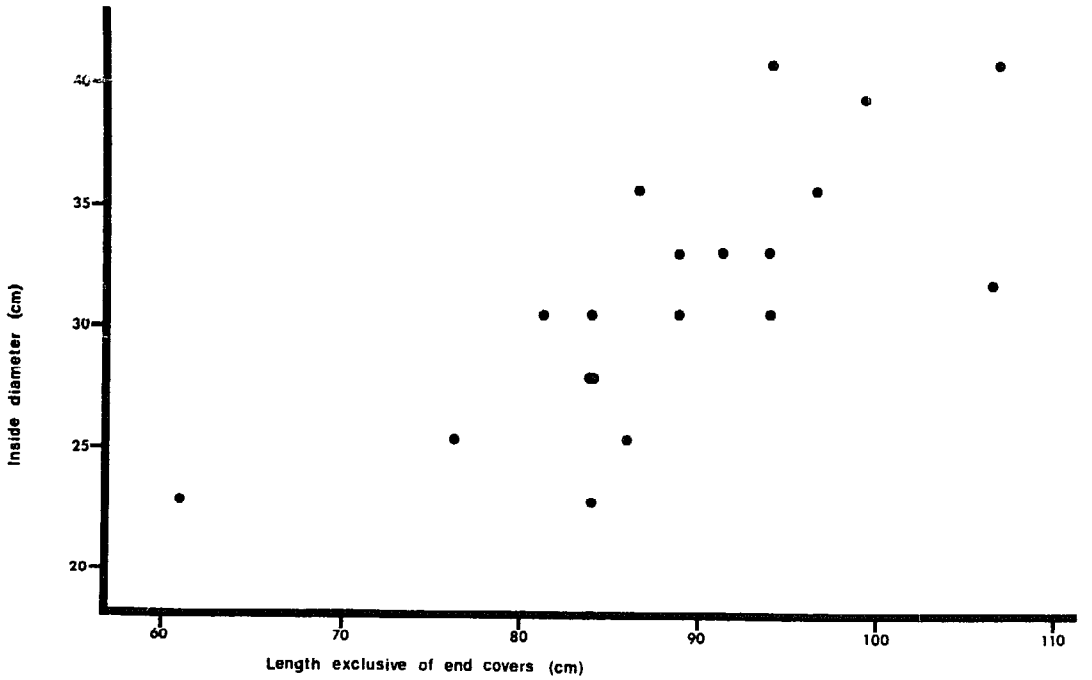


FIG.6

Inside diameter of 19 log hives plotted against their length. The results show that logs of small diameter are made into shorter hives and larger logs into longer hives

KEEPING BEES IN FIXED-COMB AND MOVABLE-COMB FRAMELESS HIVES

by KIREA I. KIGATIIRA
(Officer-in-Charge, Beekeeping Section, National Agricultural Laboratories, Nairobi, Kenya)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 9-13)

Movable Comb Frameless Hive

The invention of the movable-comb hive is the work of the ancient Greeks (Georgantas, 1957). "Anastomo confini", a skep with its mouth above and covered with movable bars, has been in use in Greece from antiquity until the present day.

It is acknowledged to be the fore-runner of the modern hive with movable frames. The Greek beekeeper learned to direct honey comb construction so that he could remove the combs from the hive and replace them as required. Bars are adjusted across the top of the hive to provide attachment and support for the combs. The hives narrow and combs assume this trapezoidal shape as in nature. Such combs are attached only to the top bar and not to the hive body, and therefore can be removed and returned. This hive is, nevertheless, not convenient or sufficient mainly because, since the mouth of the skep is circular, each comb hangs from a bar of different length, hence it has a unique position in the comb system and lacks interchangeability which is an important element in modern beekeeping.

The Tanzania Transitional Hive(Ntenga, 1972) uses bars 2½ inches (62 mm) wide provided with double grooves spaced 1¼ inches (31 mm) apart, or African bee natural comb spacing. This hive is transitional between fixed-comb and movable-comb frameless hives, since the combs are moved in pairs.

In Kenya, a modification of the Greek basket hive with movable, interchangeable bars, which is referred to as the Kenya Top Bar Hive (KTBH),is successfully replacing the traditional log hive with fixed combs (Kigatiira, 1974). The bar is cut from the two angles to meet at the centre, forming a V-shaped starter, which is dipped into melted wax. Combs are built along this wax starter on each bar. Working with this hive it is important to handle the combs carefully, because the attachment is delicate and combs are easily broken. As long as the top bar is held upward or in a vertical position the combs will not break, but it should never be rotated sideways or horizontally, or the weight of the comb will cause it to break away from the top bar. The capped honey comb is removed from the hive, scored with an uncapping fork, and after cutting it from the top bar, is placed in a basket hand extractor and the honey removed.

The "David Hive" (Linder, 1972) is more or less like the KTBH. Full honey combs are carefully removed with the bars, and

after scoring with an uncapping fork are introduced into a wire net where they are firmly held, then placed in a hand extractor and honey removed. Still attached to the bars, the combs are returned to the hive for the bees to refill.

The hive developed by William Bielby (USA, 1972) is a good example of transition between movable-comb frameless and movable-frame hive. It has a brood chamber with a sectional internal contour; the vertical elevation has the shape of a catenary curve which corresponds to the natural shape of the comb of the honeybee. Across the top of this brood chamber are movable combs hanging from standard bars correctly spaced. The hive may have a number of detachable supers designed to accommodate frames of orthodox rectangular shape.

By shifting to movable-comb frameless hives, much better quality honey is obtained than when all types of combs, and bees, are mixed up together. When honey is extracted using basket extractors, instead of the combs being crushed together, the pollen remains with the comb, and a product free from pollen is obtained.

Pros and Cons Of Fixed-Comb Hives

The barrel hives with fixed combs are cheaper than the top-bar hives. Their construction requires simple tools such as traditional chisels. When suspended from a suitable tree, they are protected from overheating, predators, some pests and savanna fires. During harvesting a reasonable quantity of wax is obtained. The shape of the barrel is unique and not very attractive to many people; this reduces theft. The hives are light and are placed in trees which themselves attract the bees.

Coupled with the above, management is difficult in that it is impossible to examine combs in the light and return them to the hive. Climbing trees during manipulation is a great risk to the beekeeper. The quantity of wood required for the construction of a log hive is massive. There are no facilities for controlling bees during the operation, and it is very difficult, though not impossible, to improve or modify operation by the use of modern hive accessories.

Advantages of the Movable-Comb Hive

1. The combs can be removed from the colony for inspection and replaced. This enables the beekeeper to observe the condition of the queen and the health of the colony.

2. Honey combs can be removed from the colony without disturbing the brood nest. No harm is done to the colony, and the bees are left to gather additional honey.

3. Honey quality is improved, since pollen and brood combs are not included with the harvested honey.

4. A fairly high yield of beeswax is maintained, since the honey combs are not returned to the hive, as they are with the frame hive.

5. The hive is simple, easy to construct and relatively cheap, in comparison to the frame hive.

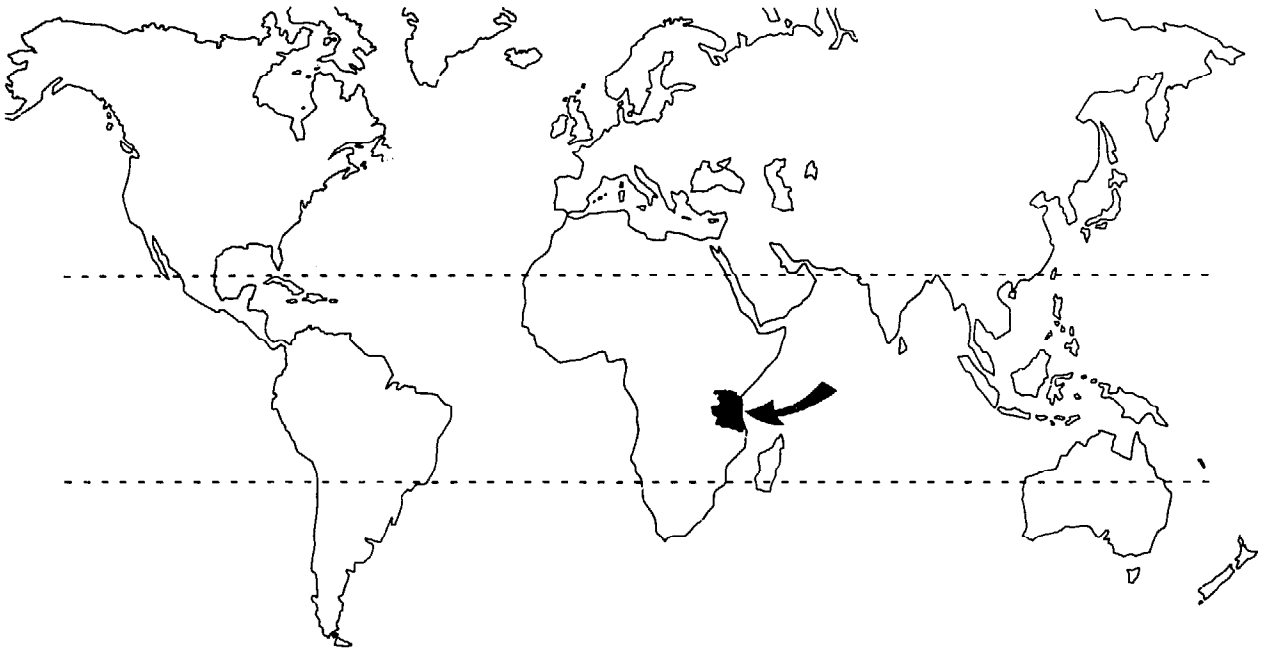
6. If necessary a queen excluder, made of coffee wire with five squares per inch, can be used in the centre of the hive to separate the honey from the brood. The worker bees can pass through this, but the queen cannot.

7. A frame type feeder can be used.

8. The colony can be examined with the least opening necessary, thus affording easy control of the colony with smoke.

Conclusion

It should be realised that modern beekeeping encourages more intelligent management and aims at higher success than can be hoped for by the exclusive use of the straw skep or other fixed-comb hive. Mobility of combs alone is not enough; it must be coupled with interchangeability and support, which are greatly required in modern bee management. Honey production can be a large business if the outside interest and information are adapted in principle by the developing countries.



BEEKEEPING DEVELOPMENT PROGRAMMES IN TANZANIA

by G. NTENGA
(Ministry of Natural Resources and Tourism, Game Division, P O Box 426, Dar-es-Salaam, Tanzania)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 147-154)

BEEKEEPING DEVELOPMENT PROGRAMMES IN TANZANIA

by G. NTENGA
(Ministry of Natural Resources and Tourism, Game Division, P O Box 426, Dar-es-Salaam, Tanzania)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 147-154)

Beekeeping Before Independence

There is little evidence regarding the importance of beeswax as an article of commerce in pre-German times (before 1885), although it is clear that the Portuguese traded in beeswax with people along the East African coast. The trade was improved by the Germans, who found that Tanganyika was an important source of beeswax. In order to upgrade its quality for use in their refining industry, they put much effort into teaching honey hunters and beekeepers how to render beeswax into clean cakes, and this led to the achievement of a high quality product.

The Germans attempted beekeeping to a limited extent, and it is thought that they tried to introduce European bees; Smith (1961) noted that German bee houses are remembered by people in the Kilimanjaro area. Certain improvements in the design of traditional hives were made, and around 1906 Dr. Morstatt of Amani advocated the use of box hives and the preservation of bee colonies when their honey was taken, instead of killing them.

In the days of British administration (1918-1961), interest in improving beeswax production was taken by an Agricultural Entomologist based at Morogoro. According to Harris (1931) extension work was carried out: through encouraging beekeeping in areas where no beeswax was exported, by demonstrating that it had a market value; through improving methods of wax preparation where beeswax was already produced; and through improving hive design in areas of intensive wax production. After wrestling with the problems, it was realized that the scope of the beekeeping industry in Tanganyika was so vast that a full-time appointment was needed. A Beeswax Officer was therefore appointed, "to make a thorough study of African bees and to determine how native beekeeping, wax and honey production can be improved and stimulated" (Smith, 1958). These were the original terms of reference,issued by the British Colonial Office in London, which gave birth to a specialist branch of the Agricultural Department. They were followed by certain other directives, to the effect that all efforts should be made to increase production by using larger hives, and by increasing their number. This was the basis of all beekeeping activities in Tanganyika during the British administration.

Beekeeping Organization After Independence

After independence in 1961 there was a fresh look at the beekeeping industry as a whole, and fresh directives were issued by the Forest Department:

1. To endeavour to change from primitive beekeeping methods to modern methods, by gradually introducing the movable-frame long hive specially designed for African forest conditions.

2. To finalize trials with all types of bee houses, and to publish a report on their usefulness or otherwise to beekeeping in Tanganyika.

3. To organize beekeepers' associations for receiving technical knowledge and for marketing bee produce.

4. To set up apiaries using platform stands, and to find solutions to various problems encountered in this form of beekeeping, with a view to eliminating the hazards of tree beekeeping methods.

5. To finalize queen introduction methods applicable to beekeeping in Tanganyika (Beekeeping Section, 1964).

Further directives redefined the whole beekeeping policy under short-term and long-term projects. Short-term projects were:

1. Modernization of the existing bush and forest beekeeping to the maximum possible, through the use of modern hives.

2. Improvement of methods of collecting and cleaning honey and beeswax.

3. Organization of marketing of honey and beeswax.

Long-term projects were:

1. Research in beekeeping, especially in the field of bee ecology, bee forage and bee breeding.

2. Study of the economics of intensive bee farming (Beekeeping Section, 1967).

Since the decentralization of the nation's administrative structure in 1972, the functions of the Beekeeping Section have been grouped into three major subsections, with the general objective of ensuring effective development and utilization of products of the beekeeping sector, as follows.

1. Planning and Development

This subsection has the following major functions:

(a) Developing long-term and 5-year plans for the sector;

(b) Assisting regions to prepare their annual beekeeping plans, and reviewing them for economic viability, technical feasibility and consistency with the overall sectoral plans;

(c) Providing extension services for the local population involved in beekeeping activities;

(d) Promoting beekeeping in selected regions;

(e) Maintaining up-to-date statistical information on the beekeeping sector.

2. Research and Training

(a) Preparing and ensuring effective implementation of research plans;

(b) Preparing formal and in-service training courses;

(c) Selecting candidates, preparing curricula and providing staff for the training courses;

(d) Liaison with the training section which provides administrative services for the formal training courses.

3. Commercial co-ordination

(a) Assisting co-operative societies (Ujamaa villages) in the collection, storage, distribution and marketing of honey and beeswax;

(b) Carrying out market research on existing and potential markets for honey and beeswax;

(c) Co-ordinating and, initially, actually managing all export activities.

All present beekeeping development activities in Tanzania are now based on the above organization.

Beekeeping Development Potential

Much lies ahead for the scientist and technician for developing the beekeeping industry in Tanzania. Approximately 320,000 km^2 of mainland Tanzania is under forest cover, the greater part being open woodland. This forms the principal habitat of a very prolific and productive race of honeybees, Apis mellifera adansonii. In areas where industrious men have taken up beekeeping, much honey and beeswax is collected annually. The forests and woodlands abound in indigenous species of trees, shrubs and herbs, most of which produce nectar that the honeybees collect and use in producing honey and beeswax. In Tanzania most of the nectar comes from leguminous trees, particularly of the family Caesalpiniaceae; in the miombo woodland areas the most common genera are the Brachystegia and Julbernardia.

In the drier parts the genus Acacia (Mimosaceae) is important, and where numerous herbs and shrubs occur they are good sources of nectar and pollen (Smith 1962). There are still large expanses of forest and woodland which have not yet been exploited for honey and beeswax production.

From recorded statistics, Tanzania at present exports an average of 368 tons of beeswax worth 5.5 million Tanzania shillings ($688,000) and 467 tons of honey worth 2.3 million Tanzania shillings ($288,000). The bulk of the honey is consumed locally, and nearly as much beeswax as the amount exported is thrown away through ignorance and ineffective marketing. It is estimated that production and exports could be increased tenfold if all the forests and woodlands were sufficiently and properly exploited.

TANZANIA: Map showing named localities.

Making a pegged-bark hive in Tanzania.

A report entitled "Tanzania beeswax" (Ntenga, 1976) identifies the major honey and beeswax producing districts.

The Present Programme

1. Market Development

This is considered to be of the highest priority, in order to provide channels for the existing bee produce. At present two centres offer adequate marketing facilities accessible to producers. One, belonging to the Tabora Beekeepers Co-operative Society, has been operating for over fifteen years, and at present caters for 3150 beekeepers. The second, at Handeni, has recently been developed with the aid of the West German Government, and has a similar capacity for producers in Tanga, Kilimanjaro, Arusha, Morogoro and Dodoma Regions.

The establishment of such centres, fully equipped with collecting and processing machinery, and a discriminatory system whereby high quality products receive attractive prices, and low quality ones fetch low prices or are rejected, helps to stimulate production of crops of the desired quality. Prompt payment for the products is a vital aspect, which serves to encourage greater production.

During the next five years one other centre is planned, to be established in the south to cater for the honey and beeswax producers in Lindi, Mtwara and Ruvuma Regions, including parts of Rufiji district of Coast Region. It is envisaged that the need will arise for the establishment of smaller units, particularly for producers in Kigoma and West Lake Regions. It is important, however, that before such centres are established feasibility studies should be carried out, with simple straining equipment located in selected areas. Heather honey presses loaned to or purchased by producers have proved to be of tremendous value. Ujamaa villages or corporations could initiate these efforts.

It is of paramount importance in this respect to win the beekeepers' co-operation. Without this, the products could be either adulterated or not properly rendered, and the whole venture might even collapse. This happened to the Nyamwezi Development Corporation in the early days of market development for honey and beeswax in Kahama District (Ntenga, 1976). Efforts should be made to teach the beekeepers how to prepare their produce for the market, and properly applied legal steps could help to attain the desired quality standard.

2. Improvement of Bee-Keeping Methods

Improved beekeeping stems from the use of beehives from which the crop can be collected without destroying the colony. In the early days of beekeeping development, the pattern of the "Sudan" hive was adopted, and modified for use in Tanganyika. The most important appliance was a queen excluder: there is no record of the successful use of a queen excluder in traditional hives.

With the founding of a Beekeeping Division of the Agricultural Department in 1949, modern frame hives made their appearance, first the Langstroth and then the Modified Dadant. A number of difficulties were experienced in the use of these hives, more especially due to the characteristics of the adansonii

bees. Anomalies associated with their natural comb spacing (compared with that of European races) led Smith (1961) to make certain modifications to the Dadant frame, eventually developing the African Dadant hive.

Subsequently Hubbert (1964) introduced a two-chamber African long hive, and the author developed the African Dadant hive (Ntenga, 1968), and also the transitional hive and the Tanzania Commercial hive (Ntenga, 1972). These latest versions have been modified into the more workable patterns that are currently in use in all experimental and production apiaries.

The use of simple hives will continue for many years. Suitable materials for making them have to be found without continuing the practice of debarking live trees. The advantages of simple hive - in terms of time, labour and money - make it difficult to change the ways of the traditional beekeepers. Efforts ought therefore to be made to teach them how to collect crops from simple hives without destroying the bees.

3. Centres of Various Types

Demonstration centres established in selected areas can greatly aid the extension efforts. Success is being achieved in the demonstration centres developed in Handeni District, Tanga Region. Beekeepers are brought to these centres for two months of practical training, and return to their home villages to look after village apiaries. Each demonstration centre has 300 hives. The development of modern beekeeping depends on effective beekeeping staff. So, in addition to maintaining demonstration centres, each beekeeping employee is required to build up and maintain a modern productive apiary.

Chandler (1975) has set a good example by studying in detail the traditional methods of beekeeping among the Wameru in Arusha Region. Such studies are needed in other areas, for they throw light on problems hitherto unnoticed, and make it easier to decide on the best line of approach in developing beekeeping in a given area.

As well as the above, it is vitally important to set up hive-manufacturing workshops, looked after by well trained beekeeping officers. This ensures that the equipment is accurately made, and up to the standards set. There are at present three workshops: at Tabora Training Centre, Forest Training Institute in Olmotonyi, and Handeni. Two others are under construction: one is at Arusha, Themi estate (beside the Research Laboratory), and one at Kondoa.

It is planned during the next five years to set up a wax foundation mill in one of the richest wax-producing districts. This mill is likely to be widely useful, in view of the beekeeping development programmes in several other African countries.

4. Development of State Bee Farms

The main purpose of setting up a state bee farm is to provide a working example of a modern farm where prospective bee farmers can obtain training and practical experience in commercial honey and beeswax production. The farm is also expected to provide package bees and nuclei, making available bees for

stocking new hives. Breeder stocks for the queen rearing unit can be selected from the bee farm: much can be learned about colony development from colony inspection records, and also about the phenology and intensity of nectar flows.

Although suitable locations for the apiaries for the farm should be carefully selected, they are not difficult to come by in Tanzania. There is adequate knowledge regarding plants that are important nectar yielders,and these are present in all vegetation belts. In areas where for some reasons static beekeeping cannot pay, migratory beekeeping can profitably be practised.

During the next five years it is planned to establish three bee farms,one every other year. Their proposed locations may be changed, since the Beekeeping Section is now transferred from the Forest Division to the Game Division, in which areas will become available for rational beekeeping that have hitherto been completely protected from human interference; the beekeeping will be done without disturbing the protected wildlife.

5. Bee breeding and Behaviour

For a bee-breeding project to be successful, it should be under the guidance of a competent geneticist. There is at present no provision for a bee geneticist in Tanzania, so initial efforts are directed towards establishing a queen-rearing unit which will guide all the small queen-rearing units attached to state and village bee farms.

To ensure success in this project, a number of "holding grounds" will be established in areas known to be inhabited by relatively docile strains of bees. Gentle behaviour is generally associated with cool regions. The northern zone and the southern highlands zone have this reputation, including West Lake Region and the Mwesi highlands of Mpanda District. The central queen-rearing unit at Arusha will obtain queens from these areas, and carry out the necessary selection and rearing.

6. Bee Botany and Pollination

Smith (1960) carried out an extensive study of plants of importance to bees, and factors which influence nectar secretion. The optimum stocking of apiaries in specific vegetation areas - in woodlands, upland grasslands, wooded grasslands, bushlands and thickets, and upland and lowland forests - urgently needs to be determined.

Pollination experiments of some significance were carried out in 1956 on pyrethrum. Recently Chandler and Mdemu (1975) have studied pollination of lucerne by adansonii bees. Pollination experiments on coffee have not been finalized. Most reports on pollination by bees in Tanzania have been based on observations and experience.

7. Stingless Bees

In Tanzania there is scope for developing apiculture with stingless bees for the production of honey and pollen. According to Chandler (1975) there are probably ten species of Meliponini in Tanzania, of which one Trigona species is particularly important, because it has been exploited for honey and wax by traditional methods for many years.

The development of a modern hive for Trigona togoenis could open a new field of enterprise in Tanzania. Further studies on the biology and management of this bee are needed.

8. Training

The need for recognised standards in the training of staff has been realized since 1958 when liaison was established with the British beekeeping examination institutions. Earlier, beekeeping extension staff were given basic training in simple beekeeping as outlined in a Beekeeping Division Pamphlet (Smith, 1955).

A much wider knowledge was needed for the beekeeping instructors. These were given training in frame-hive beekeeping on the lines of the British Beekeepers' Association system. An eight-week Beemaster course was thus established in 1958 to meet this requirement. Candidates who qualified for the Beemaster Certificate were required to work for two years in the field to gain practical experience, before they were given another training leading to a higher qualification, the Expert Beemaster Certificate, later known as the Senior Beemaster Certificate. This qualification was similar in standard to the Senior Certificate of the British Beekeepers' Association and the Expert Beemaster Certificate of the Scottish Beekeepers' Association, and was recognized by the Examination Board for the National Diploma in Beekeeping. The National Diploma in Beekeeping is generally the highest qualification and is similar in standard to the National Diploma in Agriculture and related diplomas; it is required for all senior appointments of beekeeping staff in Tanzania.

In Tanzania today two institutes provide training for beekeeping staff to the standard of the National Diploma in Beekeeping of the UK. The Tabora Beekeeping Training Institute provides basic training to Beemaster level, and also makes provision for short courses for beekeepers in various parts of the country. Higher training is given at the Forest Training Institute at Olmotonyi, Arusha, and provision is made there for candidates from other African countries.

Overseas training is also arranged, and Canada is particularly active in providing special training in apiculture. Nine officers have been trained there, and one in the German Federal Republic.

9. Statistics

Good planning for beekeeping development depends much on information already available, on the annual production of bee produce, numbers of hives, apiaries, beekeepers, and number and location of good beekeeping areas. One project within the beekeeping development programme is the establishment of a records system to make essential information available for planning and management.

10. Ujamaa Beekeeping

Since the development of Ujamaa (self-help) villages in the late 1960's, efforts have been continued to establish collective bee farms of a size that the villagers themselves will be able to manage. Under the special fund for regional development, more than 12,000 modern hives have been distributed to cover 450 villages, commonly 10 to 50 per village. Protective clothing, smokers and honey presses have been given to some villages. In areas where response is very good, the villagers are encou-

raged to contribute traditional hives. The excellent response in Kondoa District deserves special mention.

11. School Beekeeping

Special effort is directed towards developing school apiaries, to teach pupils how to keep bees, and to show them that beekeeping is a profitable undertaking as well as an interesting hobby. Beekeeping is one of the activities in the national campaign for agricultural development in secondary schools. Catholic Relief Services have carried out a survey on possibilities of promoting beekeeping in primary schools. Some schools already keep bees.

12. Publicity

Articles are regularly published in local papers. Material for the radio is usually broadcast in the general Maliasili (Natural Resources) programme. Film shows are given in special cinema vans in rural areas throughout the country.

Foreign Involvement

In July 1973 the Canadian International Development Agency launched a three-year assistance programme for developing the beekeeping industry in Tanzania. One of the major projects tackled was upgrading the training courses at Olmotonyi. Success is evident from the quality of the officers who have since graduated there. A national beekeeping research centre has been developed at Themi Estate,Arusha. Two cinema vans have been provided for extension work throughout the country. The CIDA assistance provided personnel and training at a stage of rapid beekeeping development in Tanzania.

The German Federal Republic is fully involved in the development of a honey processing and packing plant at Handeni, under the Tanga Integrated Rural Development Programme. The centre is now fully functional, and 18 tons of honey were handled in 1976 from Handeni and the neighbourhood. Three demonstration centres have been established, each with staff quarters, classroom and store, and 300 colonies. This project is fully financed by the Government of the German Federal Republic.

Conclusion

There is wide scope for developing the beekeeping industry in Tanzania. The beekeeping development programme itself is extensive, and inevitably encounters problems that must be overcome if the programme is to be successful; problems associated with man and his traditions, and problems associated with the honeybee (and its enemies) which require a scientific approach. When conditions are adverse beekeeping can become disappointing and unattractive. In order to accomplish what is needed, the whole beekeeping development programme in Tanzania requires substantial financial support, to provide access tracks, hives, buildings, machinery and manpower.

References

Beekeeping Section, Tanzania (1964) Annual Report

..... (1967) Annual Report.

Chandler, M.T. (1975). Traditional beekeeping among Wameru people of northern Tanzania (Appendix I to Termination Report submitted to CIDA) Olmotonyi Forest Training Institute

..... (1975) Meliponiculture in Tanzania (Appendix II to Termination Report submitted to CIDA) Olmotonyi Forest Training Institute.

Chandler, M.T. & Mdemu, E (1975) Pollination research in East Africa - problems and promises. Proc III Symp. Pollination: 57-62

Harris, W.V. (1931) Native beekeeping in Tanganyika. Trop. Agric. 9 (8): 231-235

Hubbert, S.W.G. (1964) A realistic approach to beekeeping in Africa. Esso on the Land 1 (6): 8-13

Ntenga, G. (1968) The honey bee of Tanzania. Am. Bee J. 108 (1): 10-12

..... (1972) Hive development in Tanzania. Am.Bee J. 112 (1): 20-21

..... (1976) Tanzania beeswax. Dar-es-Salaam: Game Division, unpublished report

Smith, F.G. (1955) A course of twelve lectures on beekeeping Tanganyika Bee Div. Pamphl.No.2

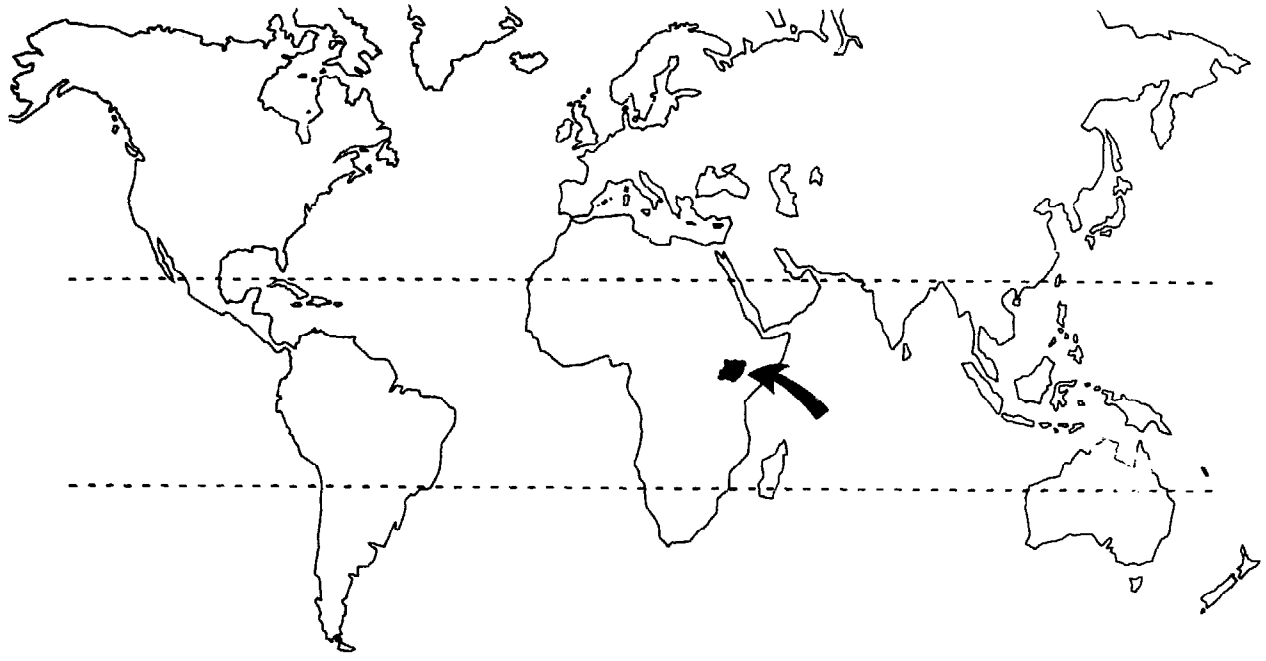
..... (1958) The origin and functions of the Beekeeping Division. Empire Forestry Review 37(92):159-164

..... (1960) Beekeeping in the tropics. London: Longmans and Green

..... (1961) The development of the beekeeping industry in Tanganyika. Arusha:Beekeeping Section, unpublished report.

..... (1961) The African Dadant hive. Bee Div. Pamphl. No.4.

..... (1962) Beekeeping as a forest industry (British Commonwealth Conference). Dar-es-Salaam: Forest Department



THE PRESENT DEVELOPMENT OF BEEKEEPING IN UGANDA

by E.C.B. NSUBUGA-NVULE

(Summarized from an unpublished report).

THE PRESENT DEVELOPMENT OF BEEKEEPING IN UGANDA

by E.C.B. NSUBUGA-NVULE
(Summarized from an unpublished report).

