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BEEKEEPING—1851 AND AFTER

By 1851 the honey bee had completed its colonization of almost the whole world, the major unconquered territory—Siberia—not being occupied until the land itself was settled during the present century. The more progressive beekeepers knew enough about their bees to do great things with them, but this was prevented because, in spite of all their efforts, they still had no suitable hive.

The step which changed this was made in 1851 by Lorenzo Lorraine Langstroth (Fig. 9), an American born in Philadelphia, and living there at the time. Langstroth had shown a rather unusual interest in insects as a child, and this was revived when, as a young pastor in Andover, Massachusetts, he visited a friend who kept bees, and saw a glass globe filled with honey in the comb. Before he returned home he bought two colonies of bees in box hives. He soon also acquired a Huber leaf hive and obtained various books on bees, including Huber's *Letters* and Edward Bevan's *The Honey-bee* (1838). He used the bar hive with a shallow super described by Bevan, and improved it by deepening the grooves on which the bars rested, leaving about $\frac{3}{8}$ inch between the cover and the bars (this is the origin of our present top bee space).



FIGURE 9. Lorenzo Lorraine Langstroth, the father of modern beekeeping.

He found that this facilitated the removal of the cover board on which the glasses rested. The key development, which cuts the history of beekeeping into two halves, was made in the fall of 1851, and we have Langstroth's own words to describe it: "Pondering, as I had so often done before, how I could get rid of the disagreeable necessity of cutting the attachments of the combs from the walls of the hives, and rejecting, for obvious reasons the plan of uprights, close fitting (or nearly so) to these walls, the almost self-evident idea of using the same bee space as in the shallow chambers came into my mind, and in a moment the suspended movable frames, kept at a suitable distance from each other and the case containing them, came into being. Seeing by intuition, as it were, the end from the beginning, I could scarcely refrain from shouting out my 'Eureka!' in the open streets."

Langstroth's intuition was justified: the bees did in fact "respect" the bee space left between the hive and the frames in which the combs were built; they did not build comb across the space, and the frames were, therefore, truly movable.

The movable-frame hive itself was in common use in the United States by 1861. It was introduced into England in 1862, and the writings of Charles Dadant in the French and Italian journals, starting in 1869, brought about its introduction into Europe; it soon spread to other countries, each of which used variants, built on the same basic principle.

With this discovery modern beekeeping began, and development in the next half-century was in the nature of an explosion compared with the slow and halting progress of the centuries before. The use of movable frames led directly to the invention of beeswax foundation by Johannes Mehring in Germany in 1857; this saved beeswax, and ensured that the bees built regular worker comb in the frames. Langstroth was thinking only of the brood chamber when he devised his frames; he used glasses above the crown board for the honey. But it was soon realized that if the honey chamber or super was furnished with similar frames, these could easily be removed when filled with honey. If means could then be found to extract the honey without destroying the comb, the comb in its frame could then be used again. This led to the invention of the centrifugal honey extractor in Austria in 1865 by Major F. Hruschka and possibly in France a few years earlier. The perfection of the queen excluder by Abbé Collin of France in 1865 enabled the beekeeper to keep the queen, and hence the brood, out of the honey chamber. By using the bee escape, produced in 1891 by E. C. Porter in the United States, he could get the honey chamber free from bees before he removed the frames of honey.

The pattern of modern beekeeping was thus established in the half-century between 1850 and 1900. Equipment invented in that period, or based on principles discovered then, has since undergone important developments, which are dealt with in other sections of this book. We now know vastly more about *the honey bee* than Langstroth did, but his discovery in 1851 remains the basic principle of *the hive*, and thus of our beekeeping today.

OTHER BEES OF ECONOMIC IMPORTANCE TO MAN

The honey bees in the whole of the New World, and in Europe whence they came, are various races of the European honey bee *Apis mellifera*—Italian, Caucasian, Carniolan, etc. Those in Africa north of the Sahara are other races of the same species. In most of Africa south of the Sahara the honey bees are a subspecies *adansonii* of *Apis mellifera*; the darker bees around the African coast may well have originated from colonies of European bees landed by Portuguese and earlier settlers (for additional information on races of bees, see Chapter II).

In Asia the situation is different. The genus *Apis*, which probably evolved in southwest Asia, has three representative species widely distributed in southern Asia today. One is very similar to *Apis mellifera* but slightly smaller; this is the native hive bee of Asia, known in India as *Apis indica*,* and kept there in hives similar to those for *Apis*

*The name *Apis cerana* is now preferred by many authorities and is synonymous with *Apis indica*.

mellifera but smaller, and with smaller combs containing smaller cells. There are several races of *Apis cerana*, some of which extend north up the eastern part of Asia as far as the east coast of the U.S.S.R. and Japan. In most areas the European honey bee surpasses the native honey bee in honey yield, and in certain other characteristics desirable in hive bees. For this reason beekeepers in China, Japan, and elsewhere are replacing their native hive bee by the European bee. In India and other tropical countries of Asia this has not been successful, because the European bees fall prey to the many enemies which they encounter there.

