CHAPTER TWENTY-SEVEN

Bees and bee-keeping in Africa

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1. Introduction

While there are over 20,000 species in the bee family (Apoidea), most are solitary not social, and bee-keeping in Africa is concerned almost exclusively with *Apis mellifera* L., which is also the common honeybee of Europe. Bee-keeping is practised throughout much of sub-Saharan Africa and also in North Africa. It is locally important in the economy of many regions, and the technology and management practices of some areas are complex and highly diversified. It is this last aspect which much of the existing literature on bee-keeping in Africa has tended to be missed or distorted largely as a result of ill-considered speculation by Eurocentric bee scientists.

The first and only comprehensive survey of bee-keeping in Africa was that of Seyffert (1930) who studied a wide range of source documents from early travellers and colonial officials. Seyffert, a German, was able to map beehive types based on available documents and his study is particularly strong for those parts of Africa formerly colonized by Germany. His synthesis has, unfortunately, been under-utilized in subsequent studies of African bee-keeping. Irvine (1957) brought together a wide range of material when giving an overview of indigenous African methods of bee-keeping. He, as Seyffert before him, also studied the writings of early travel writers and ethnographers and was able to give a descriptive overview when presenting a large number of highlights without drawing many conclusions. The more recent study of Villières (1987a,b) also covers, in some detail, traditional bee technology and focuses mainly on francophone West Africa. There have also been a number of useful studies on bee-keeping in various African countries (e.g. Svensson 1985, for Guinea Bissau; Gnägi 1992, for Mali; Himsel 1991, for Niger; Jessen 1967, Boyles 1991, Mutsaers 1993, for Nigeria; Silberrad (1976), Clauss & Clauss 1991, Wainwright 1992, for Zambia; Nightingale 1976, Geider 1989 for Kenya; Smith 1958, for Tanzania; Fichtl & Adi 1994, for Ethiopia). Crane, in a general study of the archaeology of bee-keeping (1983) and in a survey of world bee-keeping practice (1990), does little justice to the available literature on African bee-keeping.

A clear understanding of the position of Africa in terms of world production of honey and beeswax is lacking owing to incomplete records. The African *A. mellifera*

is a particularly high producer of wax and existing evidence suggests that around half of the beeswax that reaches the world market comes from Africa (Crane 1990). However, honeycomb is discarded in many areas. Curtin (1985) notes that international trade in African beeswax was already of regional importance along the West African coast prior to the eighteenth century. While a trade in beeswax continued into the eighteenth century its importance seemed to decline in competition with the more lucrative slave trade. However, with the revival of "legitimate trade", the price of beeswax increased three-fold between the 1780s and the 1830s in Senegambia, with the export volume increasing by a factor of ten over the same period. MacGregor & Oldfield (1837) mention beeswax being used in trade by the Fulɓe people of Rabbah in west–central Nigeria. Earlier this century in Nigeria, the trade and export of beeswax was of some importance to local economies (Taylor 1942, Corby 1943, Forde & Scott 1946, Buchanan & Pugh 1955). This seems to have declined since independence and many older bee-keepers describe how they used to sell beeswax 20–30 years ago but find there is no longer a market.

Honey is mainly processed and consumed locally in Africa, though there is clearly a long tradition of honey marketing in some areas, as has been described by early travellers in northern Nigeria (Denham *et al.* 1828) and in traditional stories (Skinner 1969). Its widespread use in various cultural ceremonies and production of honey beer give added significance to its role in the life of many Africans (Seyffert 1930). Mungo Park (1817) notes the production of mead in parts of West Africa. Presently, little of the honey produced in Africa reaches the world market and that which does tends to be produced in eastern and southern Africa from non-traditional sources.

In summarizing the relative importance of bee-keeping and honey production throughout the world, Crane (1990) shows that Africa has a similar number of hives to Europe, at around 13.5 million. However, she picks on the statistic of greatest hive density to support her claim to Europe's "long and rich tradition of bee-keeping". While this is undoubtedly true it distorts the overall picture.

Existing evidence suggests that the number of hives *per capita* in Africa and Europe are similar. Given a lower average number of hives per bee-keeper in Africa and the likely underestimates of the prevalence of bee-keeping there, it is reasonable to suggest that Africa has the greatest number of bee-keepers *per capita* of any continent. Last century writers found the level of bee-keeping in some areas remarkable. Monteiro (1875) along the River Quanza [=Kwanza], Angola, describes how some families have 300–400 hives. According to Bridges (Banso Reassessment Report 1934, quoted in Kaberry 1952) more than 10 per cent of the Nsaw men in the North West Province of Cameroon are involved in bee-keeping. Present observations suggest that this is still true and that the percentage is even greater among the neighbouring Oku. Corby (1943) notes that 28 per cent of the male population keep bees in several districts of Kontagora Emirate, central Nigeria.