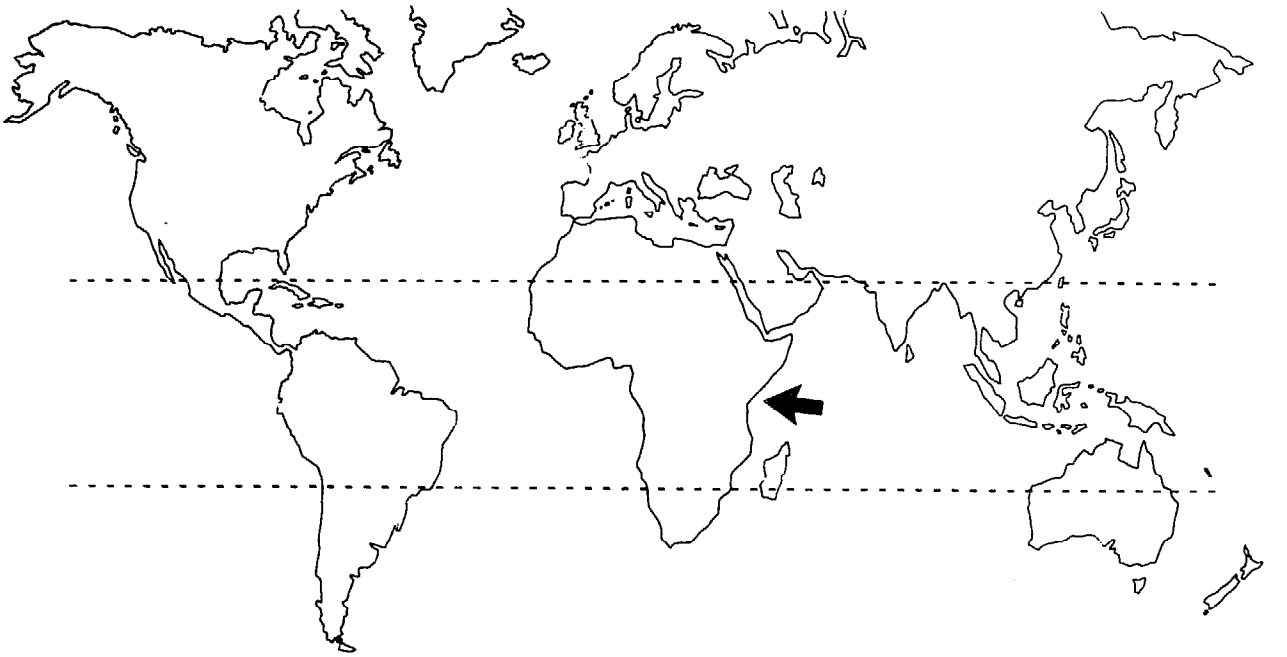
The physical features of Uganda bear some similarity to those of her neighbours Tanzania and Kenya, and the natural vegetation of the country likewise provides forage for bees.

In 1969 Professor G.F. Townsend from Canada visited Uganda and proposed an action programme that could be adopted with a view to modernizing beekeeping in Uganda. The programme was based on training staff in neighbouring Tanzania, introducing improved hives, and establishing honey collection centres. Some of the senior officers went to Canada for further beekeeping studies.

Uganda's aim is to become self-sufficient in both honey and beeswax. To date 30,000 improved Johnson box hives have been distributed and are in use, and an extension and training programme is in operation. Some local demonstration centres have been established which are in the charge of the extension programme. In order to try to stimulate honey production a limited amount of planting of good nectar producers has been carried out where the largest hive concentrations occur.

Both honey and beeswax are processed at the local collecting centres. The bulk honey is bottled at a food-packaging company for local sale. Beeswax is used in tanneries for treating hides and skins, in sugar works and other industrial processing, and the rest is exported.

The Johnson box hive, developed by the Beekeeping Section, is based on a hive introduced by Mr. E. Johnson in the 1950s at a demonstration farm in Teso, Western Uganda. A horizontal rectangular box, which can be opened by removing either end, is divided centrally to provide two compartments which are baited with beeswax to attract swarms. Before harvesting the honey the beekeeper lifts the hive, and takes honey from the heavier end.



HONEY PROCESSING AND COLLECTING CENTRES IN EAST AFRICA

by G.F. TOWNSEND
(Department of Enviromental Biology, University of Guelph, Ontario, Canada)

(Extract form "Honey Processing and Collection Centres - East Africa" in "Apiculture in Tropical Climates", IBRA, London, 1976 Pages 135-142)

HONEY PROCESSING AND COLLECTING CENTRES IN EAST AFRICA

by G.F. TOWNSEND
(Department of Enviromental Biology, University of Guelph, Ontario, Canada)

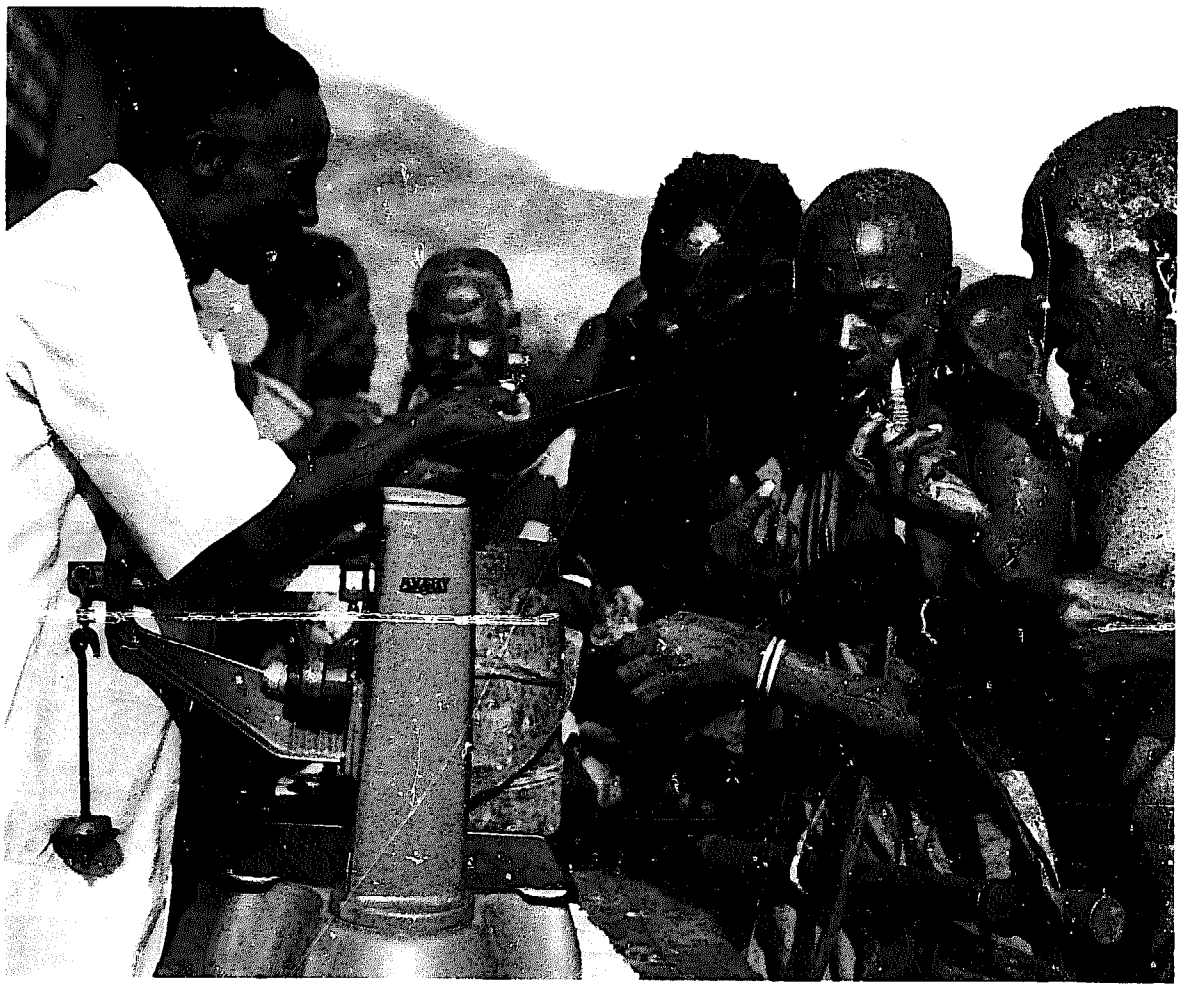
(Extract from "Honey Processing and Collection Centres - East Africa" in "Apiculture in Tropical Climates", IBRA, London, 1976, Pages 135-142)

The bee hives commonly used by traditional beekeepers in Central Africa consist of one chamber, which makes it necessary for the bees to keep the brood, pollen and honey together. Whenever honey is taken out of this type of hive, the honey, wax, pollen, brood and propolis are removed in one mass. The mixture of all these elements together makes it almost impossible to obtain a pure, marketable product. Often, in order to separate the honey from the wax, the whole mixture is heated over an open fire, with consequent burning and smoking. As a result, although East Africa produces thousands of tons of honey every year, the honey is usually badly prepared and unattractive in appearance. Because of this, its place in the local market is taken by imported honeys. If African honey could be properly prepared and distributed, there is no doubt that a ready, local market would be available.

Africans are keen beekeepers, and there are many localities where beekeeping has been firmly established for a very long time. Although the East African honey is of good quality as long as it is in the hive, faulty handling from the time of its removal until it is put on the market is responsible for the inferior quality. The type of hive used, as well as the method of removing the honey, is responsible for this loss. From the information available, the same situation also occurs throughout most of central Africa and in many of the tropical areas of Asia. The major improvement in this whole situation could very well centre around the installation of honey collection centres, provided with well trained extension personnel.

The history of honey collection centres established in East Africa has not been a successful one, except for a few instances. They seem to thrive for a few years and then disappear. The main requisite for success seems to be a strong, central marketing organization, or a government section responsible for the overseeing of apiculture developments within the country. In this way, the organization can be assisted over its rough spots, and necessary supervision of the technical operations provided. The ideal organization would appear to be a central processing and packing plant supported by satellite collection centres in the main areas of production, backed up by a government extension service of well trained personnel.

There are several main requisites for the success of a collection centre. The overall scheme must be in a position to purchase honey over the short period of the season, and sell it



Honey gatherers bringing their honey to a collection centre in Kenya.

over a longer period. It is important that the beekeeper be paid in cash for his product when he brings it to the centre. In order to encourage production of a better quality honey, there should be a price differential according to the grade of the honey. This will encourage the beekeeper to improve his production methods, and possibly to change to a different type of hive which is more adaptable to producing quality honey. Associated with the honey collection centre should be a demonstration beeyard operated by one of the government extension personnel, who would also be available to provide some of the technical assistance needed at the collection centre. The collection centre itself is best organized as a co-operative of those who are bringing honey to it. Eventually the central marketing organization, to which the surplus honey from the collection centre would be taken, could also be operated as a co-operative, made up of representatives from the collection centres involved. Organizations of this nature would, in many cases, be in a position to borrow money so that they can carry on cash transactions for the honey and wax supplied. In all collection centres, provision should also be made for handling beeswax, and this should be encouraged as a major beekeeping commodity, particularly in Africa.

A honey collection centre could vary, according to requirements, from a simple bee-tight building where honey is purchased on a graded basis and picked up for taking to the central refinery, to a small building equipped with minor straining facilities and provision for the first refining of the beeswax. No matter for what purpose, the site is important. It should be convenient to the area of production, adjacent to or on an all-weather road; it should have an abundant supply of water, and it should be placed on well drained ground. The plant should be built of brick or stone, and roofed with galvanized iron or similar material. It should be ant-, bee-, and vermin-proof. It should be well ventilated, and it should be provided with rain water tanks, because rain water is the best for refining beeswax.

Since honey is not as perishable as milk, supplies brought to the centre can wait several days before being refined or shipped to the central packing plant. In most cases, the honey collection centre will require a means of separating honey from wax or pressing honey from comb, as well as equipment to refine the beeswax partially, into moulds. If the moisture content of the honey is high, heating equipment will be required, both to strain the honey and to raise its temperature sufficiently to destroy yeasts which may cause fermentation. This is particularly true in areas of high humidity. The minimal equipment would be: a good type of platform scales; collecting tanks (preferably made of stainless steel, but galvanized if stainless steel is not available); some type of a strainer, possibly the smaller type of the cylindrical OAC strainers; possibly a honey press; some means of heating and circulating hot water; hot-water drums for melting wax; and enamelled small basins for moulding the beeswax. If the collection centre is to provide a local market with honey, then some provision should be made for the filling of bottles. A bee-proof, ant-proof locked storage for both wax and honey, prior to shipping or collection should also be provided.

The central packing plant should be located somewhere near the major market for honey; it should be much larger, and with more equipment for the handling of honey. It should have more elaborate heating and cooling facilities, as well as settling and straining equipment. This phase of the programme could be operated in many ways; it could be operated as a co-operative associated with the honey collection centres; it could be operated privately or through one of the mission-oriented organizations. For financing, possibly the best approach is through the central co-operative which would make available certain amounts of money for each collection centre to make their purchases. The central organization could also have associated with it the manufacturing of beekeepers' supplies, so that these could be taken out to the collection centres for sale when the trucks are going out to fetch honey.

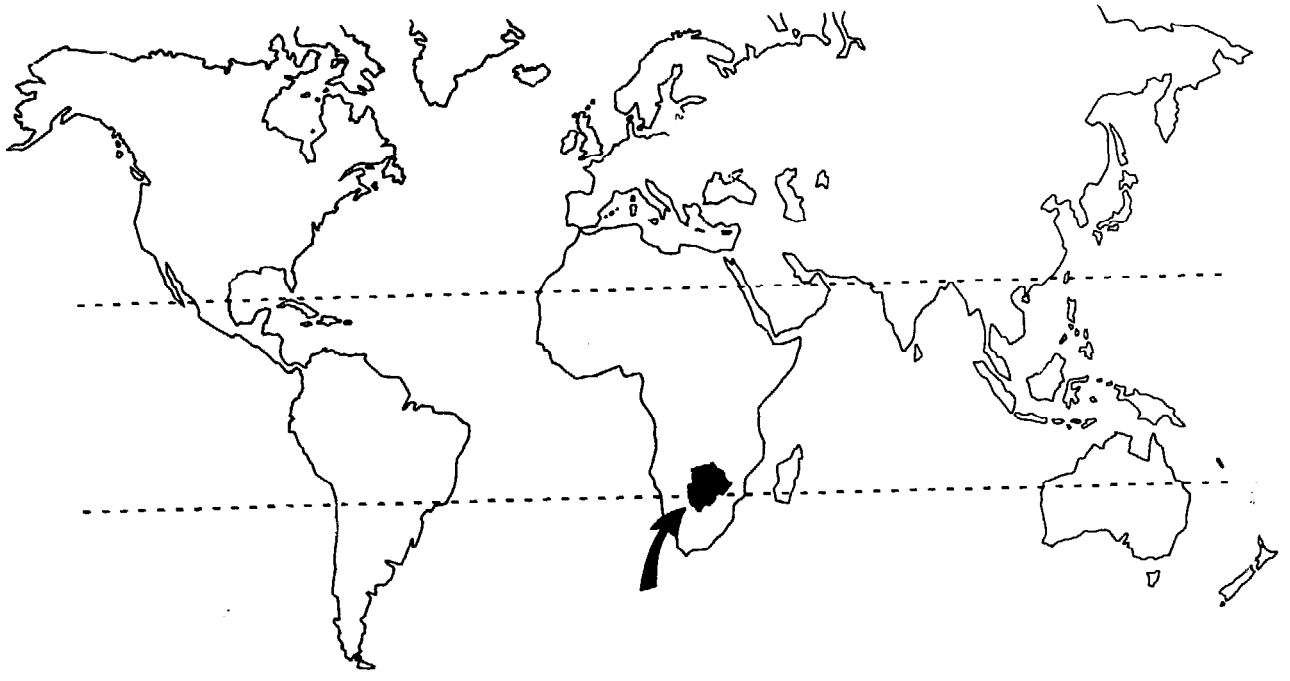
No matter how it is organized, the first requisite for the development of beekeeping in an area is the establishment of honey collecting centres where the beekeeper may bring his product and be paid cash for it. The collection centre must be organized in such a way that it can buy the honey on a graded basis, re-process it, and possibly pack it for a local market. In this way, in most cases, the return to the beekeeper can be materially increased, and the whole industry will thrive much better.

References

Crane, E. (ed.) (1975) Honey: a comprehensive survey. London: Heinemann & International Bee Research Association.

Dadant & Sons (1975) The hive and the honey bee. Hamilton, III.: Dadant & Sons.

Townsend,G.F. (1975) Preparation of honey for market. Ontario, Canada Ministy of Agriculture and Food Publication No. 544.



BOTSWANA - NOTES ON THE FIRST STAGES OF A PROJECT

ed. Tony Moody - in correspondence with Mr.E.A. Kilon, Apicultural Project, Kweneng Rural Development Association (Brigade) Molepolole.

BOTSWANA - NOTES ON THE FIRST STAGES OF A PROJECT

ed. Tony Moody - in correspondence with Mr. E.A. Kilon, Apicultural Project, Kweneng Rural Development Association (Brigade) Molepolole.

In 1977, International Voluntary Services Inc., (Washington) provided the Kweneng Rural Development Association at Molepolole, Botswana with a Tanzanian apiculturalist to initiate a production and training bee-keeping project with this important Brigade.

The Brigade Movement in Botswana began in 1965 in Serowe. Despite the names, the Brigade had never had any involvement with military or para-military activity. They are in fact named after a similar movement "the Workers Brigades" of Ghana, which were instituted to employ young men and women in productive activities. The concept of a"Brigade Centre", as used in Botswana, refers to a cluster of brigades (e.g. builders, carpenters, auto-mechanics, farmers etc.,) organized under a single local governing authority in a single locality. The movement has evolved and changed considerably in the last decade.

The Movement was founded by Patrick van Rensburg, then Principal of Swaneng Hill Secondary School. Mr. van Rensburg and his staff members were beginning to think that the kind of academic school they were creating would not touch many of the new country's problems. Botswana lacked her own bricklayers, carpenters and other tradesmen. More secondary schools were being built, but primary education was also expanding and nothing was being done for the large and growing numbers of children who were squeezed out of the educational system after Standard VII. But if some sort of training scheme could be devised which would meet these needs by blending them together, it would have to be very cheap to run; if possible it should cover its costs. A further factor was the building of Swaneng Hill School itself. The use of trainee builders was likely to be cheaper than a contractor.

The Serowe Builders Brigade started operations in March, 1965. Two years later a carpentry section opened. By this time the brigade idea has aroused interest, and in April the Department of Community Development started a builders' brigade at Lobatse; through the Department, Government was thus involved in brigades from an early date. Research at Serowe had meanwhile developed further, resulting in the launching of the Serowe Textile Workshop for girls, and the Serowe Farmers Brigade. By the end of 1967 two new types of brigade had started, a leathercraft workshop at Mochudi, and a handicraft project specialising in sisal work at Lobatse.

January 1968 saw the opening in Francistown of a new builders brigade, again under the Community Development Department. But for a variety of reasons it became increasingly difficult to keep this brigade going and in October it closed. Only three other brigades started in that year - a builder's brigade at Mochudi, another on the site of the new Shashe River School and a second farmer's brigade at Mochudi. So by the end of the year there were some nine brigades in existence under the control of three organisations: Swaneng, the Community Development Department, and the Kgatleng Youth Development Association (Mochudi) .

Kweneng Rural Development Association

This brigade centre is located 60 km west of Gaborone in Molepolole. It originally started in 1969 as a discussion group investigating possibilities in rural development. In 1971, the association was formally registered at a trust operated by people elected at public meetings.

K.R.D.A. has a Builders' Brigade with 40 trainees which emphasises training rather than production. The Boishoko centre can be considered a Textile brigade where training in dressmaking and crafts is given. Completers of this training may enter the Thusanyo workshop. Here garments, mainly primary school uniforms, are produced on a co-operative basis.

The Boikanyo mechanical and engineering programme has recently started with the aims of training mechanics for employment, maintenance of local machinery and vehicles, and light engineering work.

Other activities include an active forestry programme, a builders supply outlet, and the construction of a hotel using local materials and furnishings.

The Association has many plans for the future: a bicycle assembly plant, horticultural projects, a dairy farm, and an inclusive farm supply and service centre.

The Apicultural Project

Since his arrival at Molepolole, Mr. Ephraim Kilon has launched the pilot apicultural project at Kweneng. He reports that there is little traditional beekeeping in Botswana but that Apis mellifera adansonii is present, although its activities are somewhat restricted in the higher latitudes of Botswana by the marked winter season. There is a period of dearth, and the bees are confined to their hives, between mid-April and mid-August.

This, however, makes them relatively hardworking during the subsequent period of colony development, expecially on the first flowers of the pepper tree (Schinu molle) and the Eucalyptus camadulensis which flower first in the spring.

The honey flow season in Botswana appears to be between October and March.

Fifteen modified Langstroth hives and 5 Top Bar hives have been built in the Brigade workshops with pine-wood and weather-proof chip-board. Two other Standard Langstroth hives have been imported.

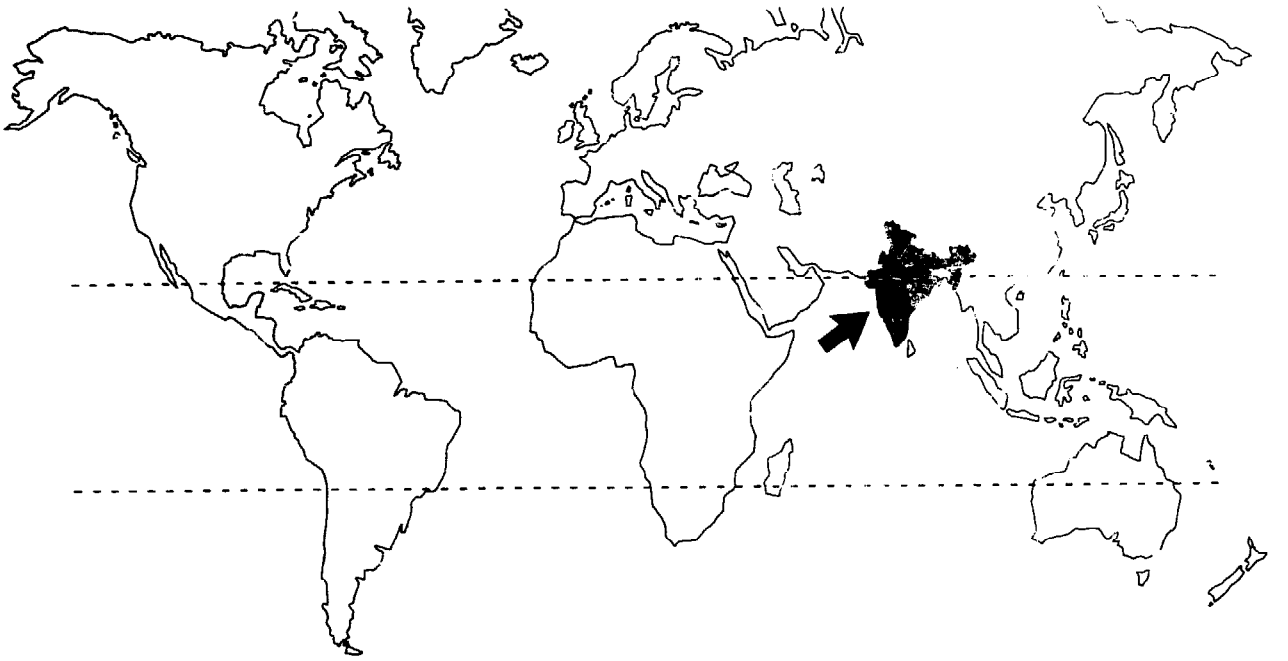
Ten of the hives are situation in a Eucalyptus plantation and 6 of them are occupied by bees which have been collected either from nests in trees or in termite mounds. Not a single hive has been occupied by passing swarms, as Mr. Kilon has experienced in Tanzania.

Beekeeping has entered the syllabus of Kweneng Brigade and three Batswana have been sent for higher technical training in Tanzania.

References

Government of Botswana "Botswana's Brigades", Government Printer, Gaborone, 1976.

Correspondence with Mr. E. Kilon.



THE BEEKEEPING DEVELOPMENT AND RESEARCH PROGRAMME OF THE KHADI AND VILLAGE INDUSTRIES COMMISSION, INDIA

by C.V. THAKAR
(Director, Beekeeping Industry Khadi and Village Industries Commission, Bombay, India)

(From "Apiculture in Tropical Climates", IBRA, London 1976
Pages 125-134

THE BEEKEEPING DEVELOPMENT AND RESEARCH PROGRAMME OF THE KHADI AND VILLAGE INDUSTRIES COMMISSION, INDIA

by C.V. THAKAR
(Director, Beekeeping Industry Khadi and Village Industries Commission, Bombay, India)

(From "Apiculture in Tropical Climates", IBRA, London 1976 Pages 125-134

Development Programme

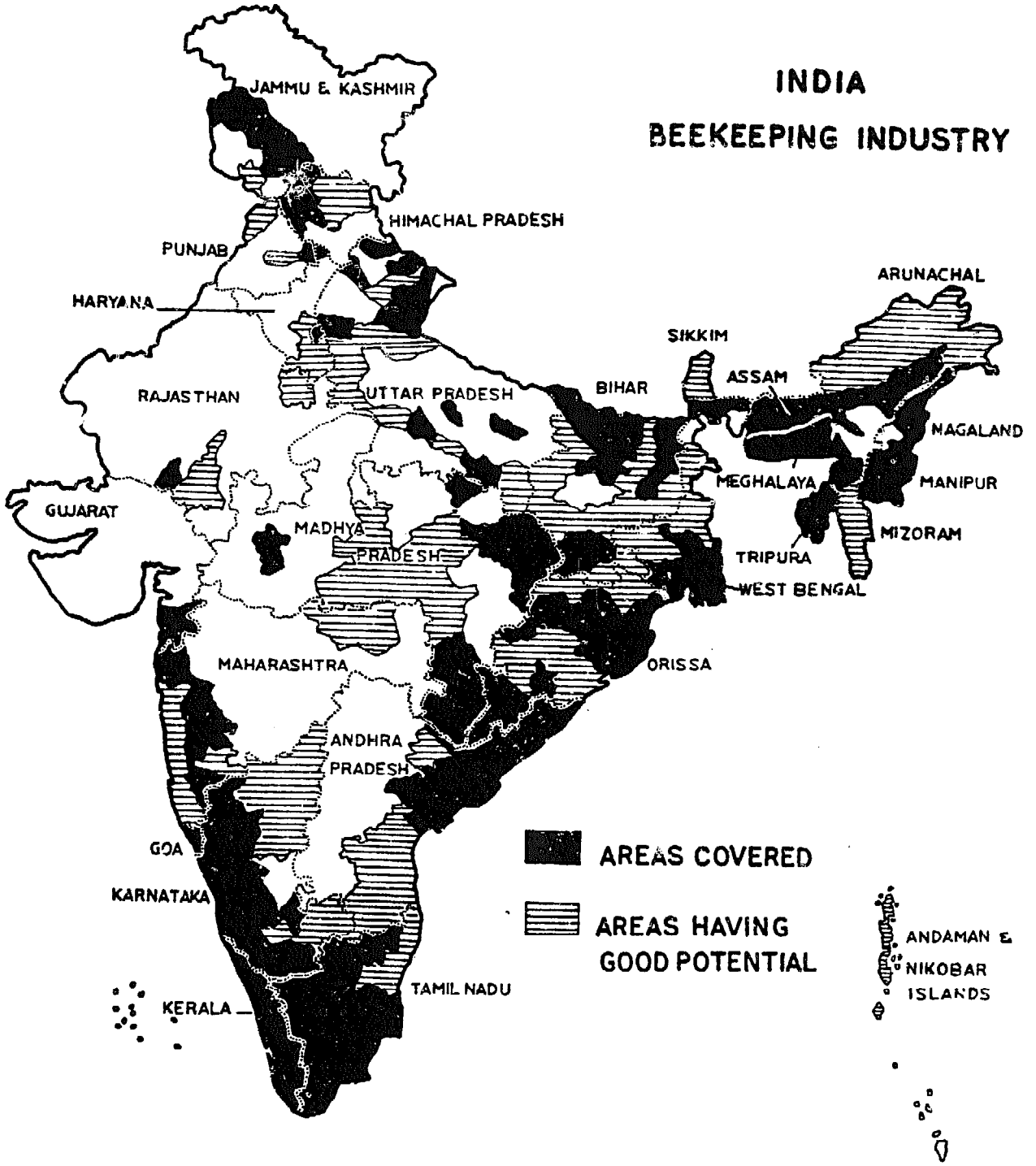
Introduction

Beekeeping is not a traditional industry in India. However, collection of honey from wild bee colonies has been practised since time immemorial. Large quantities of honey collected by crude methods had a big market, as an article of food and as medicine. Efforts to introduce modern hives with Apis mellifera have been made since the 1880s. It was around 1910 that Rev. Father Newton for the first time designed a smaller hive, suitable for the indigenous Apis cerana indica in the extreme south. But as an industry beekeeping did not develop until the 1940s when Dr. Spencer Hatch in the southern-most coastal strip of India, Swami Shambhavananda in the district of Coorg in Karnataka, Shri S.K. Kallapur and Shri S.G. Shende in the Western Peninsula, and Shri R.N. Muttoo in the central Himalayan foothills, initiated efforts to popularize it among the rural population. Agricultural departments in some states also attempted to extend this industry to rural areas. Mahatma Gandhi, the Father of our Nation, included beekeeping in his rural development programme, and several persons with missionary zeal were trained in his Ashram for popularizing beekeeping in villages. All these attempts, however, had serious limitations. It was only after the formation of an All-India Khadi and Village Industries Board in 1953, which later was constituted as the Khadi and Village Industries Commission, that the beekeeping industry received serious attention for its development in a co-ordinated manner throughout the country. The establishment of the Khadi and Village Industries Commission is really the culmination of the rural re-construction programme envisaged by Mahatma Gandhi during the pre-independence era.

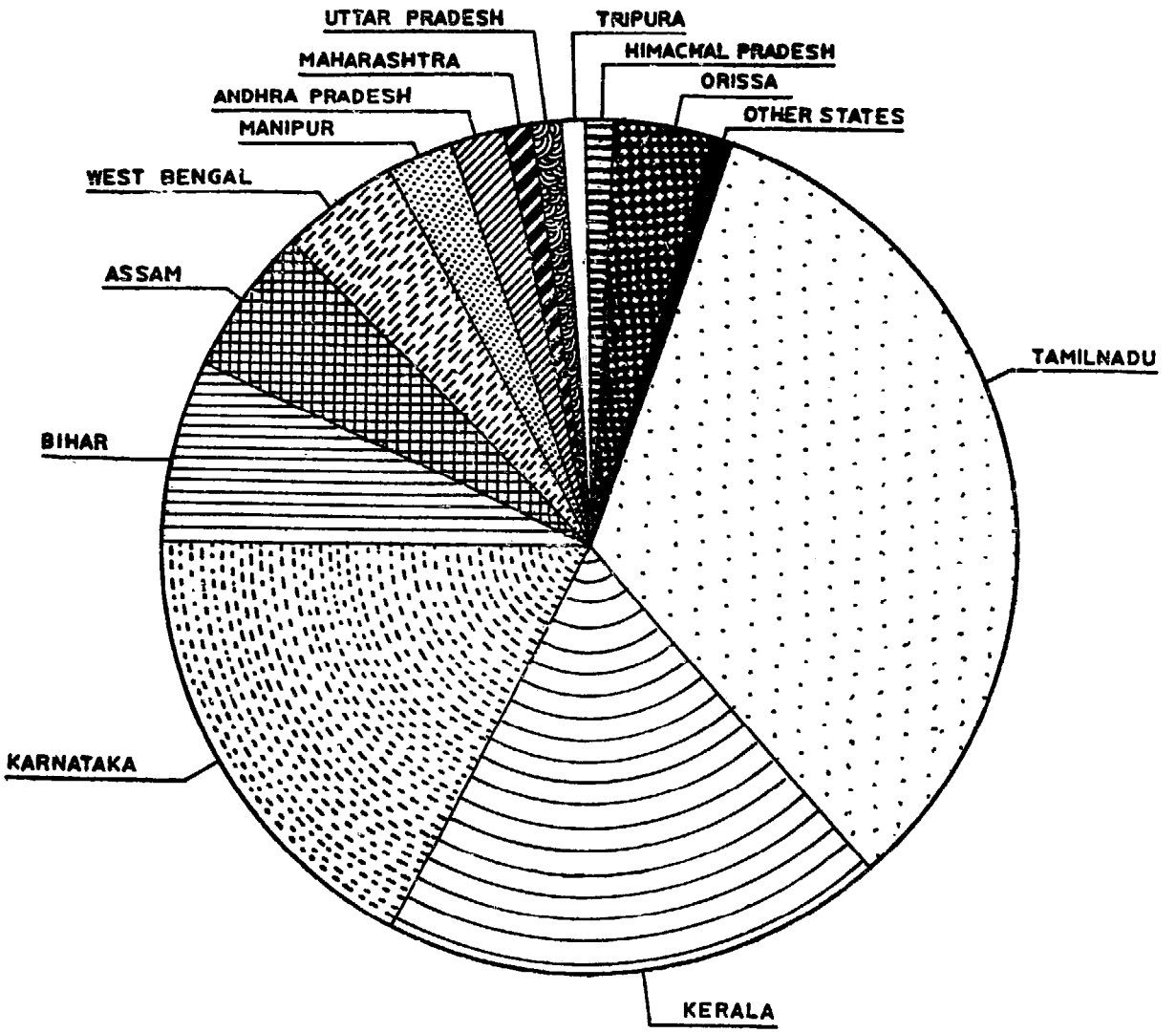
Organizational Structure

The Commission is an autonomous statutory body, established in an Act of Parliament by the Government of India; it is attached to the Ministry of Industries. It has its headquarters at Bombay and a network of technical, organizational and extension staff in all the states, reaching through district development blocks to villages. The artisans involved in the village industries activities have technical and other assistance close at hand.

