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.

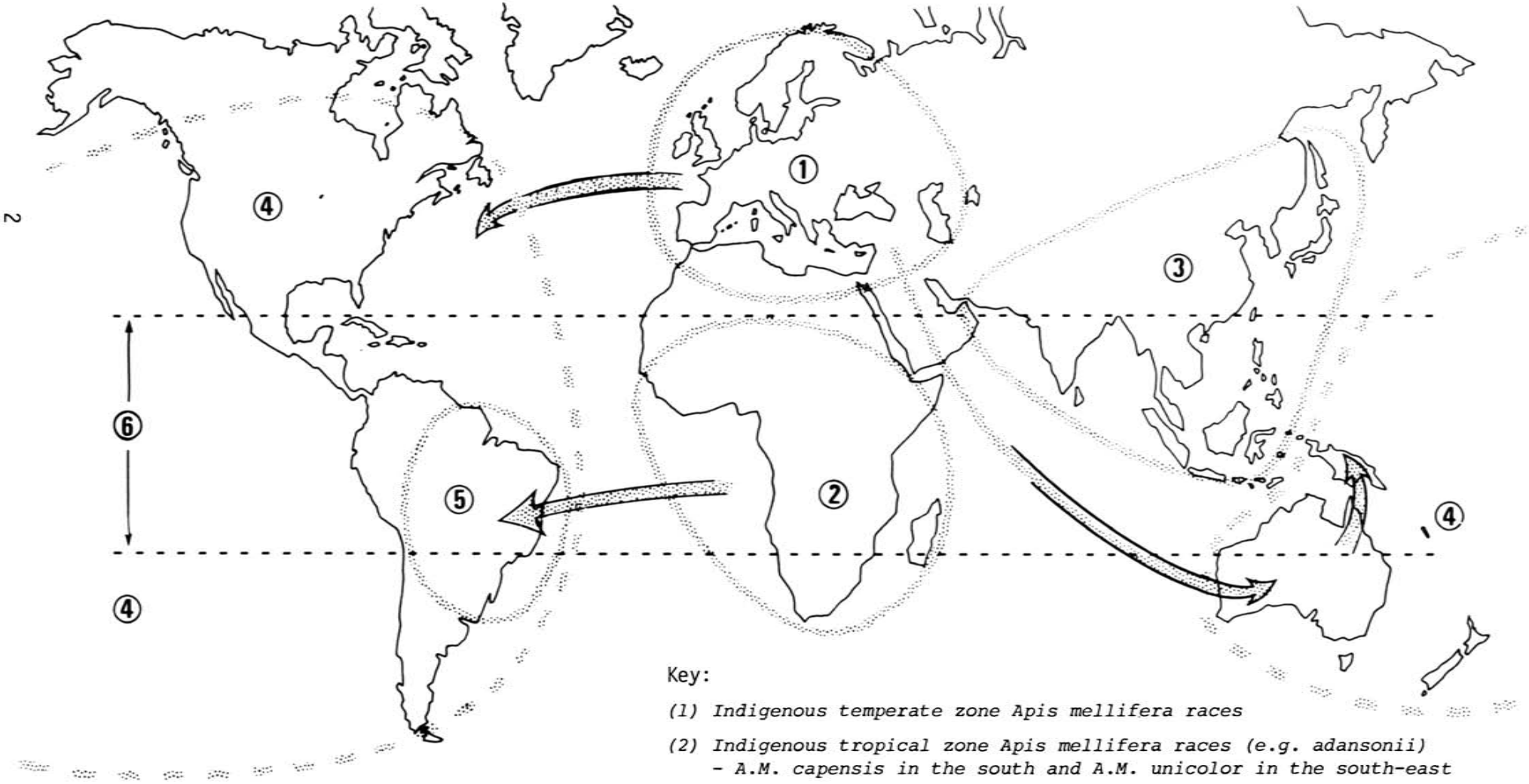
Tropical Honeybees

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

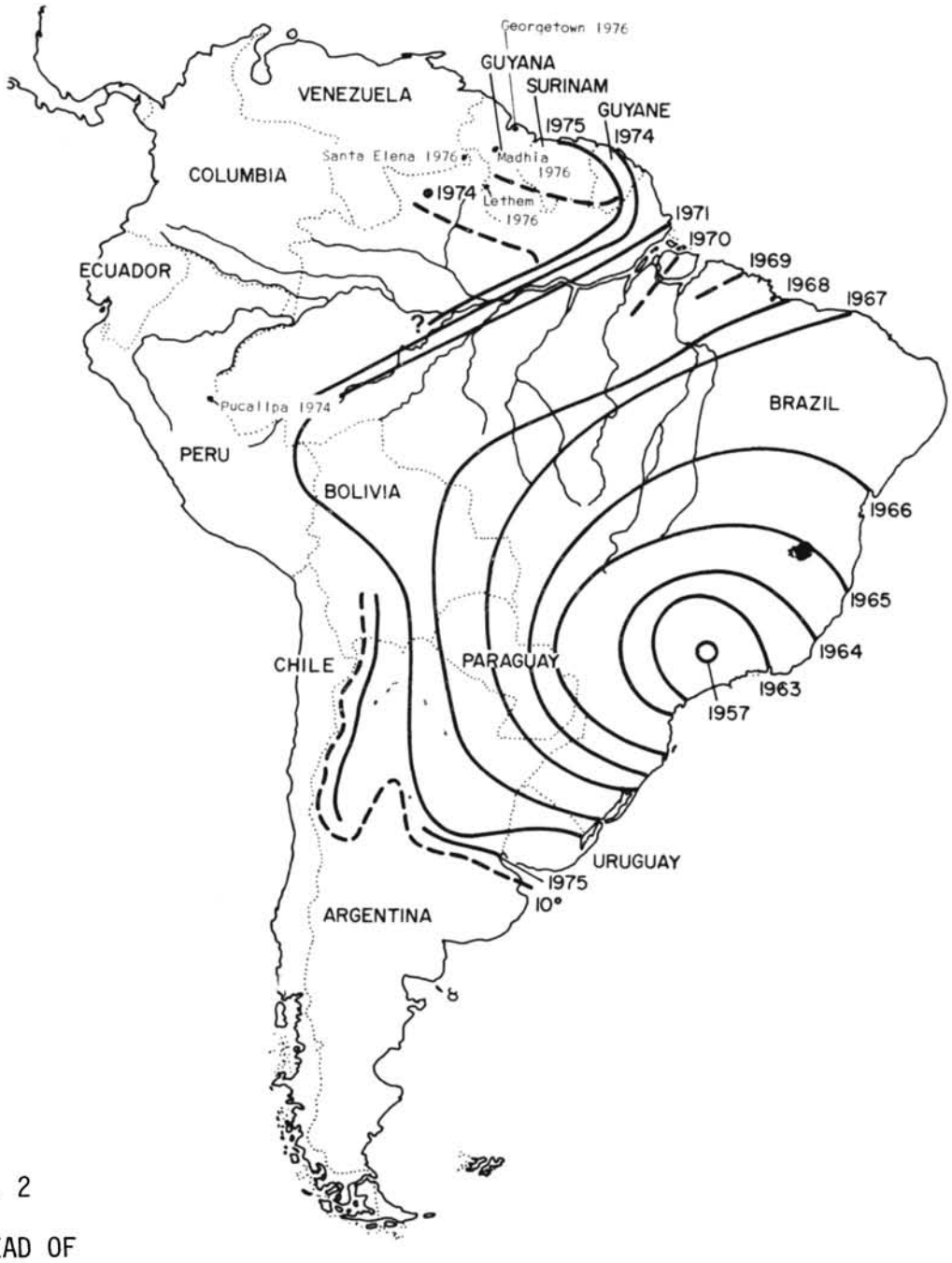


Fig. 2

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 200 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 an 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.