The origin and history of bee-keeping in Africa has been little studied and the last comprehensive survey on its distribution was nearly 70 years ago (Seyffert 1930). Most recent opinion regarding its origin is represented by the cultural evolutionist assumptions of Crane (1983, 1990), the most widely known and respected bee

scientist. Crane gives an elaborate description of the multiple influences and origins of bee-keeping in Europe. Unfortunately, she postulates that the practice of bee-keeping originated in Ancient Greece or Rome and spread to sub-Saharan Africa via the Nile valley based on her speculations concerning the superiority of "rational" European bee-keeping and a lack of early iconographic materials from Africa. However, evidence of the diversity and sophistication of African bee-keeping argue for a very ancient establishment on the continent.

2. African honeybees and their distribution

The species of main concern in world bee-keeping is *Apis mellifera*. It is thought to have originally evolved in Africa and spread to Europe (Ruttner 1992). South and southeast Asia has its own species of honeybee, *Apis cerana*, which is smaller and less productive, and the Americas had no native honeybee species. However, the geographical separation is being broken down under man's influence through introduction of the more productive *A. mellifera* to new areas including the Americas. Given its extensive geographical distribution and its importance to the local and world economy through its products, honey, wax, propolis and royal jelly, it can be regarded as a highly successful, adaptive species. The bee population in Africa is relatively high, though in some areas its preferred forest and bush–savanna habitat is becoming increasingly threatened by deforestation. The abundance of bees in Africa was noted by some early European travellers (e.g. Denham et al. 1828).

Tropical Africa also has a number of species of stingless bee (Meliponinae). Prior to the introduction of *Apis mellifera* in the 1700s and 1800s, the long tradition of bee-keeping in South America was exclusively with Meliponinae. These stingless bees are also social bees of the family Apidae and several different species are known to exist in Africa. They may also be kept in some areas, though often only owing to their colonizing a hive designed for the more productive *A. mellifera*. However, Gutmann (1922) noted that they have been traditionally kept among the Chagga in Tanzania in small horizontal log hives. They are usually only exploited through honey hunting and the quality of their honey is often greatly appreciated. Among the Oku, North West Province of Cameroon, Meliponinae honey is highly valued in traditional medicine. However, their low production means that they are chased from hives that they seek to inhabit.

Around 25 races of *A. mellifera* have been described, with at least 11 of these being found in Africa (Fig. 27.1; Ruttner 1992). Each of these seems to be somewhat morphologically and behaviourally distinct, though often introgressively. This variation has implications for bee-keeping practice though this has been little studied.

There are several races which are only to be found in North Africa. A small and relatively defensive race, *A. m. lamarckii*, which is black with yellow abdominal bands, is found in the lower Nile valley. Further along the North African coast, from the Libyan desert to the Atlantic coast, *A. m. intermissa* is found. This race is black, produces much propolis and stings readily. It is well adapted as a race to the climatic extremes of the region and though 80 per cent of colonies may perish