The functions of the Commission are to plan, organize and implement the programmes for the development of Khadi and village industries like spinning, weaving, pottery, leather-craft and beekeeping. Such programmes include stocking and supplying suitable raw material and supplying improved


INDIA
BEEKEEPING INDUSTRY
JAMMU & KASHMIR
HIMACHAL PRADESH
PUNJAB
HARYANA
RAJASTHAN
UTTAR PRADESH
BIHAR
SIKKIM
ASSAM
ARUNACHAL
NAGALAND
MEGHALAYA
MANIPUR
MIZORAM
TRIPURA
WEST BENGAL
GUJARAT
MADHYA PRADESH
MAHARASHTRA
ORISSA
ANDHRA PRADESH
GOA
KARNATAKA
KERALA
TAMIL NADU
AREAS COVERED
AREAS HAVING GOOD POTENTIAL
ANDAMAN & NIKOBAR ISLANDS

INDIA
SHARE OF STATES
IN
APIARY HONEY PRODUCTION



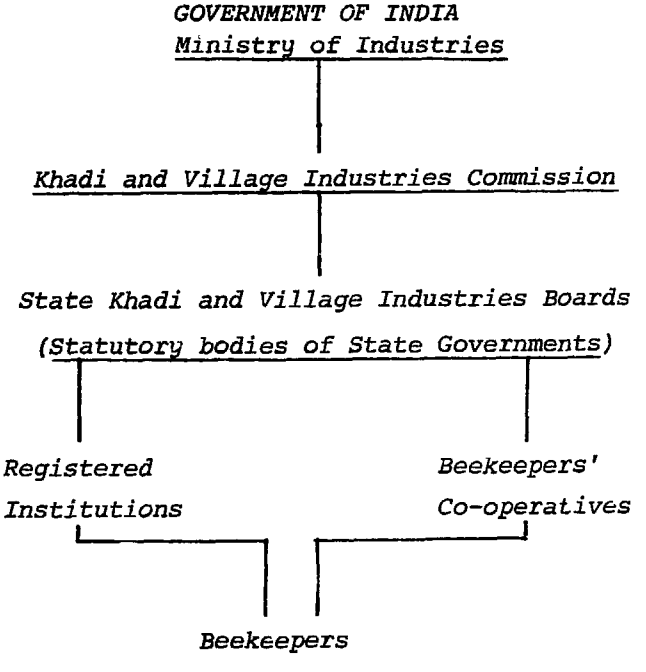
equipment, arranging the marketing of finished village industries products, promoting research in the improvement of tools and techniques, and providing training for artisans; also implementing people's education programmes through films, exhibitions, publications and other media. The Commission has so far produced four films on beekeeping.

The Commission executes the programmes through the State Khadi and Village Industries Boards and Registered Institutions and Co-operatives, to whom funds are released. The State Boards are local statutory bodies created by Acts of the State Governments, while the registered institutions are bodies registered in each state under the Public Trust Act and the co-operative societies under the Co-operative Act of the State. The local institutions and co-operatives, implementing village industries programmes in each State, function under the control of respective State Khadi and Village Industries Boards, through which they are accountable to the Commission.

Beekeeping Development Programme

The Beekeeping Directorate of the Commission has four functional wings: development, marketing, research and training. The development wing conducts surveys and prepares feasibility reports for the preparation of annual plans and perspective development. Financial budgets based on surveys are prepared in favour of State Boards and other agencies implementing programmes. The manufacture and supply of improved and standardized equipment are attended to. Technical help and supervision are also afforded by the extension wing of the Directorate, including assistance in the grading and marketing of honey produced by beekeepers. Beekeeping, as a part-time occupation, has now assumed national status as a subsidized programme for the benefit of under-employed people in villages.

Organizational structure for Khadi and Village Industries Development Programme



The Beekeeping Directorate assists the organizations implementing programmes through set patterns of assistance approved by the Commission and the Government of India. The following are the main units of assistance.

1. Sub-station — This is the basic unit for introducing beekeeping in new areas. The operative area has a radius of 5 - 8 km; it is selected through previous technical surveys. A trained fieldman is provided to educate the prospective beekeepers; he distributes hives and other equipment, and gives training in the management of colonies. This unit runs for a period of 5 years in the area, by which time it is expected that the beekeepers enrolled locally will have become self-reliant. Adjacent areas are covered similarly, and a viable beekeepers' co-operative society is established in due course, which then looks after the interests of the beekeepers in its jurisdiction; it may extend to a block level or a district level, depending upon the potential of the area.

2. Model Apiary -cum Nursery — This unit comprises an apiary for demonstrating modern management practices suited to the locality; it also supplies colonies to beekeepers through a planned programme of colony multiplication.

3. Migration — In order to induce beekeepers to migrate colonies during prolonged dearths, or for different flows or for pollination, a subsidy is provided to cover the expenditure of migration.

4. Assistance to Individuals — This pattern is intended, by grants and loans, to encourage beekeepers to enlarge their apiaries, so that they become semi-commercial or full-time commercial beekeepers.

5. Honey House — Grants and loans are provided in this pattern to beekeepers' co-operative societies or institutions, for the construction of honey houses, according to designs prepared by the Beekeeping Directorate. Such honey houses are designed for centralized collection, pooling, processing and packing of honey.

6. Comb Foundation Mill — Similarly, grants and loans are provided to the organizations implementing programmes, for purchasing comb foundation mills of a size suited to their regions.

7. Training — This pattern provides for graded training courses at all levels, from beekeepers to post-graduates.

8. Seminars and Exhibitions — The Commission assists in organizing seminars and exhibitions, at district, State and All-India levels.

Subsidies to the extent of 50% of the cost of purchasing hives and other beekeeping equipment (e.g. honey extractors, smokers, colonies,) are given to beekeepers.

The beekeeping Directorate has an annual budget of Rs. 5 million (about £250,000 or $ 700,000) for beekeeping development, research and training. Under the development programme Rs.2.2 millions are earmarked towards grants and Rs. 017 million towards loans. The Directorate has a research and technical staff of over 200, distributed throughout the country at various levels.

A beekeeper's apiary in the coastal belt of South India.

A beekeeper's apiary in his litchi orchard in Bihar State.

Progress

A small beginning was made, in a few villages only, in 1953. During subsequent five-year plan periods, more and more villages were covered, and by the end of 1974, 37,000 villages derived the benefit of modern beekeeping.

Initially, in 1953, only 232 persons were enrolled as beekeepers, but the number gradually increased year by year to 138,000 by the end of 1974. This is a clear indication of the benefits of beekeeping as a subsidiary occupation or semi-commercial enterprise, and more people are now coming forward to take up beekeeping.

Beekeeping in an organized sector made a very small start in 1953, with only 800 colonies producing 1280 kg honey. The average yield was only 1.5 kg per colony. During successive years, the number of colonies steadily increased, with a higher production per colony, and in March 1975 there were 545,000 colonies working under the Commission's programme, producing 2.3 million kg honey annually, with an average colony production of 4.7 kg.

During the last 20 years, the development of modern beekeeping has shown rapid growth, as a result of organizational efforts and of the adoption of more and more scientific methods of management (see table below)

Year	*No. beekeepers*	*No. colonies*	*Honey production (kg)*	*Average yield (kg)*
1953-54	232	800	1,280	1.5
1958-59	38,527	87,384	285,800	3.0
1963-64	57,198	164,597	713,745	3.8
1968-69	109,466	356,547	1,710,124	4.8
1974-75	136,000	545,000	2,321,000	4.7

Beekeeping in India is still largely a forest-based industry, but the Beekeeping Directorate is now planning to introduce it in agricultural areas, with emphasis on planned bee pollination of our agricultural and horticultural crops. This is encouraging beekeepers to migrate their colonies from forests to farms. Fortunately the flowering periods in forests and farms alternate, so migrations to agricultural areas from the forests, during heavy monsoon or snow, provide rich forage for colony multiplication and for additional honey yields. Though beekeeping remains a subsidiary occupation, a class of commercial beekeepers is slowly coming into being in southern India, where a few progressive beekeepers each keep 300 to 600 colonies producing 3000 to 6000 kg of honey valued at Rs. 30,000 to 60,000. As the technology reaches the villages, more people are likely to take to commercial beekeeping.

Future Development

On the basis of existing forest and agricultural areas in the country, at least 50 million colonies would be needed to exploit the natural resources of honey production and the needs of agricultural crops for cross-pollination. The national wealth contributed by beekeeping would run into several billions of Rupees. Future plans for beekeeping development in India are duly related to this long-range perspective.

Research Programme

Introduction

Bee research in India, like the beekeeping industry, has a recent history. Its growth can be traced back a little over three decades. Even so, most of the earlier research was confined to the entomology departments of provincial agricultural directorates or colleges. The emphasis was naturally on crops pests; bees were treated in a minor way, restricted to academic aspects like comparative morphology, anatomy and bionomics. This research, though valuable, had little impact on the industry. The beekeeping industry, by its highly scientific and technical nature, needed strong research support in various applied aspects for its total growth. Mention must be made here of some commendable efforts made earlier in this direction by entomologists like Dr. Sardar Singh, Shri S. Ramachandran, Shri P.L. Sharma, Shri H. Vishwanathan and Dr.T. Milne. However, these efforts were in the nature of ad hoc schemes, and their results were inconclusive. Thus there was an utter need for a sustained broad-based, integrated, applied research programme, taking account of the climatic, phenological and floristic heterogeneities of the sub-continent. This need, however, had remained unfulfilled. It was in this situation that Dr. G. B. Deodikar conceived such a comprehensive programme of bee research. Since the resources in men, material and finance were extremely meagre, a modest beginning was made at Mahabaleshwar (western hill ranges of Maharashtra State) in 1951-52. I have been associated with this work since its inception.

Through the devotion and perseverance of a few persons the work developed, and the Apicultural Laboratory came into existence in 1954. Results obtained during the following 8 years were very encouraging. However, this work was confined to a limited area of Mahabaleshwar plateau and surrounding valleys in the western highlands. A need was then felt to expand the scope of this work to cover the entire country. All-India Khadi and Village Industries Commission considered a proposal for such a programme, and in November 1962 reorganized the above Apicultural Laboratory as the All-India Central Bee Research Institute at Poona. The basic objectives of this Institute can be summarized as:

1. Improving the efficiency of Indian honeybees through improvement in
   - (i) bee forage
   - (ii) bee management
   - (iii) bee breeding through genetic selection
2. Standardization of beekeeping equipment

3. Quality control of bee products

4. Assessment of the utility of bees in increasing crop yields through planned bee pollination.

5. Organization of graded training courses at all levels.

The Central Bee Research Institute in turn planned to establish Regional Bee Research Laboratories and Field Observation Stations in different representative areas. Three such Regional Research Laboratories have been established fo far: in Mercara (Coorg District, Karnataka State); in Kodaikanal (Tamil Nadu) in the south; in Kangra (Himachal Pradesh) in the north. The Apicultural Institute at Mahabaleshwar continues to function as a Regional Research Laboratory. Field Observation Stations consisting of Experimental Apiaries (15 so far) are also being established in the areas covered by these Regional Research Laboratories. Basic data is collected from these Stations, compiled at the Regional Research Laboratories, and processed and analysed at the Central Bee Research Institute.

This programme requires simultaneous attention to such diverse scientific fields as ecology, floristics, bee botany, melissopalynology, bee management, bee genetics and bee breeding, bee pathology and the chemistry of bee products. The Institute accordingly has the following different sections:-

1. Bee Botany — Botanical surveys of different regions; evaluation of plants for their utility to bees, their density and distribution; preparation of floral calendars and floral maps of the regions; these aspects are studied under this section. They reveal the build-up and flow periods and floral gaps of the area. It is observed in many areas that there is an abrupt break in pollen and/or nectar availability, resulting in abrupt cessation of brood rearing. Feeding of pollen supplements in combination with sugar syrup is being tried, to overcome such gaps. Another important activity is the introduction and propagation of new plant species, either indigenous or exotic, to tide over these short gaps and to enrich the vegetation. So far more than 3000 plant species are represented in the herbarium of the Institute, and are evaluated for their relative utility to bees, as major, minor or ancillary sources. Local plants toxic to bees or to human beings are included in this study.

2. Melissopalynology — Confirmatory evaluation of the utility of these plants is made through palynological studies of seasonal pollen loads and nectar samples collected periodically from different regions under the purview of Regional Research Laboratories and Field Observation Stations. So far, nearly 3000 reference pollen slides of Indian bee plants in these areas are maintained in the Institute's national "Palynarium".

3. Bee Management — As noted earlier, India is a vast sub-continent, and one standard management pattern of colonies would not suit all regions. Thus standardization of beekeeping equipment and of seasonal management practices, suited to a region under study, has been worked out. Hives, extractors comb foundation mills and other beekeeping equipment have been standardized through the Indian Standards Institution. Some areas in the southern

peninsular region, and some in the northern hill regions, have been worked on; studies in the remaining areas are being initiated. In areas already studied, methods or migration, comb renewal for wax-moth control, queen rearing and other seasonal management practices have been standardized, and this information is passed on to the beekeepers' co-operative societies and other agencies that implement the beekeeping extension programme.

There are vast areas of inaccessible forests inhabited by wild animals such as bears, and devoid of human habitation. This forest wealth, though rich in bee flora, is not utilized. In order to exploit these forest belts, this Institute has designed mobile and stationary bee houses to accommodate various numbers of colonies. These bee houses are being field-tested before their standardization.

4. Bee Breeding

In India, we find different ecotypes of Apis cerana indica as we go from south to north, or from plains to hills. These ecotypes have evolved naturally in different "bee belts" in centuries past. Even within a given ecotype we find natural variation in characters like body size, tongue reach, resistance to disease. industriousness, and honey producing capacity. Out of the 1500 colonies maintained by the Institute in 15 apiaries at different places, colonies having a combination of desirable qualitative and quantitative characters are selected for breeding purposes. Queens are reared by a grafting method, and nuclei are used for mating in isolated apiaries previously populated with drones from superior stocks. Only the best colonies are allowed to rear drones. Thus a programme of mass selection, hybridization, progeny testing, culling inferior stock and selecting superior stock is continued, in order to increase the productivity of Indian honeybees. Inter-ecotypic crosses are effected in due course, for further improvement of the strain; this has given improved stocks with a significantly superior performance over successive years, compared with general averages.

5. Bee Pollination

India is mainly an agricultural country, with immense scope for bee pollination. But due to extreme heat during summer, colonies cannot be maintained on the plains of India throughout the year. The beekeeping industry in India is therefore mainly restricted to forest regions. However, with improved migration techniques evolved at the Central Bee Research Institute, it is now possible to migrate colonies between farms and forests to the advantage of both beekeepers and farmers. Experiments on the utility of bees as cross-pollinators of various agri-horticultural crops are being assessed. Considerable data in bee pollination of most of the oilseed crops have been collected, and experiments on some orchard crops, pulses, vegetables plantation crops and fibre crops have been initiated, with certain improvements in the design of experiments for crop pollination.

6. Bee Chemistry

Quality control and marketing of bee products, particularly honey and beeswax, are aspects as important as beekeeping extension and research. In India honey is obtained from three different species of Apis. About 50% of the honey is produced from the "domesticated" Apis cerana indica bees in modern hives,

Using bees for the pollination of sunflower crops in a Farmer's field in Maharashtra State.

A commercial apiary in a migratory site in Jammu and Kashmir State.

and the remainder from the wild colonies of A. dorsata, A. cerana indica and A. florea. Analytical work on Indian honeys and beeswaxes at this research institute has made it possible to lay down purity specifications for these products through the Indian Standards Institution, the Agricultural Marketing Organization of the Government of India, and under the Prevention of Food Adulteration Act of the Government of India. Methods have been evolved to distinguish extracted honeys from squeezed honeys by quantitative estimation of the pollen per gram of honey and its transmittance.

The honey flow period in the plains of India is followed by summer when ambient temperatures reach a maximum of 47°C in many places. At these temperatures the hydroxymethylfurfural content of honey rises steeply and much beyond the limit of 40 ppm permissible in European standards. This Institute has worked on the problem, and has sent its findings to the Ministry of Health, Government of India, so that the existing qualitative Fiehe's test in their specifications can be modified.

7. Bee Path -ology

Prior to 1969, Indian beekeeping was not seriously confronted with any bees diseases. Acarine disease took a major toll of bee colonies in Himachal Pradesh and Jammu and Kashmir during 1960-65. In 1970-71, European foul brood was first detected in western hill ranges of Maharashtra State, and in 1975 Nosema disease was confirmed in Uttar Pradesh and Himachal Pradesh. Both these diseases were later confirmed by Dr. L. Bailey at Rothamsted Experimental Station, UK, and he also suspects a new viral disease among some samples sent by us. There is a general belief that the introduction of these bee diseases in to India is consequent upon the repeated introduction of colonies of Apis mellifera from Europe and America. A separate wing was therefore established in the Central Bee Research Institute, for the study of bee disease, pests and predators. The disease problem is dealt with simultaneously through

(i) chemotherapy.
(ii) better management
(iii) breeding for disease resistance.

A wasp-trap has been fabricated, tested in the field, and standardized through the Indian Standards Institution.

8. Rock Bee Research

Apis dorsata, commonly known as the rock bee, is the largest and most"ferocious" honeybee of the world. The bees are very prolific honey producers, they withstand high temperatures, migrate over long distances, and are effective pollinators. They cannot however be handled easily, because of their temper, migratory habits, and construction of nests in inaccessible places. Observations on nesting behaviour were made on more than 2000 colonies in different parts of the country: on such aspects as nesting sites, comb building in relation to north-south direction, height of nest from ground level and comb structure. Preliminary experiments conducted at the Central Bee Research Institute showed that rock bee colonies can be hived in a specially designed bee box. Further experiments are in progress on supering these colonies, extracting their honey, and seasonally migrating them to suit their natural rhythm.

9. Training

Training forms an integral part of the programme of the Central Bee Research Institute, and graded training courses in beekeeping are arranged. Field men and Apiarist courses (3 and 6 months, respectively) are a regular feature. Specialized training in queen rearing, processing and analysis of honey and beeswax and other aspects is arranged according to specific requirements. Refresher courses for field staff are arranged periodically, to acquaint them with developing techniques. Beekeeping staff from other developing countries are also trained at this Institute; a post-graduate diploma course will soon be started.

10. Library and Publications

The staff of the institute have so far published over 120 research papers, and built up a comprehensive collection of books, journals and reprints of research on bees and beekeeping. The Institute houses the Branch Library of the International Bee Research Association to serve its Asian members. The IBRA supplies (gratis) surplus literature it receives from different countries of the world.

The Institute participates in editing the Indian Bee Journal. It regularly publishes Technical Bulletins on practical aspects of beekeeping in various local languages, to acquaint beekeepers and beekeepers' co-operative societies with new techniques in the industry.

The Indian Agricultural Research Institute (New Delhi) and the Punjab Agricultural University (Ludhiana) are engaged in research on physiological aspects, and on the introduction of Apis mellifera, respectively. Care is taken to avoid duplication of efforts in respective subject fields.

The Central Bee Research Institute is the only one of its type in India which is solely devoted to integrated research on various aspects of Indian bees and beekeeping industry. It will in future receive additional support from the Central Government, for the expansion of its research programme to other parts of India.

* * *

Some Notes on Kashmir Bees

(by F. A. and T.A. Shah, Shah Beekeepers, Srinagar, Kashmir)

The honeybee native to the uplands of Kashmir is a variety of Apis cerana indica, which has not been subject to hybridization. In the environment of Kashmir it performs well, both in honey production and in general management characteristics, and it is not believed that Apis mellifera would do better.

The physical characteristics of the Kashmir bee can be summarized:

(a) there are 61 worker cells per square inch.

(b) the weight per bee is 100 mg.

(c) the tongue length is 5.5 mm (preliminary measurements).

(d) the life span is some 6 weeks in the working season, and over 6 months in the inactive season.

(e) Breeding at the end of winter starts when maximum day temperatures are averaging around 5°C, and the laying capacity can reach 2000 per day.

(f) Bees forage at temperatures of 10°C and above.

In their use of brood combs and storage combs Kashmir bees will expand the brood area according to the availability of food, and when a surplus becomes available they reduce brood rearing and give preference to storing as much surplus honey as they can. Comb building is proportionate to the expansion of brood area and availability of food to be stored. Honey cappings are convex and snow-white. No propolis is used.

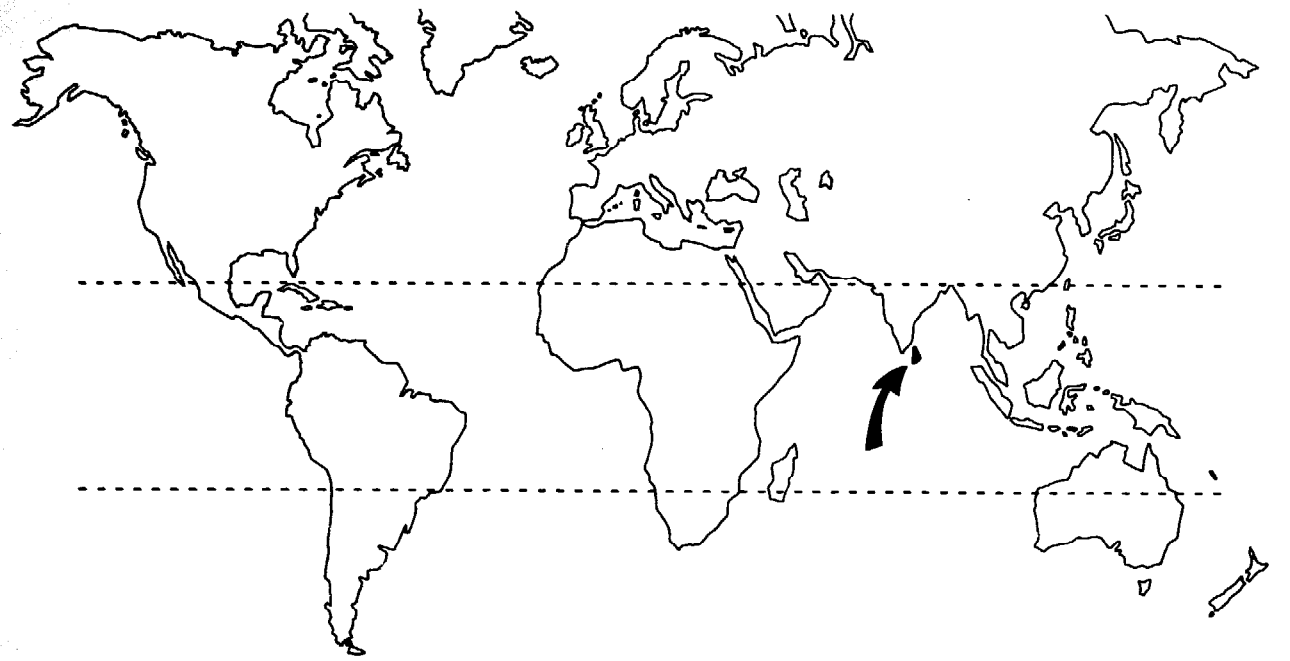
Swarming can be minimized by careful management, which should include requeening. Otherwise a colony is likely to swarm twice in a season. Provided hives are kept clean, and inspected regularly, wax moth should not pose a problem, and the Kashmir bees themselves defend their hives well against ants, wasps and robber bees.

It is possible to obtain honey yields upwards of 35 kg per hive. Shallow supers are used, but queen excluders are not essential even for production of comb honey. Honeydew is collected only in the worst conditions of drought, otherwise the honey is from floral nectar.

Bees commence foraging almost immediately after they have been migrated to rew hive sites. The Kashmir bee has also been found to forage under colder conditions than introduced Apis mellifera. In even short breaks of mild weather during the hardest part of winter, Kashmir bees have been observed foraging, sometimes several kilometres from the hive.

In general, the Kashmir bee winters very well and a small colony of 10,000 bees can subsist on 4 kg of honey. When food is scarce the bees restrict breeding and are less active, thus conserving their energy and the stores of food.

Diseases are not a problem in Kashmir, except for the recent outbreak of acarine disease in some areas.



BEEKEEPING DEVELOPMENT PROGRAMMES IN SRI LANKA

by B. A. Baptist
(Department of Agriculture, Sri Lanka)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 135-142)

BEEKEEPING DEVELOPMENT PROGRAMMES IN SRI LANKA

by B. A. BAPTIST
(Department of Agriculture, Sri Lanka)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 135-142)

The life of honeybees is profoundly affected by climate and flora. The physical and biological factors of the local environment are therefore of great significance in any development programme for honey production. The local human interests and efforts involved, and their possible potential, are also of great importance.

Beekeeping Practice

Honey Hunting

Obtaining honey from wild bees living under natural conditions was a regular practice of the primitive hunting tribes (Veddas) of the country who depended on forest and jungle produce for their food. The bees involved in these honey-hunting raids were the Giant or Rock bee (Apis dorsata) and the Asiatic honeybee (Apis cerana); both bees accumulate appreciable quantities of honey during the dry seasons of the year, chiefly in the months of June, July and August. In the process of obtaining this honey, the flying bees were driven off by smoking. The combs were then cut down and the honey squeezed out and collected, while the parts containing brood and pollen were consumed on the spot.

Primitive Beekeeping

With the practice of primitive migratory agriculture of the chena type, in which forest or jungle is cut down and burnt and the land used for raising food crops for 1 or 2 years before passing on to fresh pastures, a primitive type of beekeeping was practised. Clay pots were smeared with honey and wax to attract passing swarms of bees. Swarms of Apis cerana readily took to these pots. The honey was eventually obtained in the usual way by breaking off the combs, and this entailed much destruction of bee life. Most of this honey, with collections obtained also from Apis dorsata farther inside the forest, was normally brought to the village bazaar or town for sale. This is still continued by the rural peasantry who live in close proximity to forest land.

Hobbyist Beekeeping

The next step in beekeeping practice was taken by a few hobbyist beekeepers who generally used the western and Indian types of hives for keeping bees, with some variations in size of frame and capacity of hive. Some of them went so far as to import A. mellifera, chiefly from Australia. No notable success, however, appears to have crowned these efforts.

State-aided Beekeeping

With the setting up of a Department of Agriculture to deal largely with food production and peasant rehabilitation, beekeeping was given some official recognition and taken up

in the training programme of the local field staff. The training was, however, not intensive, nor was beekeeping taken seriously as a specific item of rural agriculture; the teachers were content merely to advise on the basis of the South Indian practices (9). The success in actual honey production was, however, spurious and isolated, and official assistance soon lapsed into the realm of propaganda.

In the late forties, however, the British Council sponsored a visit by Dr. C.G. Butler from Rothamsted in the UK, with a view to ascertaining the potential of beekeeping in the country with regard to commercial honey production (2). This was followed by providing a training of one year in beekeeping for an officer of the State Department of Agriculture.

Among the more important recommendations made by Butler (2) was the local production of a representative, standard hive at minimum cost, for which he prepared a prototype, and a simple method of management easily adopted by the rural peasantry. But he also recommended the use of comb foundation and centrifugal honey extraction to improve the very low yields available. These were to be initially made available by the State as a special subsidy. His major recommendation was that adequate provision should be made for the selection and breeding of productive strains of indigenous local bees, as obtainable from the best localities in jungle and forest areas. This he recommended to be done by a qualified scientific officer aided by ancillary staff.

Butler's recommendations were not followed up, however, except in connection with the production of hives, and financial support was given only for the construction and distribution of these, free to peasant farmers, leaving them to carry on from that stage with local talent and knowledge. Subsequently some efforts have been made to improve the position with special training and demonstration, but on such a restricted scale as to make no appreciable impression.

Honey Production Efforts

Honey Collection from Natural Sites

The primitive plundering of honey from wild bee colonies still goes on. This is for the most part confined to Apis dorsata, and is not in fact so unreasonable as it may appear at first sight. There are two major reasons for this.

First, Apis dorsata is characteristically a migratory bee, and little or nothing can be done in practice to change this behavioural feature. Associated with this habit, it will not allow itself to be confined to a closed hive that can be easily manipulated and, so far, attempts made to this end have not been successful.

The second reason is that Apis dorsata operates chiefly deep in forest areas, far away from human settlement, and generally in situations not easily accessible. So hunting raids are carried out to collect honey. If properly timed, as they are by those who adopt this practice, quite appreciable quantities of honey can be collected; though entailing some destruction of bee life, this is relatively so small as to make no difference to the survival of the species.

Associated with the plundering of honey from colonies of Apis dorsata, is also the obtaining of the wax combs of these bees. Such collection is or can be augmented by the collection of combs adbandoned when the bees migrate from one area to another. Unlike the collection of forest honey, the collection of wax in Sri Lanka from this source has not been exploited and there is some scope for development.

During the honey flow in the dry zone forest area, honey hunters do not neglect or ignore colonies of Apis cerena, which are as numerous in these areas as Apis dorsata, though somewhat less easy to detect unless searched for. This again is a task not too difficult for those traditionally engaged in honey hunting, and consequently the quantity of honey plundered from Apis cerana colonies can also be appreciable. An illustration of the scope of honey hunting is afforded by the fact that a wholesale dealer in wild honey in a single dry zone area of the North-Central Province is able to market as much as 2000 kg of honey in a season.

Honey Production from Hive Bees

The use of Apis cerana in domestic hives in Sri Lanka can be traced back to the early part of the 1920's when great interest was shown in plantation agriculture and horticulture. The earliest attempts were based entirely on the knowledge of Apis mellifera and the equipment and procedures used for this bee in the West. It is difficult to trace the results of these efforts; the general impression that can be gathered, by correspondence and publications available, is one of little success, with the benefit not going much further than the circle of friends round the beekeeper himself. In all these lone efforts, there have also been occasional attempts to get some State support in order to subsidize and popularize beekeeping activity, but again with little success. Consequently beekeeping has continued to remain purely in the province of the hobbyist and nature lover.

At a later stage, when beekeeping with Apis cerana was guided chiefly by the experience in South India, and the nature of the hives used and practices adopted were now very different, the results on the whole were disappointing. The more successful beekeepers were those who were able to place their colonies in areas accessible to established forest or to transfer their colonies to different areas according to the honey flows prevailing. Some of these beekeepers were able to obtain something like 12 kg honey from the best colonies (3,5), a quantity which could be considered appreciable only if the time spent in management and the capital required were very small. However, if the average yield of all the colonies kept by a beekeeper over a range of some years was considered, the average was reduced to not much more than 4 kg honey per colony.

Factors Affecting Production

One of the main reasons for this poor average appeared to be that in many areas of the country there were no very specific or prolonged seasons of proper flowering for an adequate honey flow. This tended to favour the development of strains which maintained a small colony size, and perhaps an excessive swarming habit. In consequence even short honey flows could not be fully exploited.

Heavy continuous rain is not infrequently experienced during the two monsoonal periods, and sometimes lasts for 1 - 2 months, causing excessive setbacks to development and sometimes serious reduction in colony size. This leads to exposure of the combs to wax moth attack, resulting in fouling of combs and absconding by the colony.