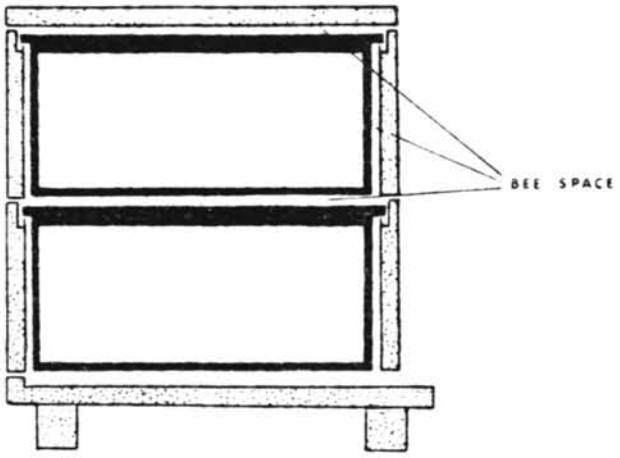


FIG. 3

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

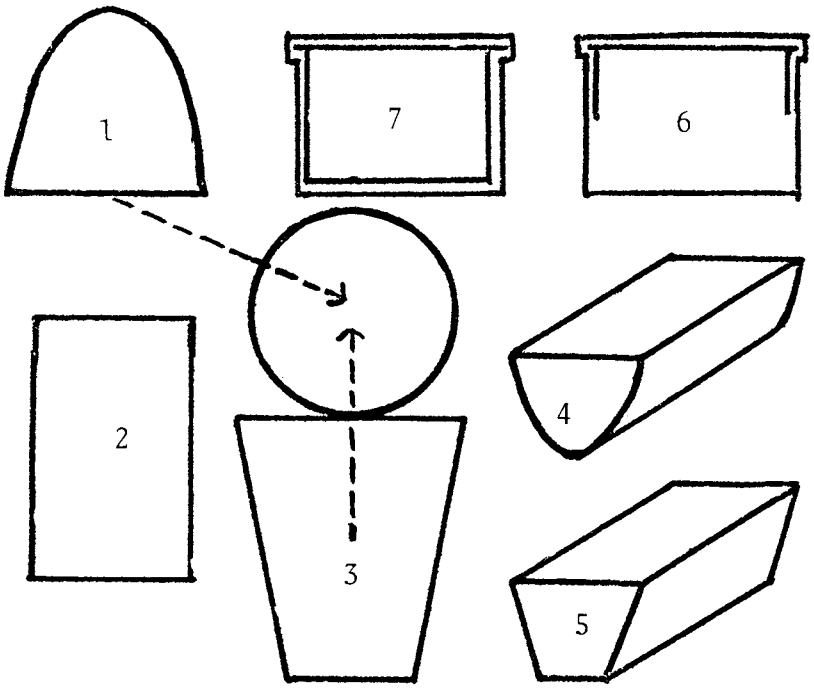


FIG. 4

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 production of beeswax must be at least 10,000 tons and could well be 15,000 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.