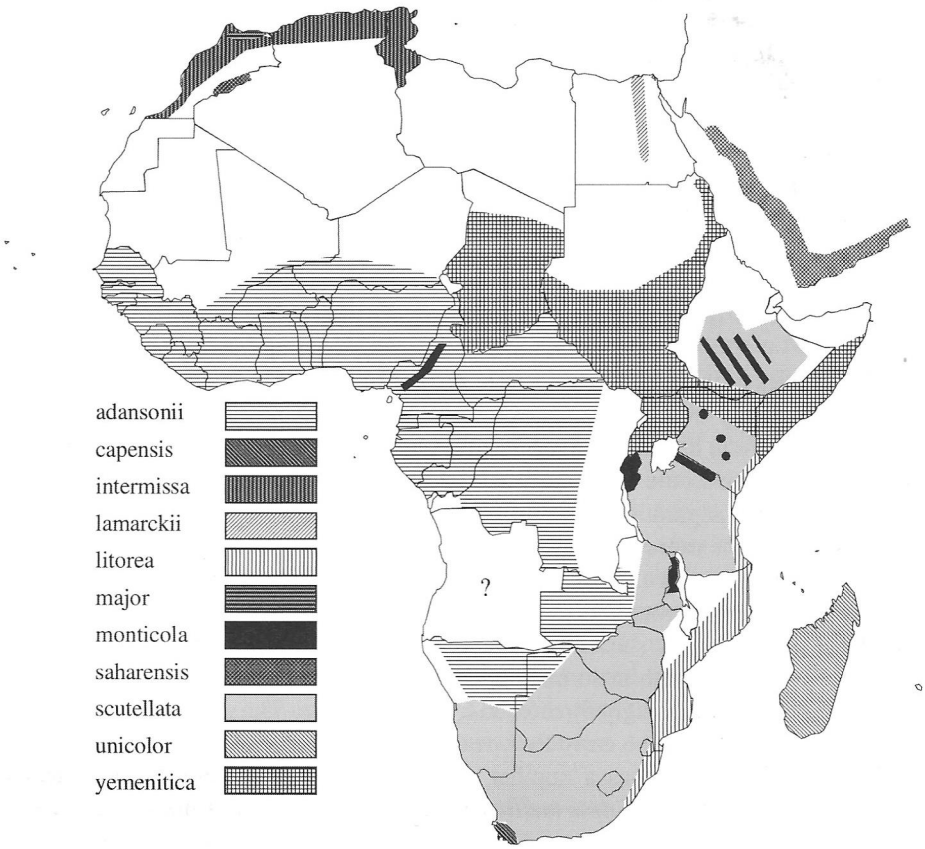

Figure 27.1 Distribution of races of *Apis mellifera* in Africa (adapted from Ruttner 1992).

during a drought it is able to recover rapidly. Those colonies that have been introduced to more temperate zones have perished. Another race that has become adapted to a particular niche in harsh environments is *A. m. saharensis* which lives in oases south of the Atlas mountains in Morocco and western Algeria. Crane (1990) states that present populations of the race are likely to be relics of a much larger population that would have populated the area when the climate was more benign. Their ability to survive under extreme conditions is a clear indication, however, that they have undergone significant adaptation to the climatic change. The race has a tan/yellow body colour and are also known for their ineffectiveness in defending their nest. Ruttner (1992) also describes the race *A. m. major* found in the Rif mountains in the north of Morocco, which is notable for its larger size.

A number of other races have been described in sub-Saharan Africa (Ruttner 1992). The known variability in morphological characteristics of bees from tropical Africa is very high when compared to the total known variability of *A. mellifera*. In general, tropical races of *A. mellifera* are smaller than temperate forms and have a more slender abdomen. Colonies produce a greater number of swarms than the

European forms and whole colonies may abscond as a result of disturbance or food shortage. The bees are perhaps best known for their highly developed defensive character, which is often termed "aggressive" by bee-keepers used to the European bee. This is a characteristic which varies across regions and also diurnally and seasonally within a region. The defensive behaviour of African bees has been locally utilized in warfare by many African tribes (e.g. the Tiv in central Nigeria).

Crane (1990) rightly makes the point that the term race perhaps draws too clear a boundary between forms that are introgressive and whose geographical proximity has allowed on-going hybridization. However, differences in morphology and behaviour can be observed with some of these according to climate (ecoclines) and distance (geoclines). The races will be briefly defined according to those described by Ruttner (1992).

The race commonly found in West Africa is *A. m. adansonii* and was named by Latreille in 1804 from bees collected in Senegal. For many years the name became used for tropical African bees in general. Little is known about these bees or indeed any honeybees west of the Rift valley (Crane 1990).

One other widely distributed race is *A. m. scutellata* which tends to inhabit open miombo woodland at about 500–1,500 m characterized by species of *Brachystegia* and *Julbernardia*. Though samples from Ethiopia to South Africa show it to be morphologically well defined and uniform, there appears to be considerable variation in its defensive behaviour (Ruttner 1992). This is the most studied of tropical African honeybees and most bee-keeping development programmes have dealt with this race.

At higher altitudes the race *A. m. monticola* can be found. Ruttner (1992) notes its presence as far afield as the highlands of Ethiopia, Kenya, Tanzania, Rwanda, Burundi, Malawi and Cameroon. It is larger than *A. m. scutellata*, approaching European *A. mellifera* in size, and is dark with longer hair on the abdomen. Crane (1990) compared it to other tropical Africa races as being less "aggressive", though she also referred to Dietz & Krell (1986) who described most colonies sampled, particularly those found between 1,550 m and 2,100 m, as "aggressive to very aggressive".

The race found on the coast of Kenya, Tanzania and Mozambique is called *A. m. litorea*. It is quite yellow and, though small, has a relatively long tongue. It is most similar morphologically to *A. m. adansonii* of West Africa. Colonies of *A. m. litorea* are quite migratory in nature and move from one area to the next in search of new forage.