The lack of good quality equipment, and relative lack of skill in management procedures, were other factors which handicapped production.

Basis For Action Programme

State Interest

In order to evaluate properly the significance of features affecting beekeeping for honey production in previously univestigated areas, it would be necessary to run an observational study on an effective scale, and preferably also to carry out a small pilot project, utilizing, as fully as possible, all the natural advantages of the area. The Government of Sri Lanka has previously been reluctant to do this, or even to entertain such an idea. With the training of an Agricultural Officer in the Apiculture Department of the University of Guelph in Canada, a fresh interest in the development of beekeeping was initiated. The Canadian International Development Agency, which was assisting beekeeping development projects in tropical countries, offered their assistance to the Sri Lanka Government for setting up a development project in this country. The interest of the Sri Lanka Government was also no doubt stimulated by the rising unemployment in rural and plantation areas, especially as honey production could possibly be a source of productive occupation and income to farmers.

Favourable Factors

The features that have been recognized in this connection are very briefly considered below.

The forest and natural vegetation of this country does support the life of natural bee colonies, which are quite common in many parts of the country. It seems logical to presume that the honey and wax produced by them, which is not lost, could be secured and utilized to augment the food and improve the economy of the rural population.

On current and past experience in the country, there are indications of potential honey flows from the following sources, apart from the natural forests, which are potentially the best sources of honey flows in the tropics.

(a) A potential flow from plantations of eucalyptus at the mid-country elevations, now quite appreciable in extent, especially on the eastern side of the island (July, August, September).

(b) A potential flow in rubber plantations, especially in the south-western region (February - April).

(c) A regular, though comparatively slight, flow from coconut, and also mustard and gingelly amongst annuals.

Some of the crops now widely grown in this country have been known elsewhere to be good honey crops, but their possibilities in this country for honey production have not yet been tested effectively.

Requirements To Counter Intrinsic Handicaps

Many local factors, chiefly associated with climate and weather affect honey production either directly or indirectly, and limit yields to an extent which rules out this activity as a full-time occupation, or its organization on an industrial basis. As such, individual benevolence and purely personal interest are inadequate for effective investigation or development.

Also, in view of the relatively poor state of development previously, it is necessary to pursue basic investigation with adequate provision. In order to ensure proper relation to the economy of the country, it is desirable to gear it to an applied scheme of production by subsidizing a pilot project of definite duration.

Preliminary Action

On the basis of assistance received and expected from the Canadian International Development Agency, an immediate programme of preliminary action has been set up with the following objectives:

(a) The investigation and demarcation of suitable vegetational areas to promote beekeeping for honey production.

(b) Securing productive strains of the local honeybee and selecting, breeding and multiplying the most satisfactory of these strains.

(c) Working out an efficient and economical system of bee management, after the manner of progressive beekeeping for honey production as carried out with Apis mellifera in the west, and in the various development schemes in the tropics which have made progress.

(d) Establishing and developing an applied or extension programme to test effectively the findings of investigational work, and guide its further progress. In this, it is expected that advantage could be taken of developments and achievements in South India with Apis cerana, under conditions which are very comparable to those in Sri Lanka.

References

1. Baptist, A.D. (1951) A geography of Ceylon. Madras: Orient Longmans Ltd

2. Butler, C.G. (1953) The present status of beekeeping in Ceylon and possibilities for its future development. Brit. Agric. Bull. 6: 125-128

3. Dayaratne, K.H. (1968) A season's performance of an Apis colony at Erabedda. Vidyodaya J. Arts. Sci. Lett. 1 (2) : 221-223

4. Kannangara, A.W. (1939) Beekeeping. Trop. Agric. 92: 94-99

5. Perera, L.A.S. (1960) Beekeeping for honey production. Trop. Agric. 116 : 31-45.

THE ECOLOGY OF HONEY PRODUCTION IN SRI LANKA

by E. F. W. FERNANDO
(Department of Zoology, Vidyalankara Campus, University of Sri Lanka, Kelaniya, Sri Lanka)

Original Contribution

Introduction

Recently much interest has been directed towards the development and expansion of apiculture and honey production in Sri Lanka, and studies on various aspects of the biology and ecology of the indigenous honeybee Apis cerana under local conditions have therefore been needed.

A study of the foraging activity of honeybees and the availability of honeybee forage in different climatic regions and in various forest communities in the country is of importance in determining the suitability. of a particular region for apicultural practices, since a honey crop is dependent on the availability of nectar and on the number of honeybees present to collect it. The number of honeybees flying from a colony at any given period is regulated by several variable factors both extrinsic and intrinsic many of which are difficult to assess. However, quantitative estimation of flight activity at the hive entrance can provide a useful index on the foraging activities in the field and the stimuli contributing to the regulation of such activities. (Todd & Bishop, 1940: Gray 1967).

Meteorological conditions have been shown to be a major factor influencing plant growth, flowering periodicity and availability of pollen and nectar. They also influence the flight activity of honeybees. Butler (1941), Synge (1947) and Percival (1950, 1955) have shown that the pollen gathering behaviour of Apis mellifera is influenced by the time of day at which pollen is available while Wafa and Ibrahim (1950) found that such activities were also correlated with temperature. Bight and Pant (1968) have shown that in Delhi, India, there is a negative correlation between temperature and pollen gathering activity and a positive correlation with relative humidity for A. cerana Jay (1973) has reported that in Jamaica A. mellifera visits mainly male coconut flowers in the morning but gather nectar from both male and female flowers in the afternoon.

Interest has recently been expressed in the possibility of using flight activity as an index of the foraging potential of honeybee colonies that are to be used for the pollination of agricultural crops.

Most of these studies are based on the activities of Apis mellifera in temperate countries. However, the ecology of the floral sources important as honeybee forage could vary from one region to another. Apart from the observations of Kannangara (1940) and Baptist (1956; 1976) there is very little information available on honeybee forage in Sri Lanka. Further, the flight

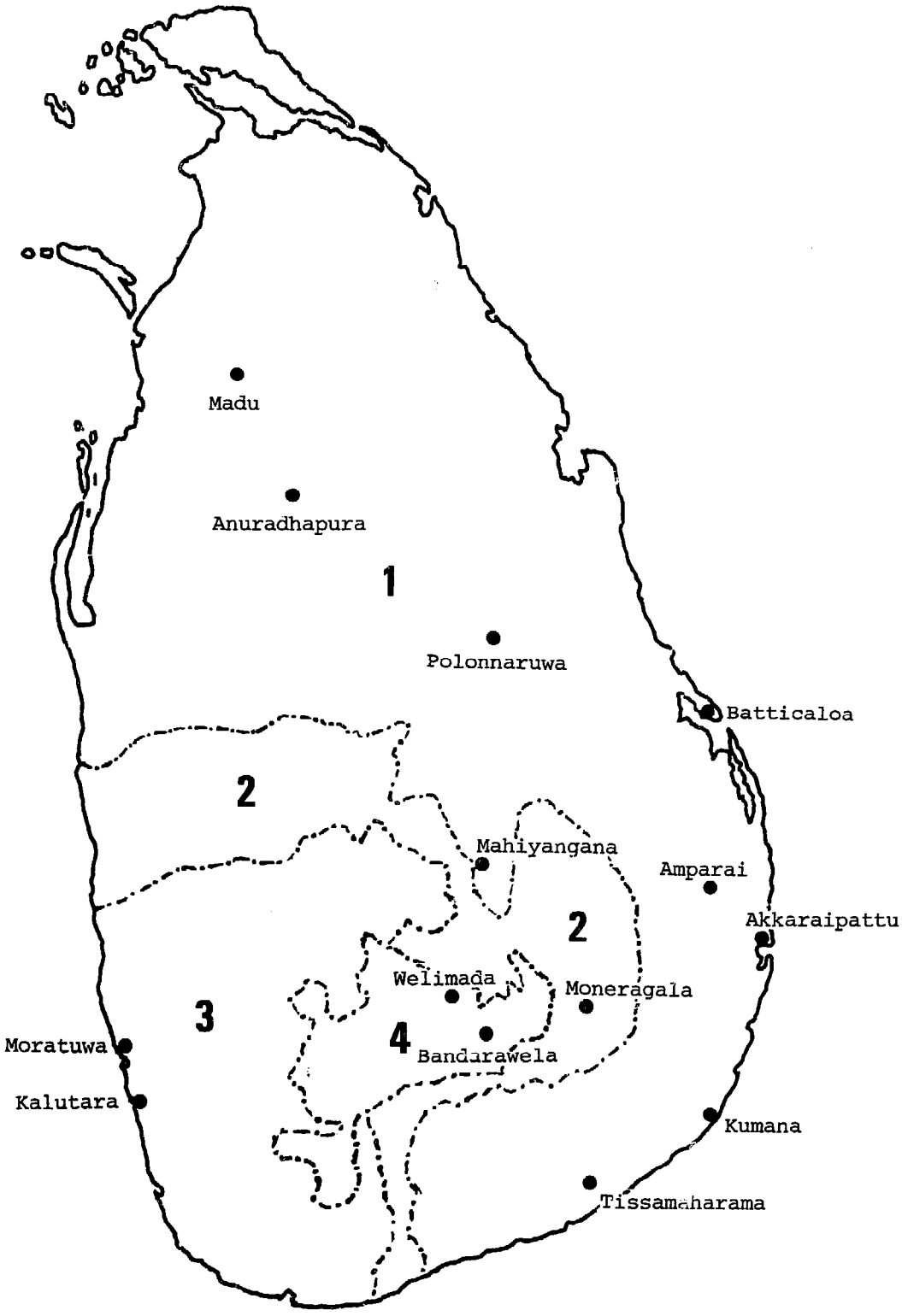


Fig. 1. The distribution of the generalized major ecosystems of Sri Lanka. (1) Dry zone (2) Intermediate zone (3) Lowland wet forest (4) Montane zone. The names indicate places from which data were obtained.

activity of Apis cerana under conditions prevailing in this country is not well understood either.

Therefore, the primary objective of this study was to collect information (a) on the flowering periodicities of some of the more important bee forage plants occurring in natural and man-made forests with a view to establishing their significance in honey production, and (b) for postulating tentative norms in foraging activity for a normal colony of A. cerana in a wet-zone region of Sri Lanka where the floral sources are predominantly coconut (Cocos mucifera).

Methods

A. Floral Sources

Observations on the flowering periods of the more important honeybee forage plants were made during surveys on the exploitation of forests for wild honey by peasants in different regions of the island. These honey hunters were also interviewed. However, time for these surveys was too limited to obtain enough information to formulate a detailed floral calendar.

Fig. 1 shows the localities where the observations were made for the present study. The phyto-geographical regions were mainly based on studies made by Fernando (1968) and Brink et al,(1971).

B. Foraging Activity

Observations were made at Moratuwa during the dry months, January to May 1974, when the colonies are most populous and flight activity was very high.

Foraging activity was studied by recording the numbers of incoming honeybees in a normal 'domesticated' colony in a movable-frame hive consisting of a brood chamber and a honey chamber, each with six frames, internal dimensions of which are shown in Table 1.

TABLE 1

Component	*Length*	*Height*	*Width (cm)*
Brood chamber	32	19	17.5
Brood frame	28	14.5	2.0
Honey chamber	32	9.0	17.5
Honey frame	28	6.0	2.0

The brood chamber rested on the floor board and had a rectangular entrance at the bottom 17.5 x 2.0 cm. A well ventilated roof covered the honey chamber. All incoming bees were counted at the entrance during 10-minute periods at hourly intervals between 06.00 h. and 18.00 h. This procedure was repeated every seventh day, from the first week of January 1974. The temperature and humidity of the environment were recorded during each observation period.

Results and Discussions

Ecology

The island can be divided very broadly into four major ecosystems (Fig. 1): (1) dry zone, (2) intermediate zone, (3) lowland wet forest, (4) montane zone. Several different habitats are found in them, including those resulting from the exploitation and conversion of natural forests for diverse agricultural practices. The general ecological and phenological features in each habitat of any one zone are characteristic of that habitat.

The dry zone vegetation is dominated mainly by tall or medium-sized trees like Manilkara hexandra, Chloroxylon swietenia, Schleichera cleosa, in addition to dense spinous scrub or dry grassland. This region experiences drought from April to September, and during the north-east monsoon rains are operative and dominant. This dry season coincides with the heavy south-west monsoon rains which dominate the wet lowland and montane ecosystems. The lowland wet forests cover the south-western part of the island to about 900 m above sea level, and are mainly dominated by Dipterocarpus spp., Mesus ferrea, Doona spp.

Rubber (Hevea brasiliensis) has been extensively cultivated in this region.

The intermediate zone ecosystem occupies the peripheral parts of the dry zone and of the wet lowland and upland regions. Some of the dominant flora are Dipterocarpus zeylanicus, Euphoria longana, and Artocarpus nobilis. Much of this region is cultivated, and is covered by coconut (Cocos nucifera) plantations and other food crops. The montane zone extends from

istic features of this zone are large expanses of grasslands

species of pine and Eucalyptus.

This rich forest flora, particularly in the dry zone (Fig. 1), sustains many natural colonies of the honeybee Apis cerana, and of the large rock bee A. dorsata, and the dwarf bee A. florea. During the main honey flow season, which usually extends from June to September, these wild colonies, especially those of A. cerana, are exploited for honey by village honey hunters. (Fig 2). During the operation, the bees are often driven away from their colonies through a hole made in the upper region of the tree cavity which harbours the colony, by letting in smoke through the flight entrance, which is widened with an axe to facilitate the removal of the combs. Honey is extracted by squeezing out the combs into a container, which is often the dried, thick rind of a large bottle-gourd, Lagenaria siceraria (Cucurbitaceae), a commonly cultivated vegetable in the dry zone regions (fig 3).

The flowering periods of some important honeybee forage plants, occurring mainly in the dry zone districts, are shown in Table 2. This is based on preliminary observations and is in no way complete. There must be still a large number of other important floral sources which are yet to be evaluated. It appears that most of these species bloom between March and the end of September. Table 3 shows that wild colonies of A.cerana yield sufficient honey, thanks to the continuous availability of

Fig. 2. A typical village honey-hunter near his dwelling.

Fig. 3. The axe and gourd used by a village honey-hunter.

during this dry season. The number of colonies hunted is not known.

TABLE 3

Amounts (kg) of wild honey collected by village honey hunters from some dry-zone regions in 1974

District	Village	Month	Honey
Batticaloa	Kallichchai	June	99.0
Batticaloa	Kallichchai	August	11.7
Batticaloa	Vahanery	August	5.4
Anuradhapura	(several)	June - August	297.0

During the monsoon period in the dry zone, there appears to be very little flowering between October and February, and plants in bloom (like Tectona grandis, a useful nectar source) will be of significance to bees only during the intermittent dry spells. It is evident from these observations that the forest resources which yield wild honey could also be exploited by colonies kept in apiaries.

Planted forests are also important sources of bee forage; some planted mainly with Eucalyptus spp. (Table 2) are common in Bandarawela and Welimade, where they provide a major source of honey for the successful honey harvests (Table 4) from domesticated colonies.

TABLE 4

Honey yields from domesticated honeybee colonies in Bandarawela and Welimade district. Each colony was provided with 6-12 frames for honey storage

Year	No. Colonies	Total yield (kg)	Yield per colony (kg) Average	Lowest	Highest
1968	35	79	2.2	0.4	9.5
1969	30	169	3.5	0.7	6.0
1970	71	221	3.1	0.7	7.8
1971	91	178	1.8	0.3	6.4
1972	133	322	2.4	0.3	7.7
1973	164	403	2.4	0.3	6.3

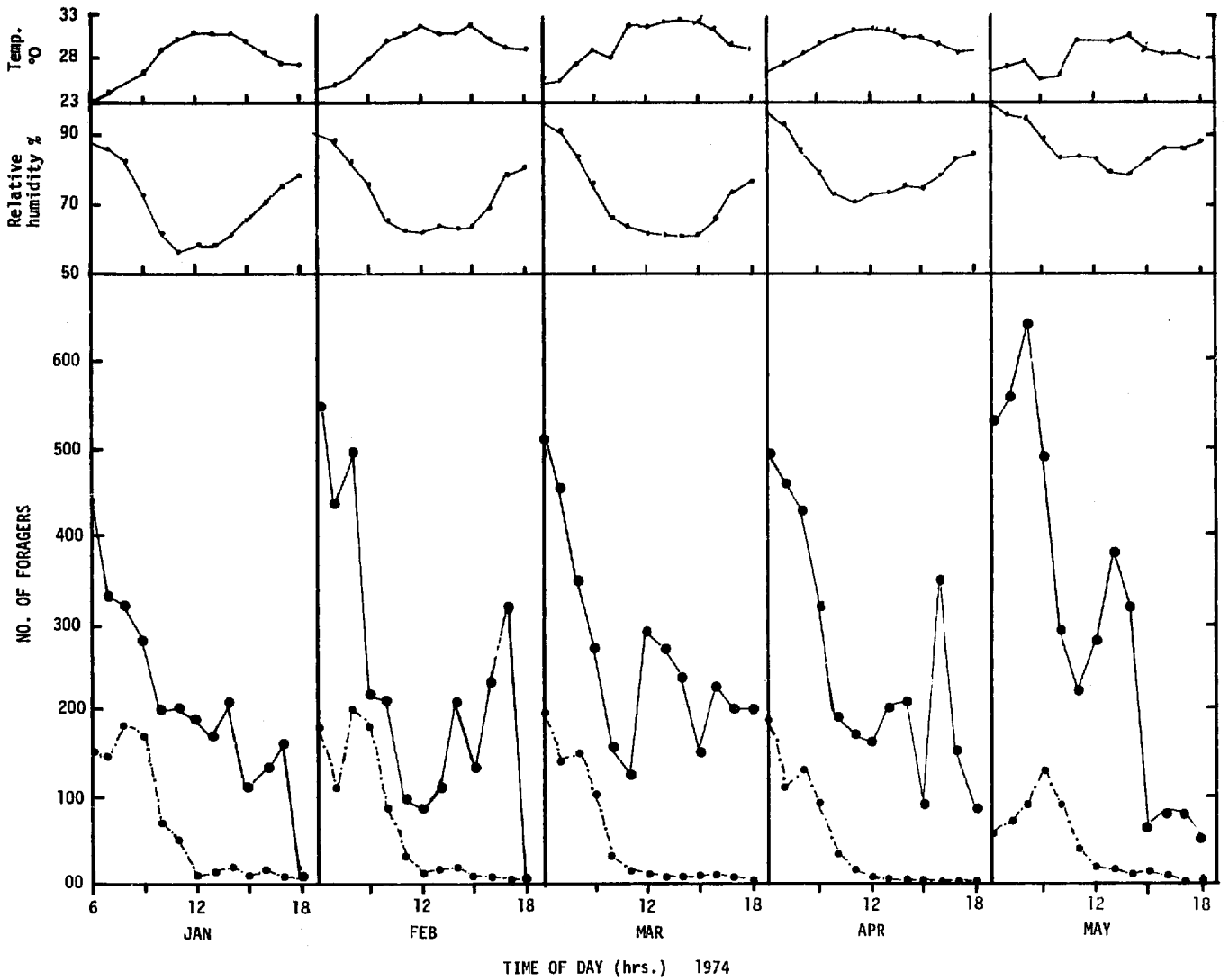


Fig. 4. Foraging activity of a colony of Apis cerona throughout the day, in each month from January to May, in an area dominated by coconut palms.

(●—● nectar gatherers; ●···● pollen gatherers.)

The young extra-floral nectaries on the petioles of rubber leaves (Hevea brasiliensis) secrete nectar from February to April, and provide a very important source for A. cerana (Fernando, 1978). Several beekeepers with colonies on coconut plantations (esp-cially in the Kalutara district, in the lowland wet zone) transfer them to nearby rubber plantations during this period.

Foraging Activity

The daily foraging activity in a colony of Apis cerana in an area where the dominant flora is coconut is shown in Fig 4. Of the total foraging population only about 25% were gathering pollen, mainly in the early part of the day and decreasing sharply after about 10.00h.

There was a major peak of nectar foraging in the early morning, and a smaller afternoon peak. This regular daily pattern from January to May may well be due to a heavy flow of nectar in the early morning which drops off towards midday,when temperature is high and relative humidity low.

Although the male coconut flowers remain open throughout the day, the availability of pollen for honeybees appears to be confined to the early hours, as has been observed in Jamaica (Jay, 1973). In Jamaica, however, nectar foraging was not so much confined to the morning.

The bees also visit unopened male inflorescences that have been injured by tapping to collect material for the preparation of "toddy" (a fermented liquor from the sugary exudates of injured blossoms, collected in earthenware pots). Kannangara (1940) stated that bees drink the fermented liquor and drown in it, due to intoxication. Counts were therefore made on insect populations in the liquid in randomly selected pots that had been suspended for 24 h on injured florescences (Table 5). Members of the Orders Orthoptera, Lepidoptera, Hymenoptera and Diptera were found while the resident fauna were mainly non-flying insects (Dermaptera and Formicidae (Hymemoptera)). About 77% of the visiting insects were A. cerana foragers where-as there were very few A. dorsata and A.florea. The relatively high proportion of A.cerana could be due to the presence of domesticated colonies nearby.

The exudate collected contains a high percentage of sugars; syrup prepared by boiling and concentrating this liquor, before any fermentation occurs, can contain as much as 75-80% sucrose (Pulle, 1975). The reason why A. cerana is attracted to the exudates is due to their high sugar concentration, and the bees drown accidentally while feeding, not as a result of intoxication as stated by Kannangara (1940).

Conclusions

Good potential thus exists for the planned harvesting of honey from wild colonies which are found in abundance in various forests in the different zones of the island. The establish-ment of apiaries of hives of A. cerana in coconut plantations (especially where the inflorescences of palms are tapped for collection of the sugary exudates) could be very productive, particularly in the lowland wet zone where migration of the colonies to nearby rubber plantations is economically feasible. The honey from the coconut exudates would not be high quality honey.

TABLE 5

Insects collected from earthenware pots containing fresh sap from tapped coconut flowers

Pot No.	Visitors (flying insects) Honeybees (Apis)			Other Insects	Resident (non-flying insects)	A.cerana as percentage of total visitors
	cerana	dorsata	florea			
1	73	10	5	-	26	83%
2	22	1	1	1	63	88%
3	19	4	2	5	68	63%
4	6	-	-	3	52	67%
5	11	3	-	1	27	73%
6	14	-	-	2	17	88%

More information about the distribution and flowering of bee forage plants, and about the foraging behaviour of honeybees in different ecological regions under diverse environmental conditions, will make it possible to select sites best suited for colonies of A.cerana throughout the island, particularly for establishing a cottage industry.

Both physical characteristics and chemical composition of honey obtained from colonies in coconut and rubber plantations may vary from those of honeys from colonies situated in and near the forests. Analysis of such honeys will be necessary to establish suitable standards for grading.

Acknowledgements

Mr. K. H. Dayaratne, Department of Agriculture, kindly provided the information on honey yields in the Bandarawela-Welimada districts. Thanks are also due to Dr.I.V.S. Fernando, Vidyalankara Campus University of Sri Lanka, for the critical reading of the manuscript. This project was partly supported by a research grant from the Vidyalankara Campus, University of Sri Lanka.

References

Baptist, B.A. (1956) - Beekeeping with special reference to its development in Ceylon. Proc. Ceylon Ass. Advmt Sci 12: 99 - 118

Baptist, B.A. -(1976) - Beekeeping development programme in Sri Lanka. pp. 135-142 from Apiculture in tropical climates ed. E. Crane. International Bee Research Assoc.

Bisht, D.A.; Pant, N.C. (1968) - Studies on pollen gathering activity of the Indian honeybee Apis indica F. under Delhi conditions. Indian J. Ent. 30: 163-168

Brink, P.; Anderson H.; Cederholm,L. (1971) - Lund University Ceylon Expedition in 1962. Ent. scand. Suppl.1:4-36

Butler, C.G. (1941) - A study of the frequency with which honey bees visit red clover (Trifolium pratense) together with an examination of the environmental conditions. Ann, appl. Biol. 28: 125-134.

Fernando, E.F.W. (1978) - Studies of apiculture in Sri Lanka. I. Characteristics of some honeys. J. apic. Res. 17 (1): 44-46.

Fernando, S.N.W.(1968) - The natural vegetation of Ceylon. Colombo: Swabhasha Printers 85 pp.

Gray, N.E. (1967) - Diurnal variations in the intensity of flight activity from honeybee colonies. J.apic. Res 6: 65-68.

Jay, S.C. (1974) - Nectar and pollen collection by honeybees from coconut flowers. Bee Wld 55: 105-111.

Kannangara, A.W. (1940) - Some bee plants of Ceylon. Bee Wld 21 : 94-96.

Parker, R.L. (1926) - The collection and utilization of pollen by the honeybee. Mem. Cornell Univ. agric. Exp. Stn. No. 98: 1-55.

Percival, M.S. (1950) - Pollen presentation and pollen collection. New Phytol. 49: 40-63.

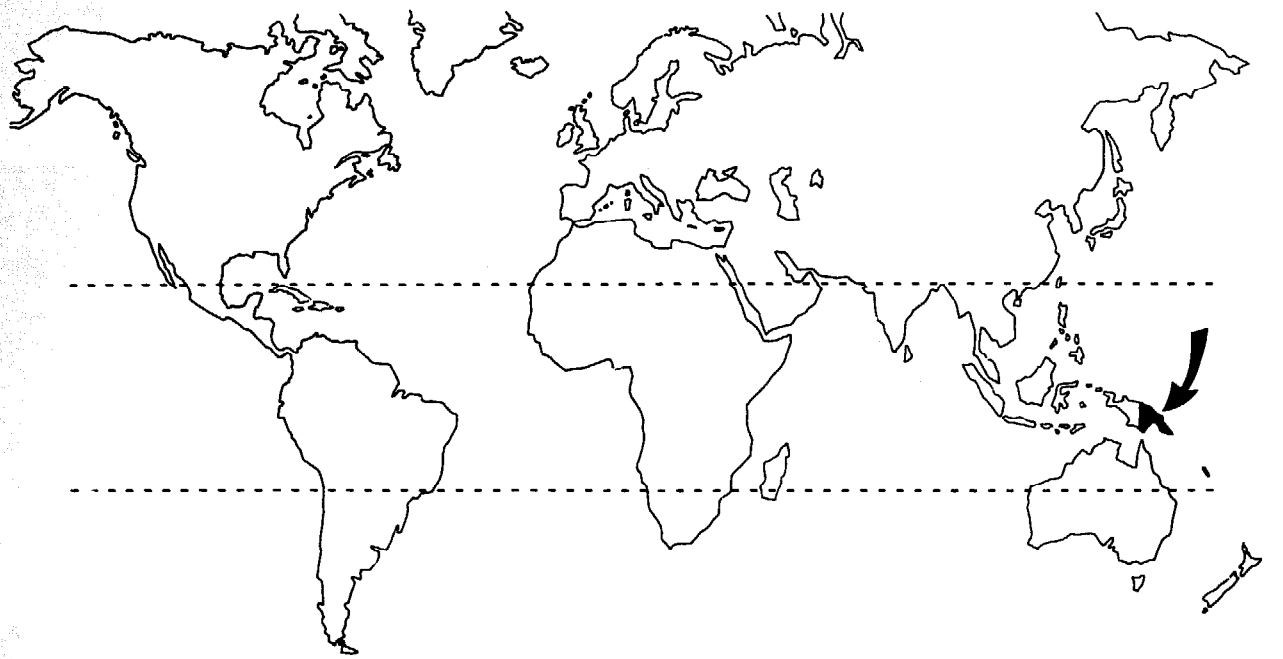
Percival, M.S. (1955) - The presentation of pollen in certain angiosperms and its collection by Apis mellifera. New Phytol. 54: 353-368

Pulle, M (1975) - Quality characteristics of sugar substitutes. Proc. Sri Lanka Ass. Advmt Sci. 31.

Synge, A.F. (1947) - Pollen collection by honeybees (Apis mellifera). J. Amin. Ecol. 16: 122-138.

Todd, F.E.; Bishop, R.K. (1940) - Trapping honeybee gathered pollen and factors affecting yield. J.econ.Ent.33: 866-870.

Wafa, A.K.; Ibrahim, S.H. (1950) - Temperature as a factor in pollen gathering activity by the honeybee in Egypt. Bull. Fac. Agric. Cairo Univ. No. 163 10pp.



INTRODUCTION AND SPREAD OF HONEYBEES IN MAINLAND PAPUA NEW GUINEA

by LYNDSAY J. KIDD
(Department of Geography, University of Papua New Guinea)
Original Contribution

INTRODUCTION AND SPREAD OF HONEYBEES IN MAINLAND PAPUA NEW GUINEA

by LYNDSAY J. KIDD
(Department of Geography, University of Papua New Guinea)

Original Contribution

Two articles by C.D. Michener (11a,11b) on Apis mellifera in Papua New Guinea were published in 1963. This paper complements them and includes further information on the introduction and spread of honeybees in mainland PNG and describes initial developments in commercial beekeeping. The details were mainly obtained by personal communication with beekeepers and others and by personal observations. The map in Fig. 1 show the locations of places named, and Table 1 lists their environmental characteristics.

Introduction and Spread of Apis mellifera

For an area of such ecological diversity, Papua New Guinea has a rather meagre bee fauna. No indigenous Apis species have been recorded, the nearest being in Java and Indonesia, to the west. The only indigenous members of the Apidae family present are those belonging to the tribe Meliponini and genus Trigona, consisting of small, dark, stingless honeybees which live in large colonies. They are represented in Papua New Guinea by the subgenera Plebeia and Tetragona. These have been exploited traditionally through hunting for wax and honey.

The earliest recorded introduction of Apis mellifera was in September 1948, when two colonies of Italian stock were established at Aiyura Agricultural Experimental Station in the Eastern Highlands and a third was sent to Goroka.

The colonies at Aiyura flourished and after two years had multiplied to thirty colonies. Swarming was common during warm, sunny periods throughout the year, and from mid-1949 swarms escaped and feral colonies spread in many directions. The honey yield was about 18 kg per hive per annum; honey flows were continuous with peaks about October and March.

In 1953 a colony was flown from Aiyua to Lumi, West Sepik, and carried on a two-day walk into Inebu, where it swarmed frequently and eventually absconded. Another colony of Italian bees was airfreighted from Brisbane to Wewak in 1949.