There are two other species of the genus *Apis* in southern Asia, which are entirely tropical. Both build only a single comb, and both nest in the open, not in a dark cavity like the European bee. Neither species can be kept in a hive, although honey can be obtained from nests of wild bees. The "giant bee" or "rock bee" (*Apis dorsata*) gets its names from its large size and its habit of nesting on rock faces. The "little bee" (*Apis florea*) is the most primitive of the honey bees, and its comb yields only a few ounces of honey.

Another group of tropical social bees also produces honey—the Meliponidae or stingless bees. Different species of these are native to tropical Asia, Africa, Australia, and America, and in Africa and America they are kept in hives for their honey. Some of the indigenous peoples of Central America, such as the Maya in Yucatán, have a very old and rich tradition of beekeeping, and bees and honey have a part in their folklore and legends similar to that in European countries. It should be made clear, however, that although these bees are "stingless," they have other means of defending themselves which are equally unpleasant to their enemies, including man.

It is only within this century, when agricultural practices have become intensive and mechanized, that attention has been directed towards keeping bees for pollination, in contrast to the production of honey and wax. And whereas the honey bee is unsurpassed as a pollinator because of the large numbers which can easily be brought to a crop, certain other bees are individually far better pollinators of certain plants. In many countries bumble bees are valued for pollinating crops whose florets have a long corolla, such as red clover, and much work has been done recently on devising a hive for these bees, and ways of getting them to occupy the hive, so that they can be taken to crops for pollination.

In parts of the Northwest of the United States there is a native soil-nesting alkali bee (*Nomia melanderi*) which is a most efficient pollinator of alfalfa. By making the soil conditions suitable for nesting, and by importing prepupae from neighboring sites, these bees can be housed on the edges of alfalfa plots, and left there to multiply and to do their useful work. *Megachile* is another important wild pollinator.

THE PATTERN OF BEEKEEPING TODAY

We have seen that beekeeping is now spread over all the habitable parts of the world. It is practiced over a greater area of the earth's surface than perhaps any other single branch of agriculture, and on it the success of some of the other branches of agriculture depend.

The patterns of beekeeping in the Old and New Worlds tend to be different. In general the New World gives the richer honey harvest, but the Old World is more densely populated with honey bees, as it is with people. In general the New World provides more useful inventions for handling bees and their products, whereas the Old World still contributes more fundamental discoveries about bees.

Broad distinctions can be drawn between the equipment used for beekeeping in the Old and New Worlds, although here again, as with every generalization, notable exceptions exist. Tradition plays an important part in European beekeeping, and it often seems to act as a brake on practical developments, whereas in some of the newer countries beekeeping techniques have forged ahead unimpeded. Beekeeping equipment used in the New World tends to be simple, uniform and mechanized as far as possible because labor is expensive; Langstroth or Dadant hives are mainly used. In Europe the hives differ from country to country, and a wide variety of "standard" hives may be used even within one country. These hives may take frames, and hence foundation, of different shapes and sizes, and also cover boards and queen excluders. Many of the hives are complicated, and in ways which decrease rather than increase honey production. In one of the socialist countries of eastern Europe a state beekeeper is expected to look after 100 hives; in England a commercial beekeeper will manage 200 to 250, and in Australia 300 or more; the most mechanized beekeepers of all, in California, can run 1000 hives each.

In the New World bees are generally kept as a means of livelihood; average honey yields in most individual countries vary from 40 to 80 pounds per hive, and average yields in the best beekeeping districts may be 200, 300, or even 400 pounds. In the Old World the proportion of hobby and sideline beekeepers is much higher, each owning 5, 10, or up to 50 hives, and getting a harvest of 10 to 40 pounds per hive.

In good areas beekeeping can be done (although not with maximum efficiency) without knowing a great deal about the bees themselves and the beekeepers are not necessarily very interested in them—nor in beekeepers' organizations. At the opposite end of the scale, the strongest beekeepers' organizations are in the European countries with the greatest density of hives, each of which gives a poor return—Austria, Czechoslovakia, Germany, the Netherlands, and Switzerland. All these countries have more than 12 colonies per square mile, and their honey yields are among the lowest in Europe.