The honeybee native to the Arabian peninsula is named *A. m. jemenitica* and bees morphologically similar to this have been found further west in Chad and Sudan. Ruttner (1992) describes them as being particularly adapted to dry *Acacia*-dominated savanna. It is similar to *A. m. saharensis* in its ability to survive prolonged drought.

The honeybees of Madagascar are considered to be an indigenous adaptation and have been named *A. m. unicolor*. They have been imported into Réunion and Mauritius which have no native honeybees. In Madagascar the bees in the coastal region show differences from those in the cooler highlands. Those in the highlands

do not behave so defensively and do not abscond. Around the Cape Peninsula in South Africa there is an isolated population of *A. m. capensis*. It is similar in size to *A. m. scutellata*, but with a dark abdomen. Its reproductive behaviour is unique for the species in that its workers can develop into full females (thelytoky). Adult workers emerge relatively quickly after the cell is sealed, with the parasitic *Varroa* mites hardly able to reproduce on its worker brood.

Ruttner's mapping of the various races in Africa was based on incidental collections and on a very limited collection of specimens that were then extrapolated on a national and regional basis. His multivariate analysis of morphological characteristics was very sophisticated and ground breaking in terms of understanding the variation within the species. However, the narrow database from Africa, the continent where *A. mellifera* is said to have evolved (Ruttner 1992), can be expected to mask the full morphological and behavioural variation that is likely to exist. This is particularly true of West Africa, where studies have been particularly lacking.

Some bee races seem to exist in close proximity to each other, though often occupying distinct ecological niches. A recent study by Kassaye[1] described the presence of at least five distinct groups of honeybees in Ethiopia with their distributions correlating to ecological variation in the country. The races found were *A. m. litorea* in Gambella, *A. m. monticola* in the highland Bale Region, a yellow bee on the eastern escarpment resembling *A. m. jemenitica*, a new proposal of *A. m. abyssinica* in the western part of the country, and the bees in the lowland had a resemblance to *A. m. adansonii* (regarded as the West African bee) but not *A. m. scutellata* of East Africa. This study perhaps illustrates that the distribution of bee races is likely to be much more complex than as yet described.

African bee-keepers usually differentiate categories of bee. Most know how to distinguish the queen, workers and drones and have theories about their biology enabling them to carry out effective management practices. Size, colour, hairiness, defensiveness, the ability to sting, the orientation of comb placement and the quality of honey production may be used to describe different bee colonies and bee types, corresponding to different bee species and races. Taylor (1942) describes four types of honeybees that are differentiated by Hausa bee-keepers around Zaria, Nigeria.

The comparative advantage and adaptive nature of various genes from African races of *A. mellifera* is clearly demonstrated by the spread of the so-called "Africanized" *A. mellifera* in the Americas. In 1956, more than a hundred queens were taken from southern Africa to Brazil of which 49 survived the journey (Kerr 1967). In 1957, several colonies swarmed and hybridized with honeybees of European origin. The spread of these hybrid forms has been followed since then with growing interest as it has led to the introduction of dominant highly defensive and absconding characteristics into the honeybee population (Ruttner 1992). The potential threat to a European style of bee-keeping in the Americas has led to an intensive study of this phenomenon. Indeed, the fullest weight of the scientific community came to bear on the issue. As Crane (1990) has summarized, there have been many statistical analyses of its morphology, its DNA sequences and wing beating frequencies, whole bee hydrocarbon assays and high-resolution supercritical fluid chromatography of its beeswax, in order to understand further its spread and its impact

on the more manageable European *A. mellifera* population. The African bees and their genes have never been so intensively studied as when they have proven more successful than was hoped in the New World. It is interesting that despite the Africanized bee being initially perceived as a major threat to bee-keeping in the Americas, some are of the opinion that they have forced a positive change in bee-keeping practice (De Jong 1996). However, as Chandler (1976) points out:

> It is one of the strange turns of history that scientists know least about the race of honeybees that is probably the most populous in the world, and certainly the one with the most potential for development as the major commercial honeybee of the tropics. It is an even stranger turn of history that more is known about a few *adansonii* genes halfway around the world from their home in the so-called Africanized bees of South America than about the varied complex of *adansonii* in their environment of evolution.

This complexity which exists among honeybees in tropical Africa has had great, but generally unappreciated, implications for the history and spread of bee-keeping in Africa. One of the key events in the evolution of modern European-style bee-keeping was the exploitation of the bee space in hive construction (Crane 1983). The bee space is the centre-to-centre distance by which bees naturally separate adjacent combs. When bars are placed in a hive with this spacing, the combs are attached one to each bar and become movable. Thus combs are more easily removed for inspection and replaced. However, the bee space among populations of *A. mellifera* in Africa varies. Clauss & Clauss (1991) record the bee space as 33 mm in Zambia, southern Africa; others have noted that in East Africa it is 32 mm; in Senegal, West Africa, 31 mm; and in southern Nigeria, West Africa, Mutsaers (1991) found it to be 30 mm. This physical manifestation of the heterogeneity in biology of the species in Africa is only one factor that illustrates how little we know about the species in Africa and its implications for current and future bee-keeping practice. It is to the complexity of traditional bee-keeping in Africa that we now turn.