Although no other introductions were documented at this stage, in 1957 Apis mellifera were observed at a location in the area near where Hon Creek joins the Purari River. Michener suggests that the bees probably spread from Aiyura down the Lamari and Aure Valleys, through terrain characterized by mountain forest and intersecting grassland valleys 3 to 6 km wide. This would be about 160 km, suggesting a movement

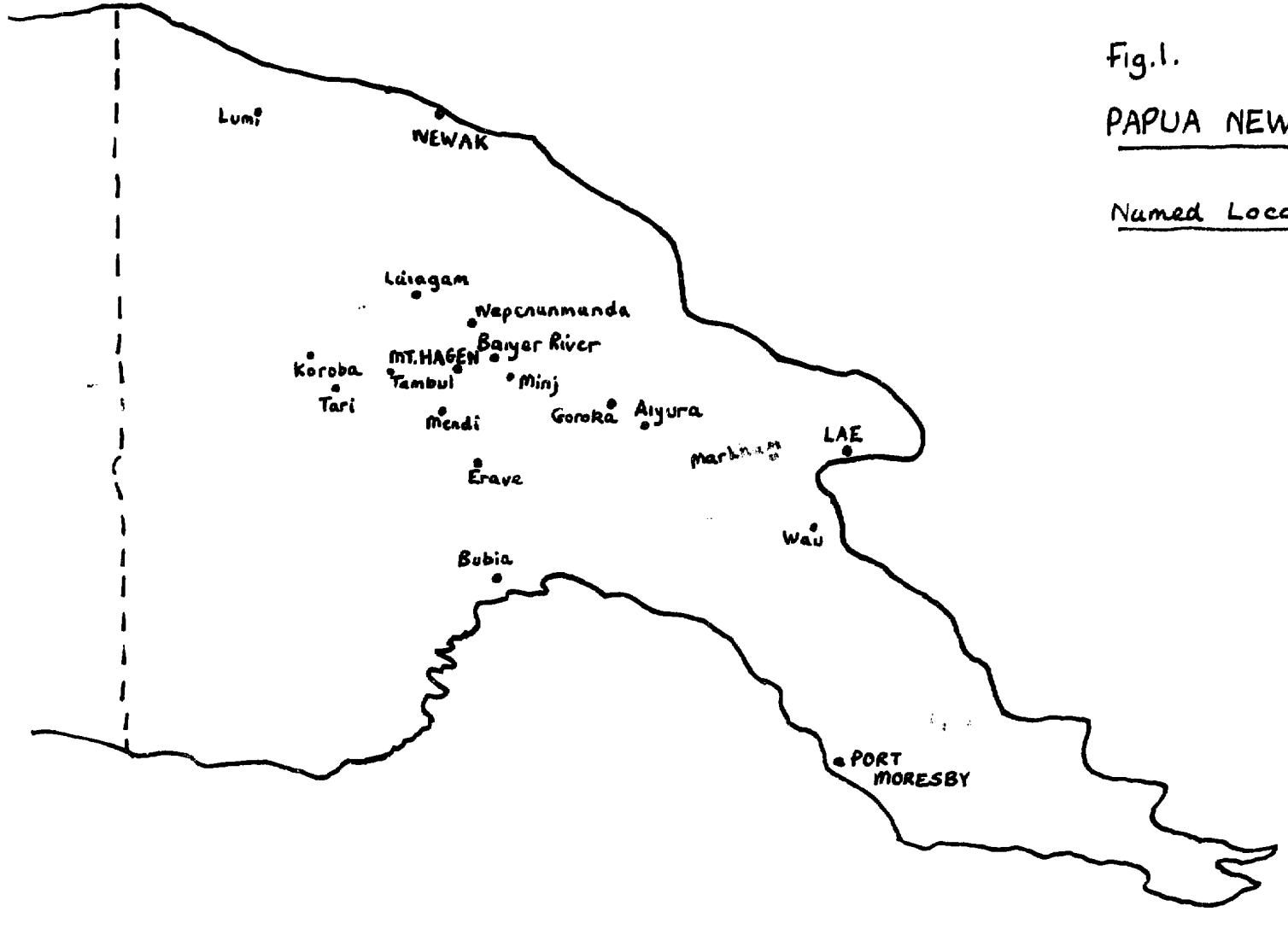


Fig.1.

PAPUA NEW GUINEA

Named Localities

of at least 20 km a year. * Apis mellifera also spread eastwards down the Markham Valley, and by 1959 was reported in the vicinity of Lae and Bubia and in the Wattut Valley near Wau.

It is reported that there were no Apis mellifera in the Southern Highlands before 1955 , when the Methodist Mission arranged for the transport of a colony from Mt. Hagen to Mendi. This colony swarmed frequently and by 1960 twelve colonies were being kept and over half a ton of honey had been produced. During this period two queens were introduced from Hawkesbury Agricultural College in Australia.

By 1959 bees were observed at Kutubu and in January 1960, bees were widely spread throughout the Highlands including Koroba, Wapenamanda and Erave.

Michener reports that several attempts were made to introduce Apis mellifera to the Port Moresby area, but although a few hives were kept successfully for several years, in 1959 there was no evidence of bees. In April 1975 the author observed Apis mellifera collecting pollen (Mimosa spp) near the Viamauri Rive 20 km west of Port Moresby, but there seem to be none in the immediate vicinity of Port Moresby.

Apis mellifera has shown its ability to adapt to a wide range of habitats in mainland Papua New Guinea. The bees nest in trees and in holes in the ground in the Kandep-Laiagam area, characterized by montane forest, native gardens and secondary regrowth. In Tambul the colonies inhabit the hollows of large tree trunks in montane forest, and in Mount Hagen they occupy roofs and walls of buildings in areas of Miscanthus floridulus grassland. At Vaimauri they inhabit areas of disturbed lowland rain-forest and young teak forest.

There is considerable variation in the success of these colonies. Brood taken from a feral colony near Tari in 1974, for example, showed signs of starvation, whereas a wild colony at the Baiyer River Baptist Mission (Kumbaweta) had ample honey stores in the same year. In 1974 about 18 kg of honey was extracted from a colony in secondary regrowth near Kuare in the Kagua subprovince, and in 1975, Mr. John Swincer extracted similar quantities of honey from wild colonies established in the walls and roofs of buildings on the outskirts of Mount Hagen town, and colonies at Kuk Tea Research Station yielded similarly.

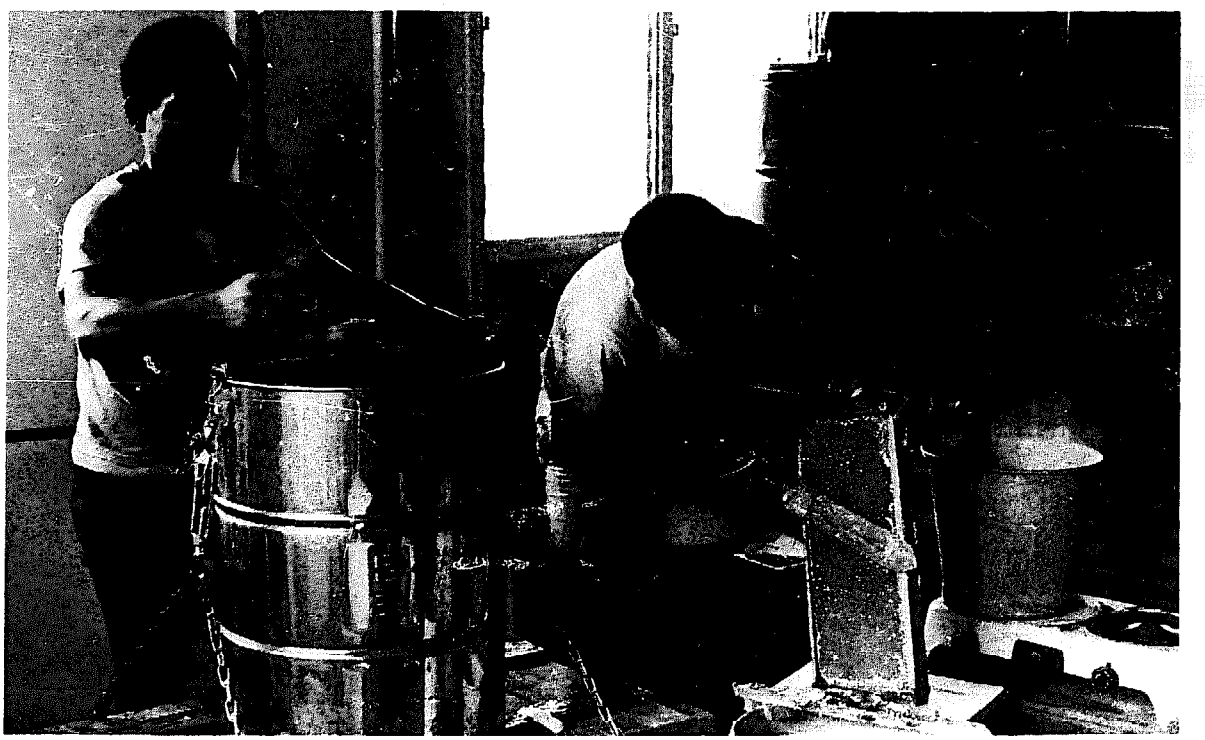
Developments In Commercial Beekeeping

Until recently honey production was almost entirely by expatriates, especially missionaries and school teachers, for home consumption. In the late 1950s the Mendi Methodist Mission produced over half a ton for sale. About 3.2 kg was sold (in powdered milk tins) for 10 shillings (K 0.33 per kg); (K= 1 PNG Kina. = US$ 1.25 in March 1977). In the 1970s prices were higher, up to Kl.65 per kg. in 1976.

In the Mount Hagen area a few colonies were kept by hobbyists when in 1974 Mr. John Swincer began setting up trials in selected parts of the Western Highlands to determine the feasibility of establishing commercial beekeeping as part of a

* Rates of spread are not necessarily considered to be uniform and need further investigation

Sampling honey in the Western Highlands of Papua New Guinea.



Extracting honey by centrifuge in Papua New Guinea.

programme of the PNG Government Department of Business Development. Wild colonies from buildings were used, and in 1975 seventy colonies were established in different environments throughout the Western Highlands.

During 1972 Fowke estimates that in the Goroka area 2,000 pounds (909 kg) of honey were sold at an average of 35c per pound (75c per kg) to individuals, to the Bird of Paradise Sanctuary at Baiyer River, to the Highlands Tobacco Factory, and to Kabiufa High School and the Hagen Health Food Shop both of which retailed it to the public. The above amount, together with that used for personal consumption and given to friends totalled about 2,400 pounds (1,090 kgs) from 16 productive hives indicating an average annual yield of 150 pounds (68 kg) per hive.

In January 1973 Janco Ltd of Japan submitted to the Director of D.A.S.F. a proposal to establish beekeeping trials in Papua New Guinea in a joint venture with Nisshin Honey Company of Japan. The agreement was that Nisshin Honey Company would provide some management services and funds for day-to-day operations, from their office in Port Moresby. The joint company was to be known as Bunging Pty. Ltd. In June negotiations began between Janco Ltd and Fowke over the purchase of bees and equipment and in August 1973 a representative of Nisshin Honey Co. arrived in Goroka to being operations. Forty-five hives were bought locally and established at the DASF extension centre at Fimito. In addition eleven colonies were obtained from Kabiufa and established at Lapegu forestry station near Goroka. In November a technical school graduate, was employed and given brief training.

However the Japanese venture is presently in abeyance, leaving about 130 colonies on various sites around the Goroka area.

During 1975 the hives were supervised by the PNG Department of Business Development in an effort to expand the project, the colonies in the Western Highlands being left under the supervision of a trainee.

During 1976 this trainee has undertaken several modest enterprises with his six colonies at Kend near Mount Hagen. In August 1976 two technicians were selected to do five months further training in beekeeping with the South Australian Department of Agriculture, sponsored by the Australian Development Assistance Agency.

In the meantime negotiations had begun between the PNG and New Zealand Governments to commence a bilateral aid programme of research into beekeeping potential in PNG. Goroka has been chosen as the location for trials, because of its apparent high beekeeping potential, its central position, existing facilities and Apis mellifera stock.

In October 1976 a New Zealand apiarist arrived in PNG, and since then 200 colonies have been split into 500 colonies to receive 500 Italian queens from New Zealand. Trial hives have also been established in coastal areas such as Port Moresby.

Discussions

In Papua New Guinea's villages the demand for consumer goods is rising, as are the costs of community obligations such as taxes. Thus with the move of PNG to independence on 16 September 1975, the need to generate revenue locally became more essential, and one way of achieving this is to encourage the development of small-scale rural-based industries.

Honey production is one such possibility. If the trials under way shows that honey production in PNG is likely to be economically viable, it could reduce expenditure on honey imports (average K 58,000 per annum) and provide a source of local revenue on a smallholder basis without large cash investment.

References

1. Dawson, C. (1975) personal communication
2. Donaldson, (1975) personal communication
3. Dressman, D. (1975) personal communication
4. Fowke, J. (1975) personal files
5. Fox, J. (1975) personal communication
6. Gibbs, R. (1976) personal communication
7. Hatcher, D. & J. (1975) personal communication
8. Johnston D. (1977) personal communication
9. Makap, N. (1975) personal communication
10. McKenzie, G. (1977) personal communication
11. Michener, C.D. (1963) The establishment and spread of European honeybees in Australian New Guinea. Bee World 44: 81

11b. Michener, C.D. (1963) A futher note on Apis mellifera in New Guinea. Bee World 44:114

11c. Michener, C.D. (1965) A classification of the bees of the Australian and South Pacific Regions. Bulletin of the American Museum of Natural History, Volume 130. New York.

12. Papua New Guinea Development Bank Files - Honey
13. Schindler, A (1975) personal communication
14. Shannon, R. (1975) personal communication
15. Swincer, J. (1976-77) personal communication
16. Wunsch G,(1975) personal communication

(A fuller report by the author can be consulted at the IBRA library.)

KEY TO VEGETATION TYPES IN TABLE 1

G — Gardens - Staple crop is sweet potato (Ipomoea batatas). Sugar cane, local green vegetables, taro (Colocasia), cabbages, bananas (Musa), often under the shade of Casuarina trees.[a]

GR — Garden regrowth - Weed growth in gardens varies considerably, depending upon the initial conditions of the site and on subsequent factors such as access of pigs. Common pioneer herbs include Polygonum, Amaranthus, Wahlenbergia, Cynoglossum, Sida, as well as many Compositae such as Crassocephalum, Erctites, Bidens and Sigesbeckia. By the second or third year of fallow, the plot is ususally dominated by sword grass (Mixcanthus floridulus). [a]

IG — Induced grassland - Result on the original vegetation of long term interference through clearing, burning and gardening. Four main types dominated by Capillipedium parviflorum, Themeda australis, Ischaemum polyestachyum and Imperatea cylindrica.

LHF — Lowland hill forest - Characterized by very mixed composition, with many hardwood species of the mixed tropical families Meliaceae, Sapindaceae, Sapotatceae, and Leguminosae.[b]

LMF — Lower montane forest - Dominated by oaks (Castanopsis) and beeches (Nothofagus) and, increasingly, conifer species.[b]

SG, SR — Sword grass and shrub regrowth - Tall grasses dominated by sword grass (Miscanthus floridulus), generally mixing with regenerating trees and shrubs especially Antidesma, Agapetes, Acalypha, Callicarpa Dodonaea, Ficus, Grevillea, Glochidion, Macaranga, Osbeckia, Rhododendron Schefflera, Schuurmansia and Wendlandia.

SPF — Sago palm forest - Dominated by Campnosperma coriacea.

Sources

a. Ford, E. (1974) Papua New Guinea Resource Atlas. Jacaranda Press. Australia

b. Perry, R. et al. (1965) Lands of the Wabag-Tari Area Papua New Guinea. Land Research Series No. 15 C.S.I.R.O., Australia.

TABLE 1

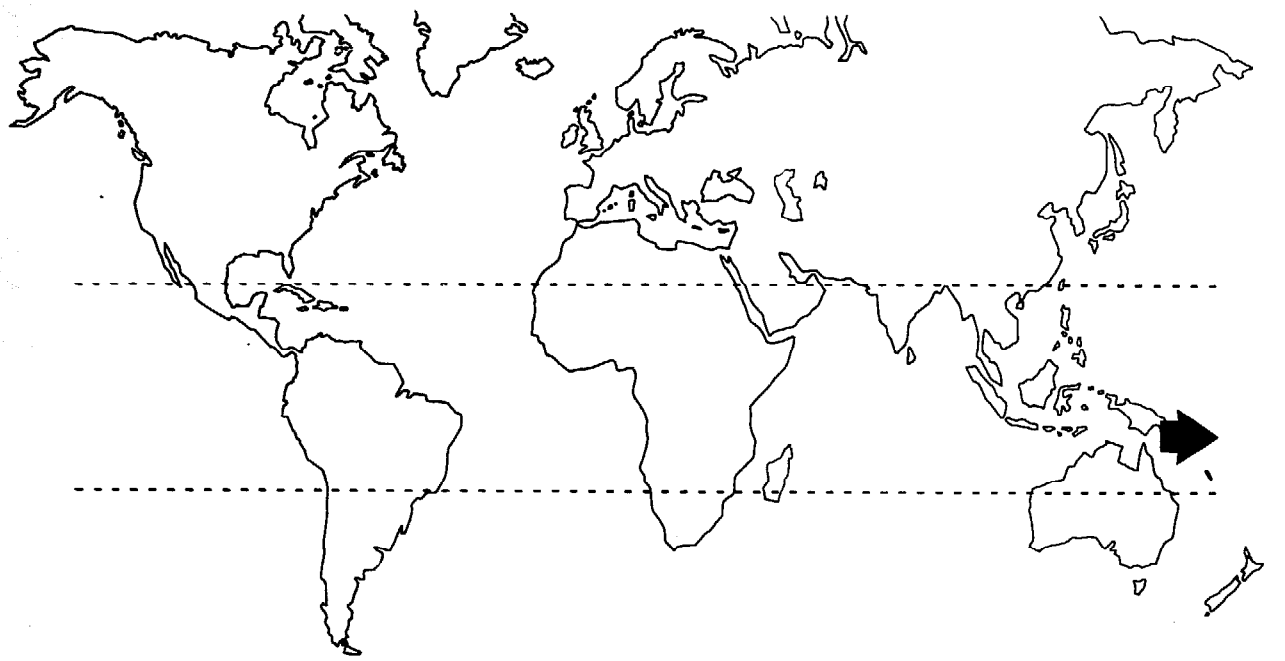
ENVIRONMENTAL CHARACTERISTICS OF NAMED LOCALITIES

LOCATION	ALTITUDE (m)	MEAN ANNUAL RAINFALL (mm)	MEAN ANNUAL SUNSHINE	AVERAGE ANNUAL INDEX % REL 0900, 1500	MEAN ANNUAL TEMPERATURE Max , Min	DOMINANT VEGETATION (See Key)
Aiyura	1570	2156	1688	79 , 73	24.1 , 13.2	IG
Baiyer River	1175	2614	-	-	28.3 , 15.6	SG, SR, LMF
Bosavi	259	-	-	-	- , -	LMF
Bubia	15	3025	1911	84 , 75	32.3 , 21.6	LHF, IG
Erave	1035	3405	-	-	26.3 , 13.9	LHF
Goroka	1565	1921	1764	85 , 57	25.7 , 14.6	IG, G, GR
Kagua	1554	3080	-	-	- , -	SG, SR, G, GR
Kandep	2316	2246	-	-	- , -	SG, SR, G, GR
Koroba	1676	3331	-	-	- , -	SG, SR, G, GR
Kutubu	810	4735	-	85 , 74	28.5 , 18.1	SPF, LHF
Lae	15	4617	2012	82 , 71	29.7 , 22.9	IG, SR
Laiagam	2134	2162	-	-	- , -	SG, SR, G, GR
Lumi	535	2646	-	89 , 78	27.4 , 20.2	SPF, coconut plantation GR
Markham (Erap)	260	1248	-	81 , -	32.8 , 21.7	IG
Mendi	1675	2800	-	79 , 75	23.5 , 12.7	SG,SR,LMF,G,GR
Minj	1565	2485	-	-	25.2 , 13.8	IG, G, GR
Mt. Hagen	1630	2586	-	87 , 67	23.7 , 13.0	IG, SR, G, GR
Port Moresby	35	995	2478	77 , 67	31.0 , 22.6	Eucalyptus savanna
Tambul	2241	2617	1292	-	- , -	SG, SR, G, GR
Tari	1600	2693	-	82 , 72	23.9 , 13.1	SG, SR, G, GR
Vaimauri River	10	-	-	-	- , -	LHF, planted teak
Wapenanmanda	1768	2488	-	-	- , -	SG, SR, G, GR
Wattut (Wau)	1065	1843	-	81 , 62	28.0 , 16.4	SG, Sr, LMF
Wewak	5	2219	-	82 , 75	30.3 , 23.0	LHF, GR,coconut plantation

-: no data available

Source of climatic data

MCALPINE, J., KIEG, G, SHORT, K. (1975). Climatic tables for Papua New Guinea. Division of Land Use Research Technical Paper No. 37, C.S. R.O., Australia.



BEEKEEPING DEVELOPMENT PROGRAMMES IN THE TROPICAL AND SUB TROPICAL PACIFIC

by G.M. WALTON
(Apicultural Advisory Officer, Ministry of Agriculture and Fisheries, New Zealand)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 159-164)

BEEKEEPING DEVELOPMENT PROGRAMMES IN THE TROPICAL AND SUB TROPICAL PACIFIC

by G.M. WALTON
(Apicultural Advisory Officer, Ministry of Agriculture and Fisheries, New Zealand)

(From "Apiculture in Tropical Climates", IBRA, London 1976, Pages 159-164)

Introduction

The Pacific ocean covers almost one third of the surface of the earth. With the exception of the major continents bordering the Pacific, very little is heard about tropical and Subtropical beekeeping in this region (Fig. 1). It is apiculturally distinct from the other tropical regions. With the exception of some Island groups on the western periphery (Indonesia, Philippines, Taiwan), the Pacific has no indigenous Apis species. The European races of Apis mellifera that are present have been introduced by man during the last two centuries. Apis mellifera adansonii has not been introduced to the Pacific region - fortunately. In the absence of a long association with honeybees, the peoples of the tropical and subtropical Pacific (the Melanesians, Micronesians and Polynesians) have not developed any traditional or cultural associations with honeybees.

In recent years considerable interest has been generated in beekeeping within the Pacific region, and a number of development programmes are currently under way. Part of this new awareness can be attributed to the emergence of a number of small independent Pacific nations, each looking for ways of improving the economic and cultural welfare of its peoples.

New Zealand Apicultural Aid Programmes

As a Pacific country New Zealand has directed most of its development aid efforts towards its neighbours in the Pacific region. In recent years New Zealand has been associated with beekeeping development programmes in the following countries:

1. Papua New Guinea

New Guinea is the largest single island land mass in the Pacific Ocean. Two countries, Papua New Guinea in the east, and Indonesia (Irian Jaya) in the west, share this mountainous land.

European honeybees have become well established in the Highland regions of Papua New Guinea (12). Early beekeeping development was stimulated by expatriates, including the missionaries (2). In recent years an active development programme has been promoted by the Papua New Guinea Department of Agriculture, Stock and Fisheries (DASF). A beekeeping teaching programme has been introduced into all high schools in the Western Highlands, and village beekeeping projects have been encouraged. The DASF is evaluating the potential of beekeeping at cottage, semi-commercial or small-holder, and commercial levels (17). A research programme is also under way, examining floral sources, climatic effects and hive types. Two young DASF officers are currently undertaking six

months of practical training and study in Australia.

As part of its bilateral aid programme, New Zealand is assisting Papua New Guinea by providing beekeeping advisers, hives, and servicing equipment. The aims of the aid project are to determine the potential for beekeeping in the Goroka area of the Eastern Highlands District, and to provide training for beekeeping advisers and persons wishing to take on beekeeping as a commercial or small-holder venture (16). An experienced New Zealand beekeeper has recently been sent to Goroka for two years to help the DASF establish the project. During this period it is proposed to increase the number of Government-owned hives to 500, and to operate them as a honey-producing venture, any profits being used for further beekeeping research and development. During the second year emphasis will be placed on expanding the industry by:

(i) selling hives to potential beekeepers in areas where beekeeping is known to be feasible

(ii) extending the advisory service

(iii) providing extraction and marketing facilities for beekeepers

(iv) assessing the beekeeping potential of other areas

2. Niue

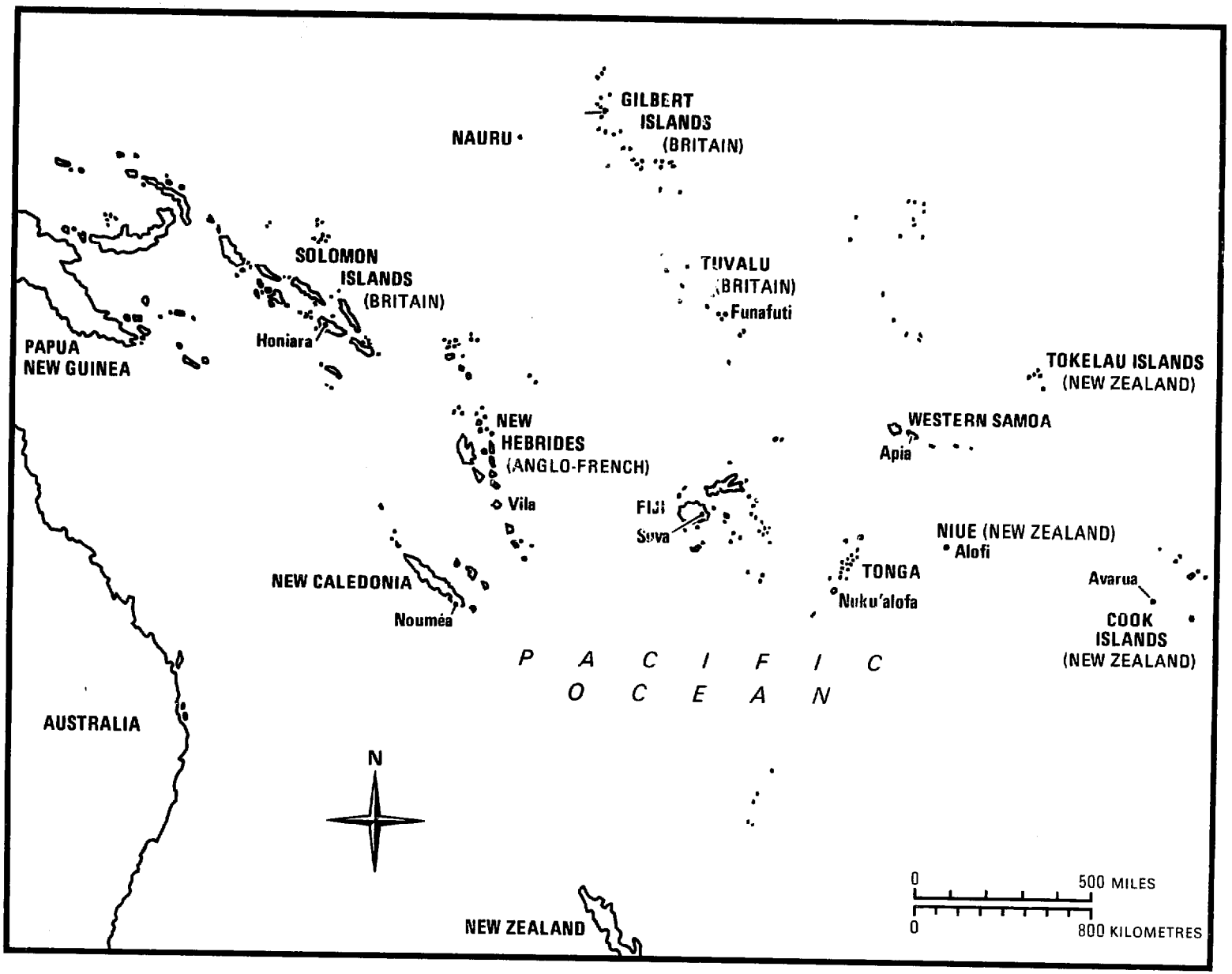
For its size the island of Nuie is probably the most intensively bee-farmed country in the world. With an area of only 259 square kilometers, this island contains one commercial beekeeping unit of 1200 hives, producing an average of 50 tons of honey per year (8). The honey industry is second only to the passionfruit industry as an export revenue earner for Niue.

New Zealand has been closely associated with the development of beekeeping on Niue Island. At the invitation of the Niue Island administration, a New Zealand Ministry of Agriculture and Fisheries adviser assessed the prospects of commercial honey production in 1966. As a result of a most favourable report, a New Zealand beekeeper, Mr. J.B. MacKisack, in association with the Niue Island Development Board, transferred 650 hives from New Zealand in 1967 (11,19). Honey from Niue Island is marketed through the New Zealand Honey Marketing Authority depot in Auckland.

Earlier this year the New Zealand Ministry of Foreign Affairs sponsored a three-month training programme in New Zealand for the manager of the Niue Island honey company, on aspects of hive management and honey marketing.

3. Tonga

More recently, another New Zealand commercial beekeeper, Mr. D.L. Ward, in association with the Government of Tonga, has established a honey-producing business on the main island of Tongatapu (260 sq km). Four hundred hives were shipped from New Zealand in 1971-1972 (21). A New Zealand aid grant of $NZ16,000 in 1975 increased the hive holding to 900. Tonga is hoping to develop a queen-exporting industry.



The Pacific: map showing named localities

Other islands in the Tonga group, including Vavau (119 sq km) and Eua (87 sq km) may be able to sustain honey-producing enterprises (20).

4. Gilbert Islands

The Gilbert Islands are a series of 16 atolls (average area 16.5 sq km) spanning the central Pacific equator. At the request of the administration, New Zealand sent an adviser in 1975 to determine the feasibility of establishing beekeeping operations in the Gilberts. With the exception of the Line Islands, there are no honeybees in the Gilbert group.

A number of features of the atoll environment limit the opportunities for commercial or semi-commercial beekeeping development. These features include the limited foraging terrain, an unreliable fresh water supply, isolation from sources of supply and markets, and a high human population density (16). Small numbers of hives could do well in the atoll situation. Exceptional honey yields per hive have been recorded on Wake Island (7,10) well to the north of the Gilbert Group, and bees have also done well on Canton Island in the Phoenix Group.

5. Western Samoa

Western Samoa consists of two large islands, Upolo (1114 sq km) and Savavai'i (1820 sq km). Beekeeping on an amateur scale has existed for many years, but there is also a potential for commercial operations (19). The Government of Western Samoa has recently sought New Zealand assistance in evaluating their islands for honey production, and this may be forthcoming. An independent survey has been made by a New Zealand citizen with a view to establishing a private beekeeping venture there (14).

Other Aid Projects

In addition to the assistance given by the New Zealand Government through its bilateral aid programmes, there are other beekeeping development projects in the Pacific. These include Rarotonga and Fiji.

Rarotonga

Rarotonga is the largest island (67 sq km) in the Cook Islands group. The Auckland Bee Club of New Zealand has embarked on an ambitious community beekeeping project, that could be the forerunner of other village beekeeping projects in the Pacific. Ten hives were recently established on Rarotonga, and a further shipment of 10 hives is planned (14). The hives will form the nucleus of a demonstration apiary under the supervision of a local Department of Agriculture officer.

Fiji

The Fiji Islands are about as far south of the equator as the Hawaiian Islands are north of it, and in land mass are slightly larger (18,272 km). Fiji appears to offer considerable potential for beekeeping development (6, 9). At present beekeeping is limited to amateur or small-scale commercial operations.

A beekeeping survey initiated by an amateur beekeeper in Suva is being carried out with the approval of the Fiji Department of Agriculture. Its objects are to evaluate the potential for honey production, to study the feasibility of a beekeeping cottage industry, and to provide a means of educating the population about bees and beekeeping (5).

References

1. Coyle, T.J. (1976 Personal communication

2. Dawson, C. (1973) Beekeeping project for Papua New Guinea. N.Z. Beekeeper 35 (4): 19-20

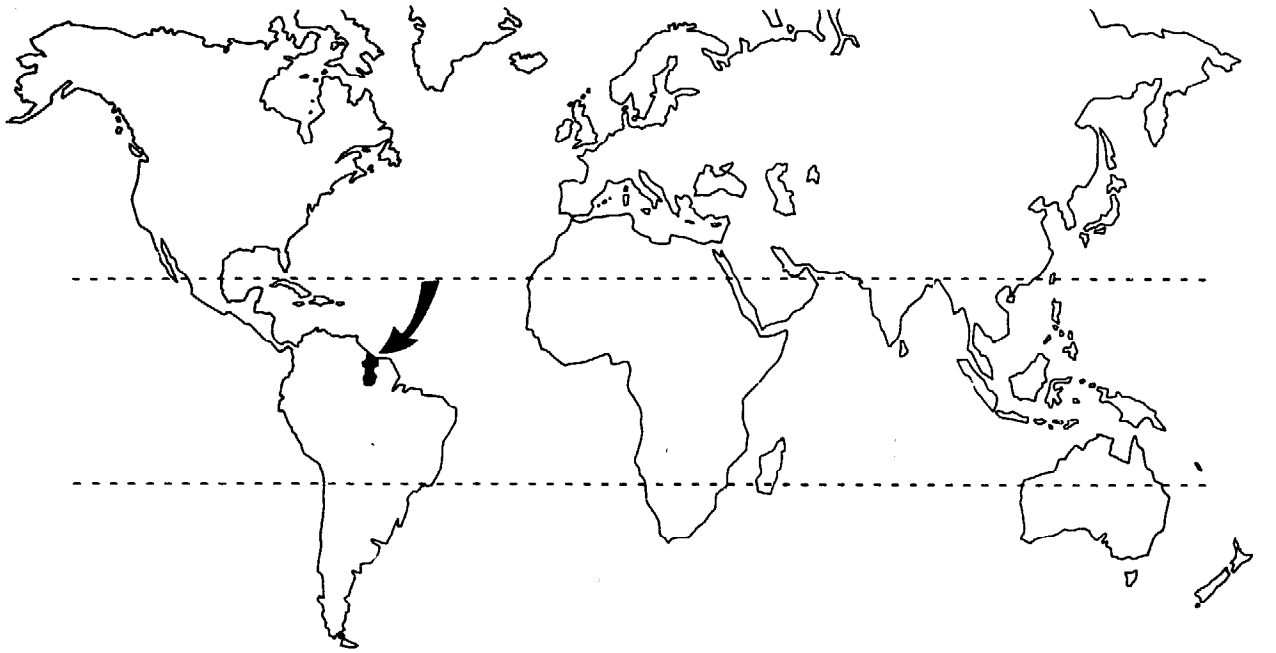
3. Dyce, E.J. (1959) Beekeeping in the 50th State (Hawaii). Glean. Bee Cult. 87 (11) : 647-651

4. Eckert, J.E. Bess, H.A. (1952) Fundamentals of beekeeping in Hawaii. Ext. Bull. Univ. Hawaii No.55 : 59 pages

5. Fox, J. (1976) Personal communication

6. Gregory, G.B. (1961) Rural industry beekeeping. Agric. J. Dep. Agric. Fiji 31: 42-43

7. Hitchcock, L.E. (1975) Personal communication



BEEKEEPING IN THE GUIANAS *

by GARD W. OTIS AND ORLEY R. TAYLOR, JR.
(Departments of Entomology and Systematics and Ecology
University of Kansas, Lawrence, Kansas 66045)
(original contribution)

BEEKEEPING IN THE GUIANAS *

by GARD W. OTIS AND ORLEY R. TAYLOR, JR.
(Departments of Entomology and Systematics and Ecology
University of Kansas, Lawrence, Kansas 66045)

Original Contribution

Introduction

Since the introduction of the African bee (Apis mellifera adansonii) in South America, there have been many conflicting reports concerning the effects on beekeeping of the rapid spread of European-African (Africanized) hybrid bees. This article attempts to document the number of beekeepers in the Guianas, their beekeeping practices, and honey and wax production, before the arrival of the Africanized bees. Using this information as a base, it should be possible in the future to assess the effects of Africanized bees as they become abundant in this region, and the time span over which these effects operate.