Europe (excluding the U.S.S.R.) has about 121½ million hives of bees, an average of 6 per square mile, a hive density three times as great as in any other continent. The average honey yield per hive is about 20 pounds a year; although this is higher than in Africa (where most of the hives are primitive ones), or Asia (where the indigenous bee gives a low yield), it is less than half that in the New World as a whole.

In spite of the great density of bees, more honey is consumed than can be produced, and western Europe is the world's great honey-importing region; eastern European countries in the socialist bloc normally import only those goods which are considered essential, and honey is not included in this category. Europeans are in general familiar with honey because it is part of their heritage from past centuries, when beekeeping belonged to the pattern of life of every rural community, and the towns were small enough to keep in touch with the country around them.

In 1955 around 50,000 tons* of honey were imported into Europe from the New World, 30,000 tons going to West Germany. By 1960 the figures had increased with West Germany importing 38,000 tons. The honey production of Europe (excluding the U.S.S.R.) is probably about 110,000 tons a year.

Just as tradition helps to maintain honey consumption, and also interest in bees among the general public, so it plays a material part in sustaining centers of learning where research on bees is carried out, and where many of the advances in our knowledge of bees and their habits are made.

U.S.S.R. This is such an immense country, occupying large territories in both Europe and Asia, that it is best dealt with separately. More than half the colonies of bees there perished in World War II, but the number is now nearly up to the prewar figure of 10 million. The honey production is about 100,000 tons a year (about 22 pounds per colony), and virtually none is imported or exported. Many of the remarks about European equipment and methods apply also to the U.S.S.R.

Certain factors are common to most countries of the socialist bloc. The larger owner-beekeeper is replaced by the beekeeping section of the state farm, owned and run by the state, or by the collective farm, run on a co-operative basis under state directives. In the U.S.S.R. two-thirds of the hives are on these farms; a collective farm has 80 on the average, and state farms specializing in beekeeping may have up to 6,000, certain combines running 25,000 to 30,000.

In socialist countries many activities, which elsewhere are left to the initiative of individuals or private enterprises, are directed from

*Metric tons are used (1000 kg. or 2204.6 lbs.). The British ton is 2240 pounds avoirdupois (1016.06 kg.); the U.S.A. ton is 2000 pounds (907.20 kg.).

a central authority. One result is the absence of conflict between what elsewhere may be rival interests, such as crop spraying and beekeeping. The value of bees as pollinators is accepted as a fact, and beekeeper and fruit and seed grower must work together in the matter: the beekeeper provides bees for pollination as part of his duty, and there is no question of his receiving a fee from the grower for this work.

Other honey-producing countries import the beeswax they require, and restrict beeswax production in order to get more honey from the hive, beeswax production then being about 2 per cent of honey production. But the socialist countries aim to be self-supporting, and methods of managing bees are designed to obtain a surplus of both wax and honey from each apiary.

Asia. Statistics are difficult to establish for many countries of Asia. Excluding the U.S.S.R., there are possibly about 4 million hives in Asia, many being primitive types without movable frames. A considerable part of the honey produced in the tropical South is collected from wild nests of *Apis dorsata*. The average honey yield from hives may be up to 15 pounds, and the total production 30,000 tons. This will probably be increased, especially with the continued replacement of unproductive native bees with European stock. The People's Republic of China has already taken vigorous action in this direction, and is also developing beekeeping greatly in some areas: figures quoted for one province show an increase from 8,000 to 195,000 colonies of European bees between 1949 and 1959. The general picture of Asian beekeeping may well be changed if the developments in China continue, and especially if more productive bees can be found which will flourish in India and other tropical parts of the continent.

Africa. Beekeeping on the north coast of Africa is not dissimilar from that in other Mediterranean countries, but south of the Sahara desert the pattern is quite different, and tropical Africa plays a unique part in beekeeping, as the source of most of the world's beeswax. Africa has some 8 million hives of bees in all. Over three-quarters of them are primitive hives in tropical countries, notably Tanganyika and Angola, which are managed primarily for the wax extracted from the combs cut out of them. Honey is a sideline which may not even be worth carrying by hand (or on the head) the long distance through the bush to a town where it might be sold. Some of the factors which have brought about this state of affairs are as follows: first, the evolution of a native subspecies of the honey bee, *Apis mellifera adansonii*, which is prolific, building sizable colonies which swarm freely in the conditions under which they live; second, vast areas of woodland which provide forage and nesting places for wild colonies, and shade for hives hung in trees; third, the presence of tribes with a tradition of beekeeping, and to whom the production and sale of beeswax is an accepted form of livelihood. The total beeswax production of Africa

is about 3,500 tons, which represents most of the beeswax offered on the world's markets. The total amount of honey collected from hives in Africa is about 45,000 tons.