The Guianas, which considered together are nearly the size of Sweden, consist of three separate political entities situated between 1°13' and 8°24'N, on the north-east coast of South America. French Guiana (a Department of France) is the smallest, with a primarily non-agricultural human population of 55,000. Surinam (pop. 400,000) and Guyana (pop.800,000) are larger countries, more agriculturally and rurally oriented, and more densely populated. The majority of the population, and consequently most of the beekeeping, are confined to a narrow band within 50km of the coast, and often much less (10 km in French Guiana).

This coastal strip is a diverse area with several different habitats: urban area, mangroves, swamps, salt- and fresh-water marshes, fertile coastal plains (in Surinam and Guyana), savannahs, and forests. The sparsely inhabited interior is predominantly rain-forest, except for an extensive region of savannah in extreme southern Surinam and south-western Guyana.

The climate of the coastal region is typically equatorial, with variable but high rainfall, and with greater daily than yearly temperature fluctuations. The mean temperature, 27°C is nearly constant throughout the year with usual day/night differences of only 3°; extreme temperatures rarely exceed 31° in the day or fall below 22° at night. Meteorological records from Paramaribo, Surinam, portray the precipitation pattern typical of this region (Fig.1). Here the yearly rain-fall average between 1901 and 1960 was 2202 mm (87 in) with a range from 1555 to 2559 mm (61 to 101 in). Rainfall in Georgetown,

---

* This research was supported by the United States Department of Agriculture (USDA 12-14-7001-363). Contribution number 1625 from the Department of Entomology, University of Kansas.

Guyana is 2207 mm (87 in), roughly equal to that of Paramaribo[4]. French Guiana, however, receives considerably more precipitation. For example, the average for Kourou is 2820 mm (111 in), with slightly more pronounced wet and dry seasons (Fig. 1).

The coastal region is characterized as having a tropical rainy climate [5]. Rainfall is heaviest from December to July. The primary dry season follows, beginning in late July or August and extending to November or December; it is characterized by clear sunny days, with occasional showers usually in the evening. In addition, there is often a dry period of 2-6 weeks in March or April. The dry seasons are only moderate in severity, and there are no areas in this region where the vegetation becomes noticeably deciduous.

Nectar and Pollen Sources

By far the most important source of nectar is the black mangrove (Avicennia nitida), known in Guyana as "courida", which lines nearly the entire coastline and estuaries of the Guianas. Many beekeepers not living near the coast keep their bees in mangrove areas to increase honey production. Black mangrove nectar is estimated to account for 90% of all Guyana honey (Allicock, personal communication). The major nectar flows occur during the two dry seasons, and heavy rains during these periods can greatly reduce honey production.

Several other common trees are worth noting. Coconut palms (Cocos nucifera) are found at the coast as well as further inland near human habitations, and serve as both a pollen and a nectar source [3] which may be important because the trees bloom all year. The papilionaceous legume, Pterocarpus officinalis, is found in coastal marshy habitats. Although individual trees bloom for only one week, the entire flowering season extends from January to March. Triplaris surinamensis flowers from mid August to mid September, thus overlapping with the black mangrove. This species is distributed further inland than the others mentioned. It serves as an important nectar source for bees kept farther from the coast (e.g. Paramaribo region, Surinam). Some beekeepers blame their decreasing yields in this region on recent lumbering of Triplaris for use in the manufacture of plywood. Citrus and mango (Mangifera indica) provide nectar and pollen near human habitations.

The general flowering phenology (appendix) has been assembled from Crane [1] and from observations by K. van Deursen in Surinam. The list is not intended to be comprehensive. Most of the species bloom during one or both of the dry seasons.

Effects of the Seasonal Cycle

Brood production, honey storage, and swarming are strongly influenced by climate and abundance of resources. Brood production is generally strong during the two dry seasons as a result of good foraging conditions and/or abundant resources (appendix). During the wetter months, however, insufficient brood is reared to maintain colony strength, and colony populations can become dangerously small. Beekeepers often have to feed their bees during these periods, mostly in June and July, although in some years from February to May also.

Nectar surpluses are accumulated during the dry seasons, and the major honey crop is harvested in October or November. Occasionally a second, smaller crop is extracted in April.

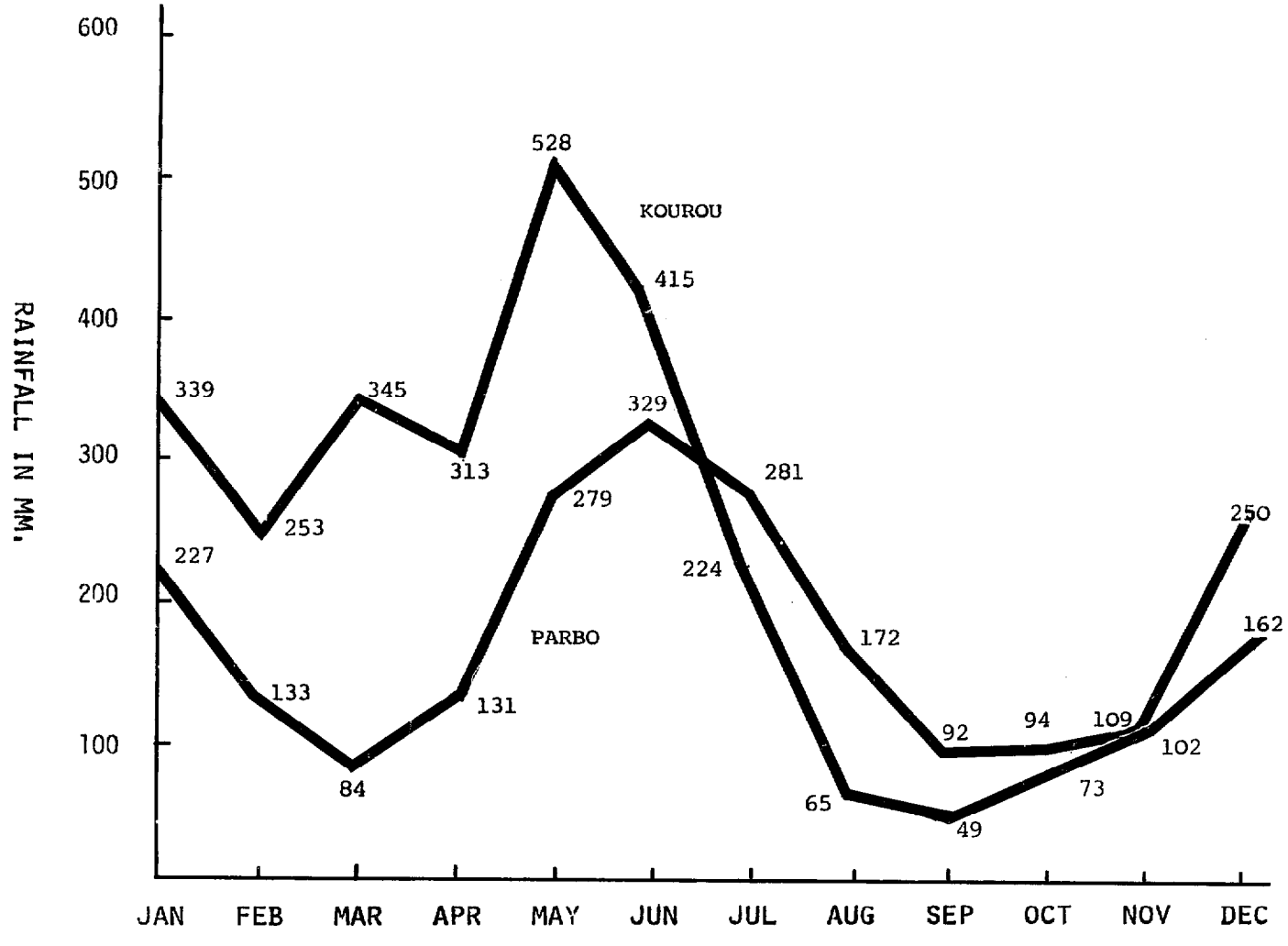


Fig 1. Annual rainfall distribution at Kourou, French Guiana (1965-1975) and Parbo, Suriname

Extended cloudy and rainy periods often occur from December to July, during which rain can wash or dilute nectar from flowers and reduce foraging to a few hours a day. During these periods bees utilize honey and pollen stored during the previous dry season.

Swarming is relatively uncommon, and in some years none occurs, presumably as a result of poor foraging conditions throughout much of the year and lack of crowding in the colonies. LeClerc in French Guiana observed that his colonies swarmed from February to April, most swarms issuing in March. In Surinam most swarming is reported to occur in August and September (van Deursen, personal communication), of these swarming periods coincides with the beginning of a dry season.

Historical Perspective

Beekeeping is not a well developed industry in any of the Guianas. European bees (A.m. ligustica) were first introduced into the region in Surinam in the later 1800s via the Caribbean islands. Here beekeeping flourished in the 1930s and 1940s, especially in the Coronie area along the western coast where several thousand colonies worked black mangrove. In 1932-33, 26,636 litres of honey were exported from Surinam,most of which was produced in Coronie. However, during and after World War II, the numbers of beekeepers and colonies decreased rapidly, and now there are only 130 colonies and 5 beekeepers in Coronie. Partly as a result of this reduction, Surinam now imports small amounts of honey. Possible reasons for the decline are emigration of people from Coronie to Paramaribo; reduced productivity due to erosion and destruction of the mangrove; absence of capital and young people interested in beekeeping; increased production costs.

At present only 36 people are known to keep bees in Surinam. They have 775 colonies, an average of 20.4 per beekeeper. Some rural farmers maintain bees, but the total number of managed colonies in Surinam is estimated to be less than 1000.

In Guyana there was a general expansion of beekeeping after the first introduction of Italian honeybees from North America in 1920; the recent slight decline is probably due to decreased interest by young people. Presently there are about 300 beekeepers, with about 2000 colonies altogether, most of which are found along the coast from the Pomeroon River east to Surinam. A few small operations are scattered in the south western savannah region. Recently, in a government-sponsored project, over 300 colonies were introduced to the extensive mangrove forests near Baramanni in the coastal north west. There have also been at least three attempts to introduce honey-bees to the forested interior at Mahdia and Ebini. These efforts have been generally unsuccessful, the former due to pesticide problems and the latter because of high rainfall and long dearth periods.

In French Guiana, Dr. LeClerc introduced about 20 colonies of Italian bees from Bologna in 1969, but he died 4 years later, and by 1975 only 15 colonies remained.

Many stingless Meliponin bees native to the Guianas can easily be kept in small hives but they are seldom used for honey pro-

duction, and then usually by people who also keep Italian bees.

Beekeeping Organizations and Government Support

Until recently beekeeping in Surinam was always an individual undertaking,often requiring considerable capital of equipment and bees. The founding of a beekeepers' association, Imkers Vereniging Surinam (P.O. Box 459, Paramaribo) in February 1975 siginificantly altered this situation. The goals of this association are to unify beekeepers for purpose of sharing equipment and technical expertise, to generate an interest in bees by non-beekeepers, to expand the honey industry in Surinam, and to disseminate information to beekeepers. The present means of achieving these ends are through educational services, such as the organization's journal, Imker Koerier, films and a ten-session course on the fundamentals of beekeeping. Also, supplies can be purchased in large quantities to reduce costs. The Imkers Vereniging is young and active, and is presently doing much to help the beekeepers of Surinam, where there is no governmental support for beekeeping operations.

The situation in Guyana is different, due to the existence of the Apiary Division of the Department of Agriculture. The Guyana Bee Officer and his two assistants have assumed most of the functions of the Guyana Beekeepers' Association, now 44 years old. The bee officers, who are employed by the government, regularly visit beekeepers, offer assistance and advice to those having difficulties, encourage beekeeping among non-beekeepers, and provide beginners with an initial nucleus colony from the government apiary at nominal cost. At present they concentrate their efforts toward the smaller operations, which have most need of assistance.

In an attempt to revitalize the honey industry, the Guyana Beekeepers' Association has recently requested governmental funds for the purchase of queens and equipment, the hiring and training of additional personnel, and the building of a honey marketing and distribution centre. The Guyana government has funded one major beekeeping experiment already mentioned which involved the equivalent of more than US$ 15,000. This covered the building of a honey-processing centre, and the purchase of supplies, queens and package bees to establish 325 hives in the previously unexploited black mangrove forests at Baramanni.

Unfortunately these apiaries declined to about 25 colonies, probably due to the use of pesticides in the area, although other factors cannot be excluded. The difficulties with this experiment, and with the introductions in the interior, could dampen efforts to expand beekeeping into new areas of Guyana.

Equipment and Supplies

Beekeeping equipment has been imported from Britain, France Canada and the United States, and is made locally usually patterned after the 10-frame Langstroth hive. Imported wood is preferred, especially for frames, because it is well dried and resists warpings. Increased costs of foreign equipment

and wood have recently reduced imports. Foundation is normally imported, but a small amount of high-quality foundation is produced by two beekeepers in Surinam for their own use. Most other beekeeping appliances except extractors are constructed locally. Homemade hives and frames often lack the appropriate "bee-space", and are therefore "cross-combed" by the bees, making inspection and management difficult.

Obtaining queens when needed can be a serious problem where there are no queen-rearing facilities. In the Guianas, most beekeepers rely on natural supercedure. New colonies are started by making divisions: frames containing eggs, young larvae and sealed brood are placed in an empty hive with a large number of workers. Queens are reared from the young larvae in emergency queen cells. This same principle is employed when a colony becomes queenless, a frame with eggs and/or young larvae being placed in the colony. Few colonies are acquired by capturing swarms, because the incidence of swarming is low. Until a few years ago, the government apiary in Guyana produced about 100 queens annually which were distributed to local beekeepers. This programme has been discontinued because of a reduction in staff. Queens and package bees are imported only in Guyana, but there has been a recent decline due to increasing costs.

Beekeeping Products

Few beekeepers in this region keep accurate records of yields, but it appears that honey production varies greatly, as a result of beekeeping practices, local floral resources, and heavy rainfall during honey flows. Leclerc obtained 30 litres per colony annually in Cayenne, French Guiana (personal communication), and under the best conditions in Surinam and Guyana yields are slightly greater. However, yields of 5 to 20 litres are typical, the lower yields often being associated with poorly maintained combs and/or lack of expertise in management. Heavy rains can also eliminate surpluses, as in 1973 in Coronie, Surinam, when no honey was extracted. Honey production in these countries is not sufficient to meet demands and some honey is imported (e.g. 24,000 lb in Guyana in 1973, 10,000 lb in 1974; 1,500 lb in Surinam in 1973).

Honeys in the Guianas are highly variable in quality. Most are amber in colour with a rather strong taste. Honey of exceptional quality is produced from black mangrove (very light in colour with a mild flavour[8], and also from Pterocarpus officinalis (very thick with a mild flavour). Much of the honey, especially that extracted during the wet season, has a high water content.

Honey prices are generally high. In Surinam sell their honey directly to consumers at an average price of US$0.83 per lb. Honey prices vary greatly in different stores, and some imported honey is sold in small quantities for as much as $4.00 per lb. In Guyana, beekeepers sell honey to a central processing company as well as directly to consumers, and prices are lower, ranging from US$0.62 to US$0.92 per lb. All honey sold in French Guiana is imported and sells for about US$2.20 per lb. Apart from the occasional use of beeswax for foundation, no other bee products are marketed in these countries.

Predators, Pests and Pesticides

Many of the general problems in the neotropics affect bee keepers in the Guianas. Predators and pests include several species of ant, robber bees and wasps, greater and lesser wax moths, termites, toads and flycatchers, but no one of these constitutes a serious threat to beekeeping. Problems with pesticides have occurred in certain areas (e.g. Baramanni, Guyana). In addition, the injection of the systemic insecticide monocrotophos into coconut palms, to control two major pests, has been shown to injure honeybees. In a Guyana experiment, the populations of colonies in a coconut grove was estimated to have been reduced by 50% within a week after application of monocrotophos[7]. Widespread use of this pesticide could affect many beekeepers in Guyana and Surinam.

Diseases of brood or adult honeybees are unknown or unrecognised as such. It seems probable that, if pathogens do exist, their occurrence is infrequent and their effects relatively insignificant.

Colonies established by escaped swarms of European bees rarely survive more than a few months in the wild. Exact reasons for this are not know, but the bees may be ill-adapted to survive encounters with predators, or periods of heavy rainfall.

The Africanized Bee

Africanized bees have been recorded recently throughout the coastal region of the Guianas as well as the southern savannah of Guiana[9]. Africanized bees were first observed in French Guiana in August 1974[10]. Later surveys found them further west in Surinam (March 1975, van Deursen, personal communication) and in Guyana (April 1976, G.W.O). As recently as April 1976, Africanized bees had still been present at very low densities in Surinam and Guyana and had had minimal impact on beekeeping. Given the history of the invasion of Africanized bees in South America, however, it is certain that all established colonies will become Africanized, unless colonies are requeened frequently with imported queens. Since these hybrid or Africanized bees differ from European bees in many characteristics[6] that can effect management (Swarming, absconding, sensitivity to disturbance, etc), beekeepers may be forced to make numerous changes in their operations. The ease with which such changes are made will depend on many factors, including the attitudes of beekeepers, beekeeping organizations, the public, and the respective governments.

It is of interest to note that in our many contacts with beekeepers we learned of no major stinging incidents in recent years. On the contrary, the Italian bees kept in this region are as gentle and manageable as those of North and Central America. In addition, although beekeepers sometimes complain of difficulties with dwindling and starvation, absconding a problem with Africanized bees under unfavourable conditions - is not known to occur.

It will be interesting to compare and contrast the observations reported here with similar notes made 5 and 10 years hence. We will resist the temptation to predict the effects of Africanized bees on beekeeping in the Guianas, except to reiterate that the adaptability of the beekeepers is one of the most important factors.

Acknowledgements

This paper could not have been written without the enthusiastic support and co-operation of many people in the Guianas. We are especially grateful to Kees van Deursen and Paul D. Allicock who provided much of the information used. Some of the comments on beekeeping in French Guiana were obtained from correspondence (1975) between Patricia Richards (University of Michigan) and Dr. Leclerc (Martinique), and we thank them both. The comments and criticisms of Kees van Deursen, David W. Roubik and Constance Corbett Otis are greatly appreciated.

References

1. Crane, E. (1973) Honey sources of some tropical and subtropical countries. Bee World 54: 177-186

2. Hoock, (1971) Les savannes guyanaises: Kourou. Essai de phytoecologie numerique. Paris. Memoires ORSTOM No. 44

3. Jay, S.C. (1974) Nectar and pollen collection by honeybees from coconut flowers. Bee World 55:105-111

4. Kendrew, W.G. (1922) Climates of the continents. Oxford: Clarendon Press

5. Landsberg, H.E.: Lippmann, K: Paffen, K.H: Troll, C (1963) World maps of climatology, Berlin: Springer-Verlag, E. Rodenwaldt and J. Jusatz under the sponsorship of the Heidelberger Akademie der Wissenschaften.

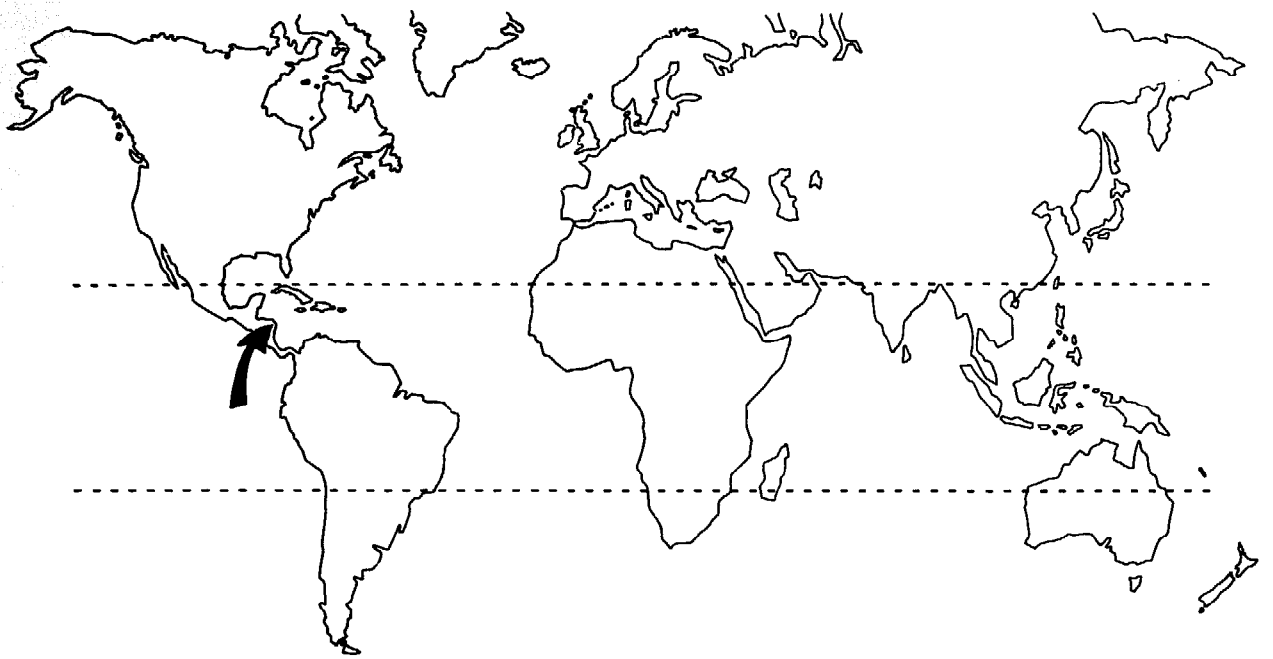
6. Michener, C.D. (1975) The Brazilian bee problem. Ann. Rev. Ent. 20: 399-416

7. Raj, B.K.: Allicock, P.D., Delph, G. Effect on honeybees from injection of monocrotophos in coconut palm. In preparation.

8. Robinson, F.A.: Oertel, E. (1975) Sources of nectar and pollen, from The hive and the honeybee, Dadant and Sons, 283-302.

9. Taylor. O.R. (1977) Past and possible future spread of Africanized honeybees in the Americas. Bee World 58 (1): 19-30

10. Taylor, O.R.: Williamson, B. (1975) Current status of the Africanized honeybee in northern South America. Amer Bee J. 115: 92, 93, 98, 99.



BEEKEEPING IN BELIZE

by HENRY C. MULZAC

BEEKEEPING IN BELIZE

by HENRY C. MULZAC

Introduction

Belize is located on the east coast of Central America, bounded on the north by Mexico and on the west and south by Guatemala. At 22,000 sq km, Belize is about twice the size of Jamaica; slightly larger than the republic of El Salavador, and is the second smallest country on the American continent. The climate is sub-tropical, and it has been demonstrated that the natural environment of Belize is very favourable to beekeeping (5). This paper describes the introduction of Apis mellifera to Belize and the beekeeping industry as its exists today.

Beekeeping In The Early Years

Although beekeeping with Apis mellifera is just 20 years old in Belize (formerly British Honduras), it has a beekeeping heritage that dates from antiquity. According to Gahne (4), a noted Belizean journalist writer in 1902, "beekeeping has been known in British Honduras as far back as the history of the Colony. Bees were kept in logs in which they first built, the honey being drawn at intervals by probing into the log with a sharpened stick (11). Gahne was certainly referring to stingless bees (Meliponinae), probably to those known in Mopan Maya as "Chuc-Cho". These are the bees believed to be characterized in the Mayan Codex Tro-Cortesianus (14). Stingless bees are still kept in some of the more remote villages of Belize, in the same way as the Maya have done for hundreds of years.

This meliponiculture has now greatly declined, and this is unfortunate because the stingless bees Melipona and Trigona are believed to be more efficient pollinators of certain tropical crops than the imported Apis mellifera. Traditional and mechanized farming methods have contributed to this decline by severely reducing the number of natural nesting sites (1). In 1957, the first hives of Apis mellifera were introduced to the Northern Districts of Corozal and Orange Walk via Quintana Roo, Mexico, by Veterinary Officer John Robbins (13). This introduction was seen as a means of reinstating pollinating insects in an area under intensive cultivation for sugar cane, and of re-establishment of an age-old trade and industry (2). One year after the initial introduction of Apis mellifera to Belize, more than 978 hives were established in the country, with apiaries as far south as the Toledo District (12).

Beekeeping Conditions and Practices

In the sub-tropical climatic conditions of Belize, two distinct beekeeping regions can be distinguished: the Dry Tropical Region (DT) which dominates the northern half of the country, and the Wet Sub-Tropical Region (WST) of the lower southern part.

The DT Region represents almost half the beekeeping area: the mean annual temperature is more than 24°C, and the annual rainfall is less than 80 inches; 4 months have less than 2 inches; and evaporation exceeds precipitation; 3 months have more than 6 inches each. The DT Region has clearly defined wet and dry seasons and is frequently subjected to extremes of one or both conditions. Generally, the rainy season lasts from May to October and dry season from November to April.

Beekeeping conditions in the DT Region are very favourable, and account for nearly 95% of the total honey production. The year starts in mid-November, the final weeks of the rainy season. Requeening (though not widely practised) is done at this time, along with the "equalization of colonies". Swarm control measures (hive manipulations and a Belizean version of the American Demaree system) are instituted in January, March and July, prior to the three nectar flows, which occur in early December, February/March the major flow, and August. August represents the end of the beekeepers' year and is also the time when most beekeepers increase their number of colonies by making divisions (dividing one colony into two, one of which rears a new queen or is given one). Divisions are also made during April as a swarm control measure on premature build up. Drought in the DT Region is always a threat, and beekeepers sometimes provide permanent water vats with feeding reservoirs for the bees near their apiaries. Honey yields in the DT Region average 51 kg per hive.(6)

The Wet Sub-Tropical Region (WST) lies in the southern portion of Belize and constitutes about 25% of the land area. It is characterized by its mean annual temperature of less than 24°C and an annual rainfall of more than 150 inches. Only one month has less than 2 inches (i.e. evaporation exceeds precipitation), and more than 10 months have more than 6 inches each. The WST Region is one of extreme variability. The "break" and "start" of the Wet/Dry Seasons vary from year to year, and so there are no set monthly activities. Usually, the dry occurs between November and March, and a locally termed "Little Dry" occurs in the latter part of August or early September.

The WST Region may appear to have some adverse beekeeping conditions, but it is in fact quite productive in the upland areas with tropical hardwood forests, which provide continuous pollen and nectar sources. The weather is rarely so adverse as to keep the bees in the hives over an extended period, near the brink of starvation. The beekeeping Mayan Indians of this region rely on certain indicator plants to forecast nectar flows and plan their beekeeping activities. The Mayan (Mopan) Indians know that suchah (Cordia alliodora) flowers 5 weeks after the minor nectar source Erythrina glaucus is in full bloom, and all weak colonies must then be built up in time for the upcoming flow. Honey yields in the upland WST Region exceed 75 kg per hive, without the use of elaborate practices and expertise.(8) The more highly cultivated lowland WST Region is less productive, being hampered by easterly winds most of the year, and the average is only 23 kg per hive. For this reason beekeepers in and around the coastal town of Punta Gorda are beginning to establish out-apiaries farther inland and in the uplands, to utilize the lush tropical cover, a

prime contributor to the upland productivity. The WST Region as a whole averages 44 kg of honey per hive.(9)

Pollen and Nectar Sources

There are a great many floral sources which provide nectar to the bees and determine the characteristics of Belizean honey.

Some of the abundant pollen plants are Bixa ornella, Vochysia hondurensis Sprague, Orbignya cohune (Mart) and Mangifera indica. Pollen is abundantly available throughout the year, so supplemental pollen feeding is unnecessary. The major nectar producing plants constitute a wide array of flowering trees. These include Cordia alliodora (Ruiz and Paron) which produces a viscous extra-white honey, and Piscidia piscipula (L), another producer of extra-white honey of extremely good quality. Other major floral sources include Coccobola belizensis (Standl), Bucidia buceras (L), Guaicum officinale and Glyricidia sepium. Again, the diversity is virtually endless, and varies sometimes even within the individual political districts. A list of pollen and nectar sources of Belize is given in Table 1. Some floral sources (such as Lonchocarpus amarus and Sapindus sapondia) produce bitter or otherwise objectionable honey, which is usually fed back to the colonies. An extrafloral source in the northern districts is cut sugar cane during harvesting season. The resulting honey is only of Bakery Grade quality.(7)

Honey Production and the Beekeeping Industry

Belize has in recent years steadily increased its annual honey production to more than 280 tons (1976). And with the recent but rapid expansion of the beekeeping industry to the west (Cayo) and south (Toledo), in conjunction with the present hive density of only 0.75 per square mile, such production could be quadrupled. The distribution map (Fig. 1) shows the main areas of beekeeping activity and the numbers of beekeepers and their hives in the individual districts. The main concentrations continue to be the northern districts of Orange Walk and Corozal, which account for 80% of the honey produced in Belize today. Honey yields in Belize have recently been estimated at 44.5 kg per hive.

Most of the honey produced is exported in 55-gallon drums to the the United Kingdom and a smaller amount to the United States. All exports of honey are transacted by the Federated Beekeeping Co-operatives of Belize (formerly The Norwalk Honey Producers Federation), on behalf of its five member co-operatives. This newly expanded federation provides its members with marketing extension and concessionary services (bee supplies). In order of production, these individual co-operatives are the Orange Walk Beekeepers, the Northern Beekeepers of Corozal, Euri Beekeepers of Cayo, Mopan Beekeepers of the Toledo District and the Lucy St. Anne's of Belize District. The managing committee of the Federation consists of 3 members of the individual co-operatives who, with the support of various government ministries (Trade & Industry and Agriculture) help to formulate beekeeping policy in Belize.

Imports of honey to Belize are negligible; they are subject to a 25% customs tariff to help to promote and protect the developing industry. Domestic consumption of honey in Belize has been, by tradition, for medicinal use and as a sweetener for

infant foods, and for many years amounted to only 28 g per capita capita [11]. But through the use of radio programmes, educational popular publications and agricultural displays, consumption today stands at more than 114 g per capita [10]. This is despite the fact that many other natural sweetners (brown sugar, molasses and tropical fruits) abound at more economical prices. Honey is sold locally in pint bottles at approximately $0.90BH (US$1 = $0.50BH) or in 1-lb plastic jars, notably from the Mopan Farmers' Co-operative which provides the bulk of retail sales of honey in this form domestically.