Farther south, beekeeping is carried out by settlers from Europe using modern hives. In the extreme south of Africa the climate is again more Mediterranean; this area is noteworthy for the occurrence of the Cape bee (*Apis mellifera capensis*), characterized by the ability of its workers to lay fertile eggs from which queens and workers are reared, although these have no father (parthenogenesis).

America. Plants native to the New World evolved in the absence of honey bees, but some of these plants provide the richest forage available anywhere. Some of the present forage is derived from Old World species, but this was not so when bees were first established there, nor does all the harvest now come from introduced plants. But it is certainly true that the continents of the New World—North and South America, and Australasia—give far higher harvests from bees than the Old World, and this is an impressive demonstration of the adaptability of the honey bee.

North America has about $5\frac{1}{2}$ million hives, with an average production of 46 pounds in the U.S. and 88 pounds in Canada. Over the whole country, there are nearly two hives per square mile in the U.S., and less than one for every 10 square miles in Canada—one-quarter and one-eightieth, respectively, of the average density in Europe. Beekeeping is in general a full-time or part-time profession, with holdings up to several thousand hives. In areas in the East where the climate is more like that of Europe, the honey yields are lower, the holdings are very much smaller, and—as in Europe—there tends to be a greater interest in the bees themselves.

There are $11\frac{1}{2}$ million colonies in Central America, with an average hive density of nearly two to the square mile. But it is still underpopulated with honey bees, and large areas of nectar-producing land are unexploited by beekeepers. The performance of the firm Miel Carlota in Mexico, which now controls about 50,000 hives between Acapulco and Veracruz, shows what can be done. About 20,000 tons of honey are produced a year, and almost all of it is exported.

The tropical part of South America is the home of many species of the stingless bees mentioned previously in this chapter; some of these species are kept for honey, but European bees thrive there, and experiments are proceeding with *Apis mellifera adansonii* from Africa. Elsewhere in South America honey bees flourish, and the average yield per hive of 40 pounds could almost certainly be increased. The total annual production is about 26,000 tons, from $11\frac{1}{2}$ million hives, and nearly all of it is exported. The colony density is about one to every $4\frac{1}{2}$ square miles, and—as in Central America—many areas are under-exploited.

Australasia. There are about 200,000 colonies in New Zealand, yielding about 6,000 tons of honey, of which three-quarters or more is exported to Europe. There are about 2 hives to the square mile, giving an average of 65 pounds of honey. The eucalypts, which dominate Australian beekeeping, are not native to New Zealand, and beekeeping there is not dissimilar from that in parts of America. Australia gives some of the highest honey yields in the world; the average for the whole country is 80 pounds, slightly lower than for Canada, but in Western Australia the average is over 200 pounds. Most of the honey comes from different species of eucalypt, and is obtained by extensive migratory beekeeping to stands of different species, which flower only once every 2, 3 or more years. As the indigenous forest is cleared in successive areas, the honey yield declines, even where the forest trees are replaced by nectar-bearing agricultural crops; it then becomes comparable with that in other good beekeeping areas of the world.

Australia produces about 15,000 tons of honey a year, 11,000 tons of which are exported to Europe; over the whole country there is only about one colony per 7 square miles.

SUMMARY

Beekeeping thus follows a varied and interesting pattern in different parts of the world. It is a pattern which has changed through the centuries with man's colonization of new regions, and which now changes every decade with changing agricultural practices, for these affect the forage which gives the bees—and the beekeepers—their harvest. As new areas are brought into cultivation, new crops grown, and new agricultural methods used, the pattern of beekeeping inevitably changes. New bee forage may be provided by new crops, but the promotion of a clean agriculture by killing weeds before they flower, and the rapid harvesting of fodder crops, both reduce the bees' forage. In some areas the control of insects which damage agricultural crops has destroyed many wild bees and other beneficial insects, whose nesting places may also be endangered by the reduction of waste land. This has left the so-called domesticated honey bee as the only pollinator available in large enough numbers, and has brought a new form of return to the beekeeper in colony hiring fees.

The present world production of honey is nearly 500,000 tons, the work of 40 to 45 million colonies of bees in the hands of perhaps 5 million beekeepers. The estimated human population of the world is about 3,000 million, and the number of individual honey bees will be about 500 times as great as this.

With all the changes noted here, two factors in beekeeping are, so far, beyond the power of man to change materially: the climate which determines what bee forage will flourish, and the habits of the bees themselves. Perhaps the challenge presented by these factors helps to mold beekeepers into the class of people that they are.