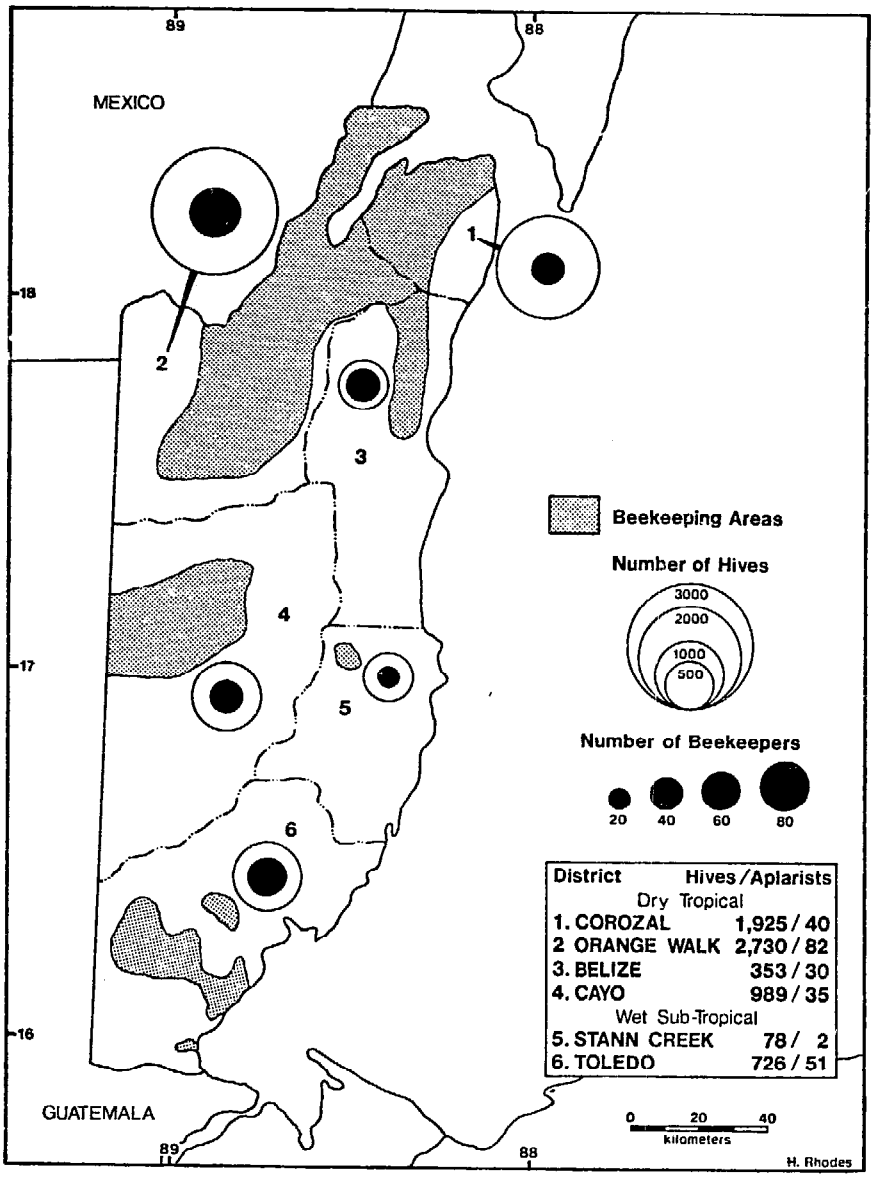
Each year, at the National Agricultural Show, beekeepers and co-operatives from all over the country vie for the best booth, and individual awards are given to the superior grades of extracted, comb and chunk honey and refined beeswax. One traditional use of honey, now diminishing, is practised in the Mayan village of San Antonio: the festive and cultural preparation of a honey wine (mead), known in Mopan Maya as "balche". It was formerly made from Melipona honey, and its potency is strengthened by adding the bark of a tree (Lonchocarpus sp) during the fermentation process. [16]

Beekeeping Materials

Since apiculture is relatively new to Belize, movable-frame hives are in general use, the Langstroth 10-frame hive being the local standard. Some fixed-comb hives are starting to appear in such villages as San Pedro Columbia and Santa Cruz of the Toledo District, where farmers are retrieving feral swarms of Apis mellifera and adopting methods of cultivation simular to those used for Melipona [18]

The main supply of hives and extractors comes from the Mennonite Communities of Spanish Lookout in Cayo, and Shipyard in Orange Walk. These hives are of good quality by Western standards, utilizing such hardwoods as cedar and mahogany, and all frames are self-spacing. There are also substantial imports of Mexican-made hives, which although crude (unplanned and with non-spacing frames) are adequate for local conditions. The poorest quality hives unfortunately come from the sawmills of the Forestry Department. They are not durable, being made from softwoods (Melina), and in general to a modified design to expedite mass production. There are many small hive manufacturers throughout the country whose quality and material vary from place to place.

Only one wax foundation press exists in Belize, and pure beeswax foundation is always in short supply. Most of the wax foundation is imported from Mexico, and as it is only 60-70% beeswax, acceptance by the bees is rather poor. Extractors are manufactured locally by the Mennonities; they are heavy and bulky, but durable and inexpensive. Smokers, hive tools, bee veils and excluders (rarely used) are primarily imported from Merida in Mexico. Occasional but large orders of bee supplies are obtained from the United States and the United Kingdom. Import of package bees from the United States has been discouraged, due to previous experiences with devastating losses. Queen bees are, however, purchased from time to time by individual beekeepers, and arrive in good condition.


89
88
MEXICO
18
17
16
GUATEMALA
1
2
3
4
5
6
Beekeeping Areas
Number of Hives
3000
2000
1000
500
Number of Beekeepers
20
40
60
80
District Hives/Aplarists
Dry Tropical
1. COROZAL 1,925/40
2 ORANGE WALK 2,730/82
3. BELIZE 353/30
4. CAYO 989/35
Wet Sub-Tropical
5. STANN CREEK 78/ 2
6. TOLEDO 726/51
0 20 40
kilometers
H. Rhodes

Government Activities In Apiculture

The Crops Development Division of the Ministry of Agriculture maintains a keen interest in beekeeping, and has two demonstration apiaries and three queen mating stations. At Central Farm in the Cayo District, site of one of the two demonstration apiaries, beekeeping courses are conducted biennially for agricultural personnel who will work in the apicultural sector. The beekeeping seminar covers a wide range of topics, with emphasis on diagnosis and control of bee diseases, and productive bee management in the tropics. The other demonstration apiary is at Central Apiaries in Corozal, where queens are reared, nucleus hives maintained, and inexpensive beekeeping equipment devised. At isolated mating stations, Italian, Caucasian and hybridized lines are maintained, and queens are sold to the industry. Africanized bees do not exist in Belize, and a recently established queen-rearing programme aims to make the import of queens unnecessary.

Beekeeping legislation, as formulated by the government and industry, calls for the yearly registration of apiaries and notification of expansion and areas of practice. The Ministry of Social Services sponsors the 4-H programme, with one of its major projects devoted to beekeeping. Youths from all over the country are trained at the 4-H centre in Belmopan, and they attend an annual beekeeping seminar at one of the country's commercial apiaries. Many are fully equipped with hives, veil, smoker and bees with the stipulation that the revenue from the first honey crop be used to start off another 4-H member. The Development Finance Corporation has very recently begun to give small farmer loans for beekeeping, with low interest rates (6%) and easy repayments.

Pesticides, Enemies and Disease

Beekeeping is firmly established in every district of Belize, except Stann Creek, where there is a pesticide spraying programme instituted by the long-established citrus industry. Poor roads to the district prohibit migratory beekeeping operations away from it. An integrated effort of the beekeeping industry and the Citrus Growers' Association could have mutual benefits. Pesticide spraying also occurs in the Orange Walk and Corozal Districts for the cane industry, but agreements between the Cane Farmers' Association and the Beekeeping Co-operatives involved have substantially reduced bee losses as a result of spraying.

Other troubles faced by the Belize beekeeping industry include Chalkbrood (Ascosphaera apis), rarely if ever fatal but potentially debilitating throughout the year. Nosema disease infects colonies slightly during the rainy season, and if left untreated will recur each year. American foul brood is less common, but where it occurs it usually affects entire apiaries.

Enemies include the bird known by its French call "qu'est-ce qu'il dit" or kiskadee (Sulfaratus trinatus), and the bufo toad (Bufo valliceps), which takes bees at the hive entrance. One toad dissected by the author contained 106 honeybees. Finally, the marching army ant (Eciton sp.) has a great appetite for bees, brood, pollen and honey; most hives in Belize are therefore placed on stands with each leg in a can of oil.

References

1. Bee World (1972) Continent of tomorrow. Bee Wld 53:3

2. British Honduras Ministry of Agriculture (1958) Annual agricultural report. Honeybees p.8.

3. Dobson, N. (1973) A history of Belize. Longman Caribbean Ltd p. 22

4. Gahne, F. (1902) Stingless bees; some of the crude ways in which bees were kept in British Honduras. Glean Bee Cult. 30 : 947

5. Kennedy, K. (1974) Beekeeping in Belize, C.A. Glean. Bee Cult 102 (9): 273

6,7. Miranda, U.Y. (1977) Beekeeping information. 19 April Inter-Ministry correspondence

8. Mopan Farmers' Cooperation (1977) Cooperative receipt books. Domestic sales of honey.

9,10 Mulzac, H.C. (1977) Honey production in the Toledo District, 4 July, Inter-Ministry Report

11. Norwalk Honey Producers' Federation (1976) Annual General Meeting. Domestic sales of Honey.

12. Owen-Lewis, D. (1976) Personal Communication

13. Radio Belize, by M.K. Chopin (1967) Honey production in British Honduras. Belize City: Transcripts-National Library

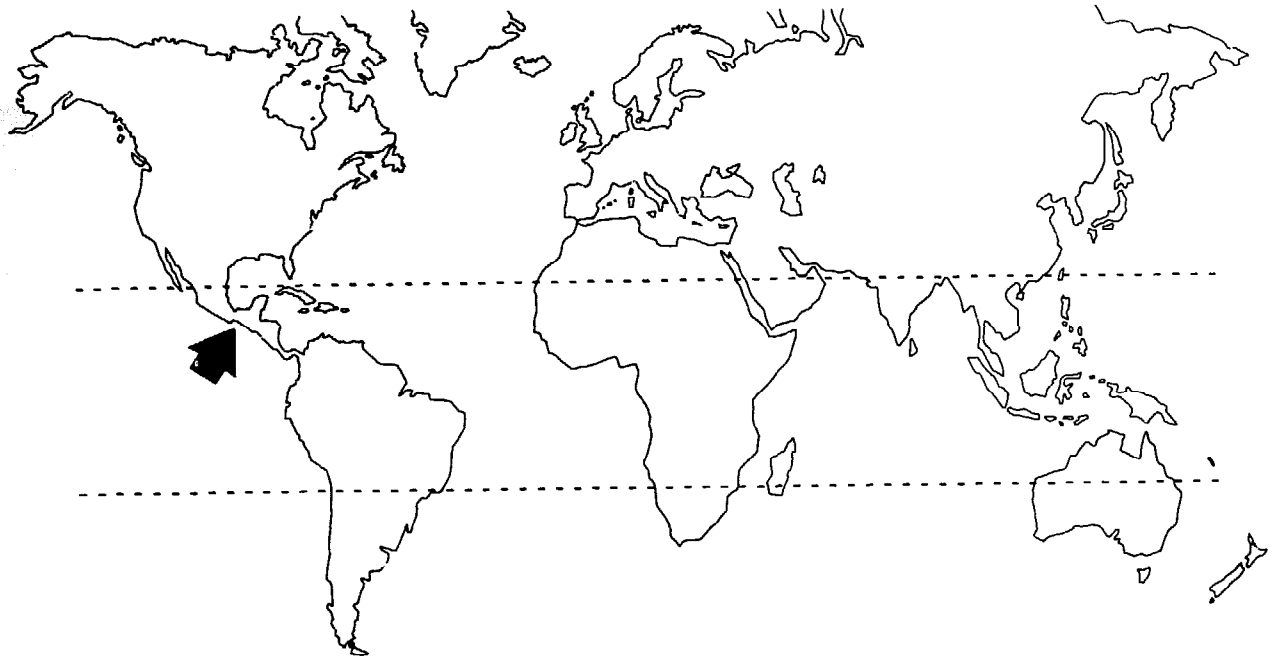
14. H.C. Mulzac (1977) Honey, the many types, its many uses. Belmopan: Transcripts - A.O. Pitts.

15. Santino, T (1977) Personal Communication

16. Schwarz, H.F. (1948) Stingless bees (Meliponidae) of the Western Hemisphere. Bull. Am. Mus. nat. Hist. No. 90

17. Thompson, E.S. (1930) Ethnology of the Maya of British Honduras. Fld. Mus. riat. Hist. 17:104

18. Turner, R. (1977) Personal Communication



APICULTURAL DEVELOPMENT IN CENTRAL AMERICA AND PANAMA: SOME HISTORIC AND ECONOMIC CONSIDERATIONS

by ROBERT B. KENT
(Department of Geography, California State College, Stanislaus
Turlock, CA 95380 U.S.A. - April 1978)
(original contribution)

APICULTURAL DEVELOPMENT IN CENTRAL AMERICA AND PANAMA
SOME HISTORIC AND ECONOMIC CONSIDERATIONS

by ROBERT B. KENT
(Department of Geography, California State College, Stanislaus Turlock, CA 95380 U.S.A. - April 1978)

Original Contribution

Establishment of the Honey-Bee

It is believed that honeybees were first introduced into Central America in Costa Rica, at an unknown date that must have been before the 1830s, when honeybees were introduced to Guatemala from Costa Rica[89]. About 25 years later, honey bees were reported in the mountainous districts of Honduras[88]. The recency of this introduction is noteworthy, since the Spanish had been in Central America for nearly 300 years previously, but the Yucatan Peninsula, for instance, had no honeybees until near the beginning of the 20th century[13,84]. their presence in the whole of Latin America is astonishingly late.

How extensively the honeybee was distributed in Costa Rica, Guatemala and Honduras during the 19th century remains unclear, and it is equally unclear exactly when honeybees were introduced into the other Central American countries. Gerstacker[47] reviewed Wagner and Scherzer's regional study, "Die Republik Costa Rica", in Central America (1856), and found no references to either honeybees or beekeeping. Apparently, honeybees were not well known in Costa Rica even at that time, and they were either overlooked or considered too unimportant to mention. It is believed that at that time, most of the apiaries were in the highland districts of Costa Rica, Guatemala and Honduras, where settlements and population were concentrated. The only Central American country where beekeeping developed commercially before 1900 was Guatemala. Early beekeeping there was practised in simple box hives and hollow logs, and concentrated in the central highlands between the old colonial capital of Antigua and the Lago de Amatitlan[89]. Although beekeeping practices were rudimentary, large quantities of honey were marketed annually in Antigua. Indian groups were the principal consumers of the honey, for fermenting into mead[89]. Very little beekeeping was practised around Guatemala City, or to the north near Salama in the Sierra de las Minas, and it was absent from the hot tropical lowlands of the Pacific and Atlantic coasts and the cool highland areas above 2000 m[89]. In other Central American countries beekeeping was on only a small scale until the end of the 19th century[85].

At the beginning of the 20th century the first professional beekeeper came to Guatemala from Germany, and commercial beekeeping was initiated[32]. Although the original goal was to improve coffee yields through honeybee pollination, coffee production did not increase. Honey production was excellent,

however, especially on the Pacific watershed in a region known as the upper Boca Costa[85]. Gradually beekeeping became a secondary agricultural activity on some coffee farms, German beekeepers teaching local people the fundamental techniques of beekeeping[85]. The beekeeping industry expanded tremendously after the First World War, when Guatemala exported honey to Germany, the Netherlands and Britain. In 1920, 200 tons * were exported, in 1923 about 650 tons, and between 1931 and 1933 over 1000 tons annually[32, 85].

By the 1930s the Pacific coastal plains and foothills of the Boca Costa were the centre of apicultural activity in Guatemala. A few of the coffee plantations in the foothills operated over 1000 colonies, but most had less than 100. Beekeeping was also practised on a much more limited scale on the Atlantic watershed in the department of Alta Verapaz, where honeybees had also been introduced in the hope of increasing the fruit set on coffee trees. Beekeeping was only profitable on a small scale, probably because the annual precipitation there is high (3000 to 4000mm), and the dry season is poorly defined

Commercial beekeeping developed more slowly in Costa Rica. The earlier introduction of honeybees in Costa Rica may also have been associated with the establishment of coffee as an agricultural crop; many of the coffee farms there were owned by Germans and North Americans[54,66,91] who might have introduced honeybees from their homelands and encouraged their husbandry to increase coffee yields. As in Guatemala, foreigners - especially Germans were instrumental in developing the beekeeping industry[61,82,87]. The first commercial apicultural activity in Costa Rica was initiated during the 1890s by Ricardo Pfau[79] who imported honeybees from Jamaica and sold both nuclei and beekeeping supplies in the Vicinity of San José. By the mid-1930s several commercial operations existed in the foothills and valleys near the port of Puntarenas on the Pacific. Although most enterprises had less than 100 colonies, one German immigrant has over 2000. Conditions for apiculture were so good in some places that two apiaries of this enterprise had over 350 colonies each[85]. While honey exports began before 1920, Costa Rica's production lagged behind that of Guatemala in the 1930's its exports totalled about 150 tons annually[17,60].

Little is known about the development of commercial beekeeping in the other countries of the Isthmus. In El Salvador it probably came about through the diffusion of information and materials from the coffee-growing areas of the Boca Costa in Guatemala. In Honduras and Belize commercial apiculture is a recent phenomenon[65a].

Current Economic Status of Apiculture

Between 250,000 and 300,000 honeybee colonies are found in Central America today, over half being located in Guatemala; next in importance are El Salvador and Costa Rica (Table 1). While the official agricultural censuses for these three countries include hives and honey production, those for Honduras, Nicaragua and Panama do not[57,67,73].

---

* All references to tons in this paper refer to the short ton (2,000 lb.); this is 10% less than the metric ton (1,000kg)

TABLE 1

RECENT STATISTICS ON HIVES, BEEKEEPERS AND HONEY PRODUCTION IN CENTRAL AMERICAN COUNTRIES (in short tons)

COUNTRY	YEAR	HIVES	OPERATORS	HONEY PRODUCTION
Guatemala	1964 (52)	162,411	--	1,671
El Salvador	1971 (38)	65,182	5,421	376
Costa Rica	1973 (20)	19,083	1,719	452
Honduras	1975 (63)	14,643	--	466
Nicaragua	1973 (29)	6,000	--	--
Belize	1975 (65)	5,321	201	146
Panama	1973 (29)	3,200	--	--

TABLE 2

CENTRAL AMERICA HONEY EXPORTS BY COUNTRY: 1954, 1959, 1964, 1969+

COUNTRY	1954	1959	1964	1969
Guatemala	2,134 (49)	2,856 (50)	1,853 (51)	2,821 (53)
El Salvador	432 (33)	497 (34)	1,407 (35)	1,367* (37)
Costa Rica	330 (23)	384 (18)	316 (24)	338 (19)
Honduras	--	--	114 (56)	115 (58)
Belize	--	--	38 (12)	--
Nicaragua	--	--	--	--
Panama	--	--	--	--

* 1968 data.

+ In short tons.

The use of the less productive fixed-comb hive varies from country to country. It is estimated that between 3% and 25% of all hives in Guatemala have fixed combs [29,49], and in Costa Rica about 15% [75]. Estimates for Honduras haved ranged from 25% to 75% [70,72], but there are few in Belize [65], and none in Panama [29]. Reports for Nicaragua are contradictory. Ordetx [69] believed there was no fixed comb beekeeping but Drescher [29] reported that half the colonies were fixed comb hives. There are no data for El Salvador.

Annual honey production per colony for modern hives in Central America lies between 15 and 40 kg. Average within this range have been reported for Belize [64], Honduras [63], Guatemala [32,48], El Salvador [5,30], Costa Rica [77], Nicaragua [28], and Panama [28]. Normal yields for most beekeepers probably lie at the lower end of this range. Annual honey production in fixed comb hives is only about 25% as much.

In exceptional years or in good foraging areas, yields can be much higher than normal. On the better bee forage in Guatemala yields per colony can reach 70 kg [32,85], while in Nicaragua yields as large as 88 kg.were reported during the 1960-61 season [69]. Phenomenal yields of nearly 100 kg [4] were predicted for the 1975-76 season in El Salvador, and in some areas of Belize averages are said to exceed 75 kg [65a].

Total annual honey production for Central America is in excess of 5,000 tons, the bulk being exported to Germany, the Netherlands and the United States. Only a small proportion of honey is sold on the domestic markets of Central American nations. Honey is produced for export in Guatemala, El Salvador Costa Rica, Belize and Honduras, and for the national market almost exclusively in Nicaragua and Panama.

Nearly all the honey exports are made by the first three countries in Table 1. Guatemala's annual production ranges from 1000 to 2800 tons [29], and about 75% is exported, most to Germany and the United States [43,52]. Production in El Salvador according to agricultural censuses was 419 tons in 1961 [36], and 376 tons in 1971 [38]. These data must be too low or production must have increased in the last few years, because in 1974 the German Federal Republic purchased 1200 tons of honey from El Salvador [1]. Honey has been exported from Costa Rica for about 60 years, except during World War II to European markets [60]. During the mid 1970s, annual production was nearly 500 tons [77], about 400 tons being exported [21,22] (Table 2).

Belize started exporting honey (31 tons) in 1960 [10]. Most has come to the United Kingdom, although recently some also to health food stores in the United States [65]. Production was 165 tons in 1974 and 132 tons in 1975 [64].

Honey was first exported from Honduras in the early 1960s. In 1965 the largest individual exporter was near Puerto Cortes on the Caribbean coast [70], there were about 200 colonies and a well equipped honey house. According to Government statistics for 1963, 145 tons were exported, about 75% to the German Federal Republic [55]. There have recently been increases, to

391 and 466 tons in 1974 and 1975 respectively [63] and to about 738 tons in 1976 [58a] the United States purchasing 366 tons.[7]

In Nicaragua and Panama honey is not a source of foreign exchange, and is often insufficient to meet national needs. In Nicaragua the annual crop probably does not exceed 100 tons, and in Panama it is about 80 tons [28]. Before the 1950s Panama often imported honey from Costa Rica and it is still reported to be a net importer of honey [39]. The position appears to be about the same in Nicaragua, which imported Costa Rican honey as recently as 1975 [22].

Regional differences in honey quality in Central America can be attributed to differences in climate and bee forage. Honey produced in a seasonally dry environment normally has an acceptable water content. Almost all honey of the Pacific coast of Central America has a water content not above 20% and thus meets the requirements of honey buyers [90]. Honey with a higher water content is produced in the more humid areas of the Caribbean lowlands, for example, in the El Peten region of Guatemala [44] and more frequently in the region near Limon, Costa Rica, directly adjacent to the Caribbean coast [60].

A few Pacific coast areas also produce unsatisfactory honey from specific nectar sources. Mangrove honey has a salty taste and its sale is difficult [83,85]. Mangrove trees are found along several portions of the Pacific coast, specifically along the Gulf of Panama, the Golfo Dulce, the Gulf of Nicoya, and the Gulf of Fonseca [86] and large honey surpluses are obtained from them. When sugar cane is grown, bees gather large quantities of sap from freshly cut stumps [27], giving rise to a dark, sour-tasting honey of inferior quality, fetching only about half the normal price [32,42,65a]. Nearly 30% of the honey in Panama is of this type [42].

National And International Aids to Apiculture

The only countries in Central America with extension services for the beekeeping industry are Costa Rica (since 1943) [14] Nicaragua, Belize and Panama (recently) [28 72]. Beekeeping became well developed in Guatemala and El Salvador without government aid [32 39], but the current distribution of honeybee disease in Central America demonstrates the value of extension services.

Until recently no bee diseases were found in Central America; although in the early 1950s beekeepers in Guatamala [32] and Costa Rica [31] inspected thousands of colonies. Costa Rica remains free of American foul brood, but this is now present in most parts of Guatemala [28], in Panama in the western province of Chiriqui and two central provinces Panama and Colon [28,44], and in Belize although no details of the distribution are available [65a]. Costa Rica's apicultural extension officer Orlando Huñoz, believed the introduction of American fould brood to be a serious danger during the late 1940s and early 1950s, through the importation of honeybees or used equipment. He was responsible for the passage of laws prohibiting their indiscriminate importation [31]. Honduras [70] and Nicaragua [28,69] are believed free of American foul brood, and no known precauions against the disease have been taken. Nevertheless, the value of a carefully planned and administered programme of

apicultural extension services must be clear to many beekeepers in Guatemala and Panama whose apiaries are infected with American foul brood.

A recent outbreak of European foul brood in El Salvador further illustrates the value of these services. In Central America in 1963 European foul brood was first reported near Tegucigalpa, Honduras [70], and the next report was not until 1975, in El Salvador [3]. Since beekeepers there were unfamiliar with the disease, lack of its early identification [3] aided its spread and destructiveness. Such a situation could have been avoided or mitigated by the existence of apicultural extension services. Such services are now being expanded in Central America. Guatamala will soon have extnesion agents in apiculture, and Costa Rica and Panama are increasing the number and ability of their extension agents through a training programme sponsored by the German Federal Republic [30,78].

Although not as effective as extension personnel, books and pamphlets on beekeeping fundamentals are useful and have been published by either government agencies or private individuals in Guatemala [62], El Salvador [9], Costa Rica [15,59], and Panama Governments have also sponsored short courses on various beekeeping topics in lieu of, or in addition to, full-scale extension services. A course in tropical apiculture was offered in Nicaragua by the Instituto de Fomento Nacional in 1965, and in Guatemala by the Instituto de Fomento de la Produccion in 1966 [40]. The late Dr. Gonzalo Ordetx was prominent in the administration of these courses. Geng [44] toured Panama for about two weeks in 1969 giving short courses at various locations, instructing local beekeepers and officials of the agricultural ministry.

Programmes of credit assistance have been employed by the governments of Guatemala, Honduras, and Costa Rica. In Guatemala, the Banco Nacional Agraria has provided beekeepers with special credit arrangements [48], although it has been noted that a lack of technical knowledge among the beekeepers has probably reduced the effectiveness of these loans [43]. Other Guatamalan agencies have administered programmes on a local level. The Servicio de Fomento de la Economia Indigena operated a technical assistance and credit programme for about 200 beekeepers with a total of 23,000 colonies. The agency assisted them in moving their apiaries from the southern Pacific coast to the valley of Salama in the Sierra de las Minas, because widespread insecticide treatments of cotton plantations in the former area had destroyed tens of thousands of colonies [48]. A programme instituted in the highlands of Guatemala in 1966, to aid the Indians there failed because they had no previous knowledge of apiculture [43]. In Costa Rica a programme of apicultural credit is sponsored by the Banco Nacional, but unfortunately most of the loans have gone to middle-class individuals and not peasant farmers [8]. The Banco Nacional de Fomento de Honduras initiated a programme of apicultural development in the northern portion of the country in 1964 [72].

Today the bank operates an office in San Pedro Sula and one in Tegucigalpa, which supply equipment and credit to beekeepers

at reduced rates [68]. In the tributary area of the Tegucigalpa office 50 beekeepers have received approximately US$ 2,000 each in credit, and are operating with between 50 and 100 colonies each [54a]. Nearly 4000 colonies have been funded in the Tegucigalpa area, and the San Pedro Sula office has reportedly financed over 7000 [1a]. The bank also purchases honey and wax from beekeepers in 22 regional agencies [1a].

Foreign governments have been involved in the development of apiculture in Central America. During the last ten years, American and German apiculturalists have worked in Costa Rica, Guatemala, Belize, Nicaragua, and Panama, and research tours by foreign experts have been common. An American apiculturist served in Costa Rica during 1967 [12,16] and Costa Rica has received aid from the government of the German Federal Republic through which a teaching and laboratory building was constructed in Turrialba, in 1973. This served as an apicultural training centre for beekeeping instructors for the governments of Costa Rica, Guatemala and Panama between 1973 and 1976. When the project terminated at the end of 1976, the facility and equipment became the property of the Costa Rican government, to be maintained by them for the beekeeping industry in Costa Rica. The contracts with the other participant nations call for the construction of similar centres in Guatemala and Panama, the host government financing the construction of the buildings, and the German Federal government providing complete modern equipment [76]. Germans also worked with a regional development agency in Guatemala in the late 1960s, organizing the colonization and agricultural exploitation of the department of El Peten, which constitutes the northern third of Guatemala [46]. In the early 1970s the Rockefeller Foundation financed the investigations of a beekeeping expert in Nicaragua [28] and an American Peace Corps apiculturist recently served in Belize [6]. Two years ago, the American based International Executive Service Corps sought an experienced beekeeper to aid the Panama government in developing and marketing bee products other than honey [3]. The results of their search are unknown.

Studies of beekeeping conditions in Central America have been made especially by Germans. Geng [42,43,44,45,46] and Drescher [28] have written unpublished reports on all countries there except El Salvador and Belize. Recently both Petersen [78] and Drescher [30] have described the operation of German apicultural development programmes. Ordetx [69, 70, 71], toured Guatemala, Honduras and Nicaragua in the mid-1960s at the request of these governments, to evaluate their honey flora. His works remain the only substantive statements on the bee plants of Central America. Espina [39] made an economic analysis of the beekeeping industry in El Salvador, which included specific suggestions to improve and expand the industry. Calkins [12] and Kent [60] have studied conditions in Costa Rica.

Equipment Supply

Movable-frame hives are produced in all Central American countries, similar to those of the United States except that the frames often lack the Hoffman side shoulder [41]. The hive bodies and frames are frequently constructed by the individual beekeeper, or by carpenters and other beekeepers who specialize in this work to supplement their income. The rising cost of

wood in Costa Rica has given impetus to the development, construction and sale of cheaper hives of asbestos-cement [81]. In Belize, Mennonite settlers have developed a cottage industry for manufacturing hives and extractors and the majority is used in the country [65]. In Nicaragua, it was often difficult to purchase these items until a few years ago, when a government agricultural experiment station initiated a programme to supply them to local beekeepers [28].

Most manufactured beekeeping equipment, however, is imported directly from the United States or Germany [28] and only a small proportion is manufactured locally. Smokers are commonly imported, but a few are constructed locally using imports as models. Centifugal extractors, mostly manual models, are also imported, but again some are built nationally using half of a 55 gallon drum for the centrifuge body. All wax foundation mills are imported. In Costa Rica there are 10 foundation mills [60] and there are possibly twice as many in both Guatemala and El Salvador. In the apiculturally less developed countries there are probably three or four mills per country, except in Belize where there is one [65a] and in Nicaragua where there may be none. Nicaraguan beekeepers have been known to ship their wax to San José, Costa Rica, to have it rendered into new foundation.

Conclusion

The countries which constitute Central America are characterized by extreme differences in apicultural exploitation and development. The number of hives, annual honey production, and honey exports show tremendous differences (Tables 1 and 2). El Salvador, the country with the smallest land area, ranks second in the number of honeybee colonies; Honduras with the largest land area, has only a quarter as many as El Salvador. Concerning honey exports, Guatemala is one of the important honey producing and exporting nations in Latin America, while Nicaragua and Panama sometimes import honey.

The existence of extension services, credit programmes, or foreign aid for apiculturists, cannot account for this variability. Guatemala and El Salvador, for example, became the two largest honey exporters on the Isthmus without any government extension services to beekeepers. In Costa Rica, the only country where an extension officer served the beekeeping industry for a significant length of time, the beekeeping industry was fairly well developed prior to the initiation of this service. Credit assistance programmes exist or have existed in several countries, but without any major impact on their beekeeping economies. Foreign aid has tended to centre in countries where apiculture is already well developed, like Costa Rica and Guatemala, while the lesser developed countries have received little or no aid. El Salvador is an exception, having a thriving beekeeping industry but receiving no known foreign aid for apiculture. Generally apiculture has tended to grow independently of the provision of extension services, credit assistance, or foreign aid.

Equipment supply does not play a role in the variation of apicultural development within this region. Most supplies can be manufactured locally, and those that are not are usually available for sale in the national capital of each country. Besides the suppliers in the national capitals, local suppliers

may develop when and where the demand justifies.

Historical forces account for much of the disparity found. Two factors seem to be common historical denominators. The first is the settlement of immigrants of European or North American origin during the mid-1800s, and the second is the establishment of commercial coffee production. Foreign settlers, especially Germans, established many of the coffee farms between 1830 and 1860 in both Guatemala and Costa Rica, and may have brought honeybees with them from their homelands. Then at the turn of the 20th century coffee growers, especially Germans in Guatemala, made concerted efforts to improve coffee yields through honeybee pollination. Although these efforts failed, honey production in coffee-growing areas was excellent, and many coffee growers continued beekeeping as a secondary enterprise. Eventually, both honeybees and beekeeping technology diffused to the local residents, and beekeeping became popularized and firmly established in Guatemala and Costa Rica. Beekeeping in El Salvador was probably initiated in much the same fashion, through the influence of coffee growers, most of whom were, however, not immigrants. In Belize the existence of a beekeeping industry is attributable to foreign influences. The country's past status as a British colony, its continuing status as a Commonwealth member, and the influence of Mennonite colonists from Canada, have all contributed to the development of its beekeeping.

Underdevelopment in apiculture appears to be associated with a lack of foreign settlement in the mid-1800s, and little coffee cultivation. In Honduras and Panama coffee production has not been significant until recently, nor was foreign settlement important during the mid-1800s. The beekeeping industry in Panama is very small, and that in Honduras is seriously underdeveloped in view of the country's size and apicultural potential. The underdevelopment of apiculture in Nicaragua is more difficult to understand. Coffee has been cultivated in Nicaragua since the mid-1800s, but foreign planters and colonists were not influential until the end of the 19th century.

Acknowledgements

The author wishes to thank Howard Gregor, who initially suggested this study, and Fred Simoons who as department head provided me with office space in the Geography Department while I used the library of the University of California at Davis. Roger Moon and Barbel Leber made helpful criticisms on an earlier draft of the paper, and Leber also translated the German language literature into English. All of the above individuals are affiliated with the University of California at Davis: Gregor, Leber and Simoons with Geography, and Moon with Entomology.

References

1. Aguilar, S.M. (1977) Personal Communication

2. American Bee Journal (1975) The World Honey Market. Am. Bee J. 115 (6): 218-219

3. (1975) Beekeeping volunteer needed in Panama. Am Bee J. 115 (7): 255, 282

4. (1976) The World Honey Market. Am. Bee J. 116 (1): 6-7

5. (1976) The World Honey Market. Am. Bee J. 116 (5): 206-207

6. (1976) The World Honey Market. Am. Bee J. 116 (6): 254-255

7. (1976) Peace Corps volunteer from Brooklyn assists Indian beekeepers in Belize. Am. Bee J. 116 (8): 378-379

8. Armino, A. (1975) Personal communication

9. Barrientos, L (1960) Cartilla practica de apicultura moderna. Santa Ana, El Salvador: Tipografia San Jose

10. British Honduras, Collector of Customs (1961) Trade report for the year 1960. Belize City: Government Printer

11. British Honduras, (1965) Trade report for the year 1964. Belize City: Government Printer

12. Calkins, C.F. (1969) Notes on beekeeping in Costa Rica Glean. Bee Cult. 97 (9): 526-571

13. (1974) Beekeeping in Yucatan: A study in historical - cultural zoogeography. University of Nebraska, Lincoln: Ph.D. dissertation in geography Ann Arbor: University Microfilms

14. Costa Rica. Ministerio de Agricultura e Industrias (1944) Memoria correspondendiente al ano de 1943. San Jose: Imprenta Nacional

15. Costa Rica. Ministerio de Agricultura y Ganaderia (1967) Abejas y cosecha de miel. Boletin Divulgativo No. 49 San Jose: Servicio Informacion Agricola

16. (1968) Informe anual de labores 1967, memoria. San Jose

17. Costa Rica. Direccion General de Estadistica y Censos (1933) Informe de la Direccion General de Estadistica y Censos, ano 1932. San Jose: Imprenta Nacional

18. (1960) Comercio exterior de Costa Rica 1959. San Jose: Direccion General de Estadistica y Censos

19. (1970) Comercio exterior de Costa Rica 1969. San Jose: Direccion General de Estadistica y Censos

20. (1974) Censo agropecuario 1973. San Jose

21. (1974) Comercio exterior de Costa Rica 1973. San Jose: Direccion General de Estadistica y Censos

22. (1974) Exportacion partida por pais, mensual, acumulativa, Estadistica y Censos: unpublished computer printout.

23. Costa Rica. Ministerio de Economia y Hacienda (1956) Anuario estadistico 1954. San Jose: Seccion Publicaciones

24. (1965) Anuario estadistico 1964. San Jose: Seccion Publicaciones

25. Crane, E. (1956) The economic status of bees in the tropics, Pans 11 (3): 303-341

26. (1972) Continent of tomorrow. Bee World 53 (3): 105-106

27. (1975) The flowers honey comes from. pp, 3-76 from Honey: A comprehensive survey. ed. E. Crane. London: Heinemann & IBRA

28. Drescher, W. (1973) Erfahrungsbericht der Guatachterreise vom 14.2.73-30.3.73 nach Zentral-Amerika, sowie ein Planungskonzept fur das Projekt FE 1775, Bienenzucht in Mittelamerika (Costa Rica, Panama, Nicaragua, und Guatemala), Bon: Institut fur Landwirtschaftliche Zoologie und Bienenkunde

29. (1976) The use of movable-frame hives in development programmes (Africa and Latin America), pp. 23-30 from Apiculture in tropical climates ed. E. Crane, London: International Bee Research Association

30. (1976) Experience with German apicultural development programmes. pp. 119-124 from Apiculture in tropical climates, ed. E. Crane London: International Bee Research Association

31. Dyce, F.J. (L953) Beekeeping in Costa Rica. Am. Bee J. 96 (7): 296-298

32. Elmenhorst, C.W. (1952) Beekeeping in Guatemala. Bee World 33 (6): 93-96

33. El Salvador. Direccion General de Estadistica y Censos (1955) Comercio exterior 1954. San Salvador

34. (1961) Anuario estadistico 1959, II. San Salvador

35. (1965) Anuario estadistico. Comercio exterior 1964, I San Salvador: Ministerio de Economia

36. (1967) Segundo censo nacional agropecuario, 1961. San Salvador: Direccion General de Estadistica y Censos

37. (1969) Anuario estadistico. Comercio exterior 1968, I San Salvador: Ministerio de Economia

38. (1974) Tercer censo nacional agropecuario, 1971. San Salvador: Direccion General de Estadistica y Censos

39. Espina, D. (1964) Plan de formento apicola. San Salvador: Banco Central de Reserva de El Salvador

40. (1967) Beekeeping credit in some countries of Latin America. XXI International Beekeeping Congress Paper 126: 386-392 Bucharest: Apimondia

41. Gardener, R.H. (1976) The San Benito frame. Glean. Bee Cu't. 104 (9): 336-337

42. Geng, Hans (nd.) Informe acerca de la apicultura en Panama y recomendaciones para su formento - FE 895 unpublished

43. ..(nd.) Projekt FE 895. Bienenzucht Guatemala. Bericht und Gutachten. unpublished

45. ..(1969) Gutachten uber Imkerei Guatemala. Engelthal, German Febderal Republic: unpublished

46. ..(1970) Projekt FE 395. Bienenzucht Guatemala und Costs Rica. Abschussbericht und Gutachten. Engelthal, German Federal Republic: unpublished

47. Gerstacker, A. (1863) On the geographical distribution and varieties of the honeybee with remarks upon the exotic honeybees of the Old World. Ann. Mag. nat. Hist. 2:333-347

48. Guatemala. Banco de (1964) Investigaciones sobre la apiculture en Guatemala. Informe Economico del Banco de Guatemala 12 (10-12): 4-14

49. Guatemala. Direccion General de Estadistica (1955) Anuario de comercio exterior 1954. Guatemala

50. (1960) Anuario de comercio exterior 1959. Guatemala

51. (1965) Anuario de comercio exterior 1964. Guatemala: Ministerio de Economia

52. (1969) Segundo censo agropecuario 1964, tomo I, Guatemala Editorial del Ejercito

53. (1970 Anuario de comercio exterior 1969. Guatemala: Direccion General de Estadsitica

54. Helms, M.W. (1975) Middle America: A Culture History of Heartland and Frontiers. Englewood Cliffs, N.J.: Prentice-Hall.

54a. Honduras. Banco Nacional de Fomento (1977) Lista de projectos apicolas, Region Central (Tegucigalpa)

55. Honduras. Direccion General de Estadistica y Censos (1964) Comercio exterior de Honduras, exportacion 1963, tomo I.

1963, tomo I. Tegucigalpa: Direccion General de Estadistica y Censos

56. ..(1965) Comercio exterior de Honduras, exportacion 1964, tomo I. Tegucigalpa: Direccion General de Estadistica y Censos

57. ..(1967) Segundo censo nacional agropecuario, 1965-1966, Tegucigalpa: Direccion General de Estadistica y Censos

58. ..(1970) Anuario estadistico 1969, tomo III, comercio exterior, volumen I, exportacion. Tegucigalpa: Direccion General de Estadistica y Censos

58a...(1977) Comercio exterior de Honduras. exportacion 1976. Tegucigalpa: Seccion de Informacion y Publicaciones

58b. Honey Market - News (1977) Imports of honey in pounds into the United States by country of origin and by customs district, 1976. Honey Market News 61 (1) : 11

59. Kellog, C.R. (nd.) Apicultura para el novivio. Turrialba, C.R.: Instituto Interamericano de Ciencias Agricolas

60. Kent, R.B. (1976) Beekeeping with honeybees in a tropical environment -- The case of Costa Rica. Unpublished master's thesis in Geography. University of California,Davis.

61. Leopold, W.F. (nd) Der Deutsche in Costa Rica. No location or printer given.

62. Liuti, J.L. (1941) Apicultura. Guatemala: Dirrection General de Agricultura

63. Melzer, G.R. (1975) World honey crop reports Bee World 56 (4):139-140

64. Mulzac, H. (1975) World honey crop reports Bee World 56 (1): 8

65. ..(1976) Personal correspondence

65a...(1978) Beekeeping in Belize. From Unexploited beekeeping potential in the tropics. London: Commonwealth Secretariat

66. Munro, D.G. (1967) The five republics of Central America, 2nd ed. New York: Russell and Russell

67. Nicaragua. Oficina Ejecutiva de los Censos (1972) Censos nacionales 20 de Abril 1971, agropecuario. Cifras preprelimінares, recuento manual. Boletin No.2. Managua: Ministerio de Economia, Industria, Y Comercio

68. Nowotny, F. (1976) Personal correspondence

69. Ordetx, G.S. (1963) Informe sobre los recursos apicolas de Nicaragua. Managua: Instituto de Fomento Nacional, unpublished.

70. ..(1963) Flora apicola de Honduras. Tegucigalpa: Banco Nacional de Fomento. unpublished

71. ..(1966) Informe parcial sobre los recursos apicolas de Guatemala. Guatemala: Instituto de Fomento de la Produccion. unpublished

72. Ordetx, G., Espina Perez D. (1966) La apicultura en los tropicos. Mexico: Bartolome Trucco

73. Panama. Direccion de Estadistica y Censos (1974) Censos nacionales de 1970. Tercer cencos agropecuario, 16 de May de 1971, volumen II, produccion pecuaria. Panama Contraloria General

74. Panama. Ministerio de Desarrollo Agropecuario (1973) Sobre proteccion a la industria apicola. Decreto No. 19, de I de Agosto de 1969. Panama:Talleres Fotolitografia de Informacion Tecnica, Ministerio de Desarrollo Agropecuario

75. Paniagua, B. (1972) Desarrollo de la apicultura en Costa Rica. Unpublished thesis, Escuela Normal Superior, Heredia Costa Rica.

76. Petersen, H. (1975) Personal communication

77. ..(1975) World Honey Crop reports. Bee World 56 (1): 8

78. ..(1976) German beekeeping development programme in Central America. pp. 155-58 from Apiculture in Tropical Climates, ed. E. Crane. London: International Bee Research Assoc.

79. Pfau, R. (1893) Catalogo descriptive de la Jardineria Central con instrucciones de cultivos y tratado sobre apicultura costarricense. San Jose: Tipografia Nacional

80. Portig, W.H. (1965) Central American rainfall. Geogrl Rev. 55 (1): 68-90

81. Ramirez, W. (1975) Asbestos-cemento, un materia que voluciona la industria apicola. Agroindustria 5 (23): 8,10

82. Saenz, A.(1970) Historia agricola de Costa Rica. San Jose, C.R.: Rodrigo Facio

83. Sandweg, A. (1975) Personal communication

84. Sandford, M.T. (1973) A geography of apiculture in Yucatan, Mexico. Master's thesis Geography, University of Georgia

85. Sapper, K. (1935) Bienenhaltung und Bienenzucht in Mittel-amerika und Mexico. Ibero Amerikanisches Archiv 9: 183-198

86. Sauer, J.D. (1975) Remenant seashore vegetation of northwest Costa Rica. Madrono 23 (4): 174-181

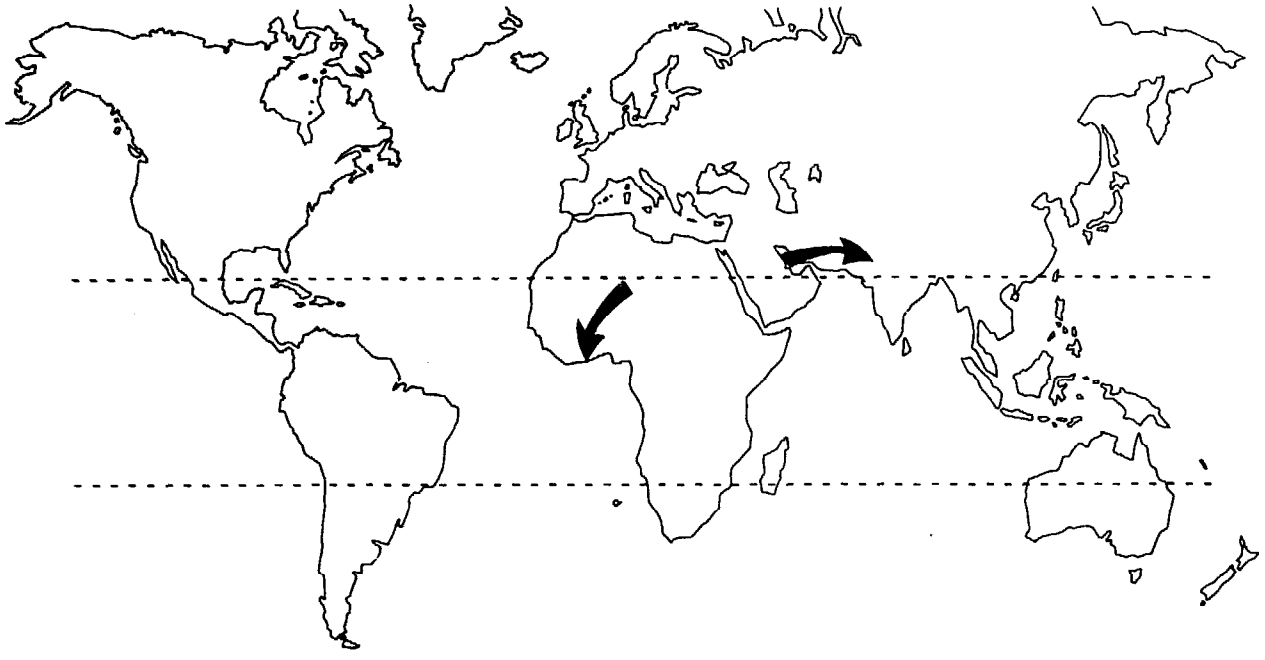
87. Segismundo, Principe (1975) Personal corresponence

88. Squier, E.G. (1855) Notes on Central America: Particularly the States of Honduras and El Salvador. New York: Harper and Brothers

89. Stoll, O. (1887) Die Bienenzucht in Guatemala. Revue Coloniale International 2:545-552

90. Vorwohl, G. (1973) Ubersicht uber das Ergebnis der chemischanalykalischen Unterschung einiger Zentralamerikanischer Honige. University of Hohenheim. Unpublished.

91. West, R.C.; Augelli, J.P. (1976) Middle America: its lands and peoples. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall.



GHANA & NEPAL: BEESWAX USED IN LOST WAX BRASS-CASTING

a photographic review

TONY MOODY, Commonwealth Secretariat

GHANA AND NEPAL:
BEESWAX USED IN LOST WAX BRASS-CASTING
A PHOTOGRAPHIC REVIEW

by Tony Moody

Introduction

Beeswax is commonly used in the lost wax technique of brass-casting, where idols, figurines and latterly souvenirs are made from brass scraps in village workshops. This technique is used throughout Asia and Africa. Beeswax models are made and coated with clay and ash, and baked to form a mould.

The mould, while still warm, is pierced and the wax allowed run out. The mould is then put back in the fire, carefully upright with brass scraps atop the hole. As they warm and melt, the brass fills the mould, which is then cracked open to release the cast figure.

In West Africa this technique is used from Senegal to Tchad, but is particularly renowned in the Ashanti region of Ghana, where miniature brass castings have traditionally been used as gold weights. Some photographs show details of some of these figures. Other photographs show stages in the process as observed in Nepal recently by David Wright of Intermediate Technology Industrial Services, Rugby, England.

The figurines in the photographs were bought in the village of Kurufoforum outside Kumasi: a village where the peasant households specialize in this production and where villagers have formed a production co-operative.

The Technology Consultancy Centre at the University in Kumasi is giving management extension advice to this co-operative and aiding them to improve the design of their ovens for casting the brass. The beeswax they use is now imported from neighbouring countries at a very high cost of nearly £45 sterling per kg: a price that reflects both the scarcity of beeswax and the scarcity of foreign exchange in Ghana today. Despite this high cost, the production of these figurines is a very significant boost to the incomes of families in this co-operative.

Until now the casting have all been of ornamental figurines which rely upon the domestic and export tourist markets for demand. There should be scope, however, to expand the market for brass castings by introducing designs of household fittings for which there is a broader consumer demand, both domestically and for export. One could imagine that door handles, cupboard hinges and latches, bearing the imprint of Ashanti tradition and workmanship, would have a market alongside the existing range of simple cast designs.

But one of the first steps that the Kurufoforum co-operative wants to take, and needs to, is the development of its own production of beeswax. With the help of the Technology Consultancy Centre, they hope soon to embark on their own beekeeping programme.

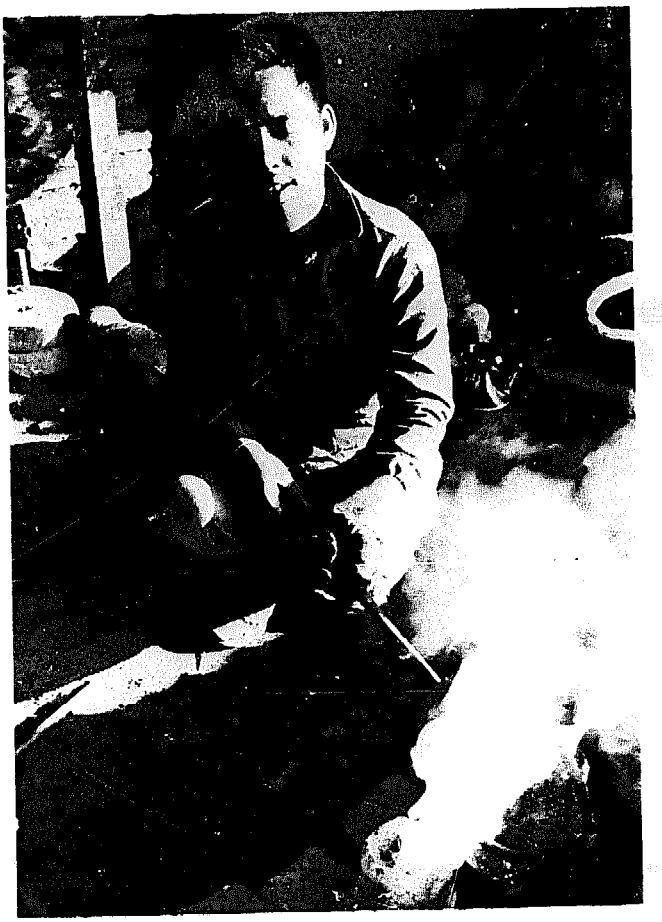
The paper printed earlier in this book by Dr. August Gorenz relates how beekeeping was quite possible in Ghana in 1962-65 and forest honey is still collected by other villagers around Kumasi. It would not require much more than a few years assistance from an experienced tropical apiculturalist before these villagers would be able to institute improved beekeeping practices. If and when this should happen, beeswax supply will be greater for the brass-casters, and a popular foodstuff will be gathered for village consumption and domestic Ghanaian markets.

(D. Wright)

Brass-casting in Nepal

(Top) Taking a mould from the fire.

(Right) Pouring molten brass into a mould – note the pile of moulds in the background.



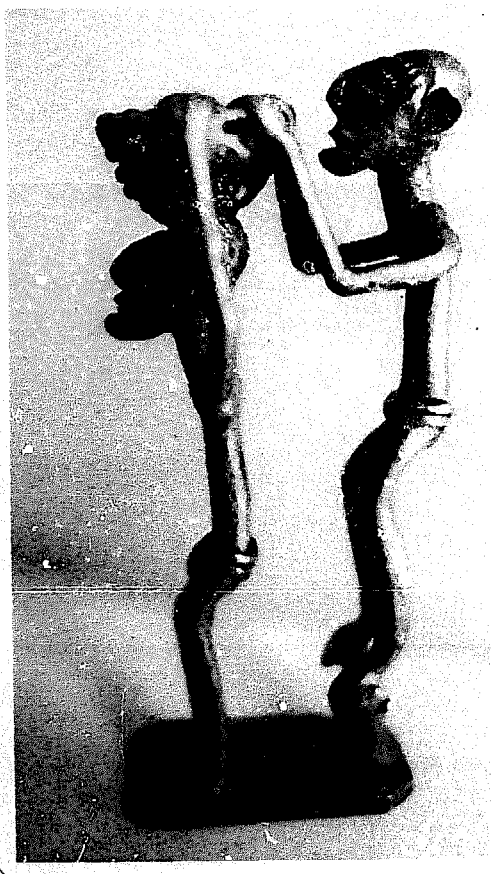
(D. Wright)

Ashanti Figurines

The old man is carrying a gunpowder keg on his head – and he is smoking a pipe. The blatant message of danger is a typical motif of the "proverbial" message in these figurines.

(Right) The old lady is carrying firewood.

(Bottom) The old man cannot resist looking in the woman's basket. It is empty, however, and there is no reward for the would-be thief!



APPENDIX I

COMMON PLANT NECTAR SOURCES IN MALTA, SRI LANKA, THE GUIANAS AND BELIZE

(a) Maltese Islands

Botanical Name	English Name	Maltese Name
Asphodelus microcarpus	Branched asphodel	Berwieq
Borago officianlis	Borage	Fidloqqom
Calamintha nepeta	Lesser Calamint	Kammilota
Convolvulus arvensis	Bindweed	Loblieba tar-raba
Coridothymus capitatus	Mediterranean wild thyme	Saghtar
Diplotaxis erucoides	White wall rocket	Gargir
Foeniculum vulgare	Fennel	Busbies Salvaġġ
Freesia refracta	Freesia	Frezja
Galactites tomentosa	Creeping Thistle	Xewk Abjad
Gladiolus segetum	Corn Flag	Mabb il-qamh
Heliotropium europaeum	Heliotrope	Ghobbejra bajda
Inula viscosa	Large flea bane	Tulliera
Malva Silvestris	Common mallow	Ħobbejża
Mattiola tricuspidata	Wild stock	Ġiżi salvagga
Mentha pulegium	Penny Royal	Plejju
Narcissus tazetta	French daffodil	Narcis
Oxalis pescaprae	Cape sorrel	Ħaxixa ingliza
Papaver hybridum	Bristly Poppy	Pepprin
Ricinus communis	Castor oil plant	Riġnu
Rosmarinus officinalis	Rosemary	Klin
Rubus Ulmifolius	Bramble	Għollieq
Sonchus oleraceus	Smooth sow thistle	Tfief
Urginea Maritima	Aeaside squill	Għansar
Verbascum sinuatum	Mullein	Xatbet landar
Vicia sativa	Common vetch	Ġilbiena sewda

(b) Sri Lanka

Botanical Name	Local Name	Flowering month
Azadirachta indica A.Juss (Meliaceae)	Kohomba	May-June
Chloroxylon swietenia DC (Rutaceae)	Kurutha	May-June
Cocos mucifera L. (Palmae)	Pol	All Year
Drypetes sepiaria (Wright & Arn.) Pax & Hoffm. (Euphorbiaceae)	Weera	April-May
Eucalyptus camaldulensis Deheh. (Myrtaceae)	Karpantine	April-May
E. citriodora Hook (Myrataceae)	"	June-August
E. grandis Hill ex Maiden (Mycrataceae)	"	June-August
E. microcorys. F. Muell (Mycrataceae)	"	June-September
Euphoria longana Lam. (Sapindaceae)	Mora	May-July
Feronia limonia (l) Swingle (Rutaceae)	Divul	March-April
Hevea Brasiliensis Muell (Euphorbiaceae)	Rubber	March-April
Madhuca longifolia (L) J.F. Macbr. (Sapotaceae)	Mee	June-July
Manilkara hexandra (Roxb.) Dubard (Sapotaceae)	Palu	May-July
Mallolotus albus (Roxb.) Muell Arg. (Euphorbiaceae)	Tu Kenda	April-May
Musa paradisiaca L. (Musaceae)	Kehel	All Year
M. sapientum L. (Musaceae)	Kehel	All Year
Neolitsea cassia (L.) Kostermann (Lauraceae)	Davul kurundu	April-May
Pleurostvlia opposita (well) Alston (Celastraceae)	Panakka	May-June
Sapindus emarginatus vahl. (Sapindaceae)	Penela	February

Schleichera oleosa (Lour.) Oken. (Sapindaceae)	Kon	May-July
Syzygium assimile Thw. (Myrtaceae)	Damba	May-June
S. cordifolium (Wright) Walp. (Mycrtaceae)	Damba	May-June
S. cumini (L.) Skeels (Myrtaceae)	Ma dan	July-August
Tectona grandis L.f. (Verbenaceae)	Tekka	November-February
Terminalia arjuna (Roxb.) Wright & Arn. (Combretaceae)	Kumbuk	May-June
Zyziphus mauritiana Lam. (Rhamnaceae)	Debara;masan	May-July

Flowering Phenology of some major Guianan nectar plants.

(c) The Guianas

(from Crane 1973 except where otherwise noted

Species	
Avicennia nitida	Mar-Apr, Aug-Nov.
Pterocarpus officinalis*	Jan-Mar.
Triplaris surinamensis	Aug-Nov
Anacardium occidentale	Jan-Feb, Aug-Sep.
Tabebuia spp.	Apr-Jun.
Haematoxylon campechianum	March, Oct-Nov.
Hymenaea courbaril	March, Sep-Nov.
Inga spp.	Mar-May, Sep-Nov.
Eucalyptus spp.	Mar-Apr, Oct-Dec.
Citharexylum sp	April, November
Mikania parkeriana	Mar-Apr, Oct-Jan.
Quassia amara	April, Aug-Sep.
Wedelia trilobata	continuous
Cocos nucifera	continuous

* *information from van Deursen*

(d) Belize

	Months of Flowering
Acacia sp	September
Achras sapota	August
Acromia mexicana	January
Albizzia sp	January
Anacardium occidentale	February
Anona spp	February
Avicennia nitida	April
Bixa ornella	September
Bucidia belizensis	Feb, May
Carica papaya	October
Cassia spp	April, Sept.
Ceiba pentandra	April
Coccoloba belizensis (Standl)	March
Cordia alliodora	March
Crescentia cujete	October
Cynodon dactylon	August
Dalbergia Stevensonii	April
Enterolobium cyclocarpus	July
Glyricidia sepium	January
Gossypium mexicanum	August
Guaiacum sanctum	August
Haematoxylum campechianum	April
Ilex panamensis	April
Inga sp.	September
Lonchocarpus spp	July
Mammea americana	January
Mimosa sp	October
Nectamdra samiomea	July
Orbignya cohune	April
Persea americana	July
Phytolaca icosandra	October
Piscidia piscipula	March
Pithecolobium sp.	October
Psidium guajava	May
Rhizophora mangle	October
Phinorea spp.	March
Roystonia spp.	August
Rynchospora cephalotes	September
Sabal spp.	July
Sapindus saponaria	June
Schizolobium parahybum	November
Sideroxulan anyadalinum	January
Swietenia macrophyalla	March
Tabebuia spp	February
Tamarindus indica	March
Terminalia obovata	June
Vitex spp	July
Zanthoxylum Kellermanii	March
Zea Mays	February
Mangifera indica	January

APPENDIX II

CONVERSION OF NON-METRIC UNITS INTO SI UNITS (SYSTEME INTERNATIONAL D'UNITES)

Length	1 inch (in)	= 2.54 centimetre (cm)
	1 foot (ft)	= 30.48 cm
	1 yard (yd)	= 0.914 metre (m)
	1 mile	= 1.61 kilometre (km)
	1 Angstrom unit (AU)	= 10^{-10} m
Area	1 square inch = 6.45 cm^2	
	1 square foot = 0.093 m^2	
	1 square yard = 0.836 m^2	
	1 square mile = 2.59 km^2 = 259 hectare (ha)	
	1 acre = 0.405 ha	
Volume	1 imperial pint (pt) as used in UK	= 0.568 litre
	as used in USA	= 0.473 litre
	1 imperial gallon (gal) as used in UK	= 4.55 litre
	as used in USA	= 3.79 litre
	1 imperial fluid ounce (fl oz) as used in UK	= 28.4 ml
	as used in USA	= 29.6 ml
	1 cubic inch = 16.39 cm^3 or 16.39 ml	
	1 cubic foot = 0.028 m^3	
	1 cubic yard = 0.765 m^3	
Weight	1 ounce (oz)	= 28.4 gram (g)
	1 pound (lb)	= 0.454 kilogram (kg)
	1 stone or 14 lb	= 6.35 kg
	1 cwt (long, UK) or 112 lb	= 50.8 kg
	1 cwt (short, USA) or 100 lb	= 45.4 kg
	1 zentner / centner / quintal	= 100 kg (in USSR = 50 kg)
	1 ton (long, UK) or 20 cwt (long)	= 1.016 tonne
	1 ton (short, USA) or 20 cwt (short)	= 0.9072 tonne
Weight or volume per unit area	1 lb/acre	= 1.12 kg/ha
	1 cwt/acre	= 125.4 kg/ha
	1 (imperial, UK) gal/acre	= 11.2 litre/ha
	1 (imperial, USA) gal/acre	= 9.36 litre/ha
Concentration of solutions	1 oz/(imperial, UK) gal	= 6.236 g/litre
	1 oz/(imperial, USA) gal	= 7.49 g/litre
	1 lb/cubic foot	= 16.02 g/litre
Speed	1 mile/hour (h) = 1.61 km/h	= 0.44 m/second (s)
	1 ft/second = 1.097 km/h	= 0.305 m/s
Atmospheric pressure	1 lb/square inch = 0.070 kg/cm^2 = 51.7 mm mercury	

Temperature	x^{o} Fahrenheit = $\frac{5}{9}$ $(x - 32)^{o}$ Celsius				
Energy	1 calorie = 4.186 joule (J) 1 British thermal unit (BTU) = 1055 J				
Fractions and multiples	deci-	(10^{-1})	d	deca-	(10^{1}) da
	centi-	(10^{-2})	c	hecto-	(10^{2}) h
	milli-	(10^{-3})	m	kilo-	(10^{3}) k
	micro-	(10^{-6})	μ	mega-	(10^{6}) M
	nano-	(10^{-9})	n	giga-	(10^{9}) G
	pico-	(10^{-12})	p	tera-	(10^{12}) T

Reprinted from "International Bee Research Association Dictionary of beekeeping terms", Volume 5 (1977), ed. Eva Crane

Printed for the Commonwealth Secretariat by
Hobbs the Printers of Southampton (1434)

May be purchased from
Commonwealth Secretariat Publications
Marlborough House
London SW1Y 5HX

ISBN 0 85092 160 0

Price £2·50