3. Origins and diffusion of bee-keeping in Africa

There are several archaeological finds concerning the exploitation of bees for honey in Africa. However, these appear to be exclusively related to honey-hunting rather than bee-keeping, unlike some sites in Europe where bee artefacts have been found. Africa has the most known rock-paintings related to honey-hunting than any other continent (Crane 1983). This is attributable mainly to the work of Pager (1973, 1976) who describes a number of sites in southern Africa and north of the Sahara. Unfortunately, no rock-paintings depicting honey-hunting in Africa have been dated, though Pager (1976) claimed, probably erroneously, that rock-paintings suggest honey-gathering activities in the Ice Age. Similar honey-hunting practices to those depicted are still carried out in central and southern Africa.

Table 27.1 Location of rock-paintings in Africa related to bees or honey-hunting.

	Comb patterns	Catenary curves	Formlings	Ladders	"Swarms" of bees	Honey-hunting
North Africa						
Algeria		x				
Libya				x		
Tunisia			x	x		
western Sahara	x					
Morocco		xx				
East Africa						
Tanzania		x			?	
Southern Africa						
Lesotho		?		x		
Malawi		?	?	x		
Namibia	xxx	xx	x	x	x	
South Africa		xxx	xx	xxx	x	xx + ?
Zimbabwe		x	xxx	xxx	xxx	x + ?

x = one site, xx = several, xxx = many, ? = uncertain. After Crane (1983).

Table 27.1 shows the location of rock-paintings in Africa which relate, or seem to relate, to bees or honey hunting. Several of the rock-paintings show only depictions of honeycomb or forms characteristic of bee nests, while others have honey hunters in groups of up to five surrounded by bees as they take the honey. An alternative interpretation by Petie (1974) suggests, however, that some paintings depict the netting of birds. Ladders are often also depicted in the paintings and (more rarely) other types of honey collecting equipment. The use of fire or smoke to assist in warding off the bees is also depicted in one painting from Zimbabwe.

The earliest evidence of bee-keeping comes from Egypt (Kuény 1950, Crane & Graham 1985), where four scenes from temples and tombs have been dated at around 2400 BC, 1450 BC (two) and 600 BC. The oldest scene is a stone bas-relief found in the sun-temple of Neuserre at Abu Ghorab and is presently in the Egyptian Museum, Berlin. It depicts harvesting from stacked horizontal hives in a similar way to peasant bee-keepers in contemporary Egypt, though the ancient hives tended to be shorter. The honeybee native to Egypt is *A. m. lamarckii*, which builds smaller colonies and is more defensive than the European bee. Crane (1983) suggests that the style of beehive construction, horizontal hives built in stacks, is well adapted to the biology of the bee, an adaptation which first took place at least 5,000 years ago.

The other three scenes are found in tombs (73, 100 and 279) on the west bank opposite Luxor. The scene in tomb 279, where Pabesa of the Saite dynasty (660–525 BC) is buried, again shows horizontal hives stacked on one another. The hives are painted blue-grey which Crane (1983) suggests indicates that they were made of clay or unbaked mud. The harvested honey is poured into containers or the

honeycomb is sealed within round pottery containers that appear of the same type still in use in Kashmir (Crane 1983).

Crane (1994) states that though she believes that Roman knowledge of bees derived from ancient Greece, bee-keeping practices described by Roman authors were derived from the western Mediterranean region, particularly North Africa, including Carthage, rather than directly from Greece. Evidence for this is that the practice of managing a hive from the opposite end to the bee entrance was described by Roman authors but did not seem to be the practice of ancient Greece. The same practice is found in ancient Egypt and in contemporary North Africa, and indeed throughout much of Africa where conservative bee-keeping is practised.

The complex pattern of traditional bee-keeping in Spain was partially influenced by the importation of technologies from North Africa during the Arab occupation of the peninsula from about 1300–500 BP. In the foothills of the Pyrenees in Aragon, the word used for apiary (*arnal*) is a loanword from Arabic where it means "the bee" (Chevet & Chevet 1987). This can be seen in the walled apiaries or bee shelters resembling those of ancient and contemporary Egypt and present day Morocco by the Berber, as well as in the use of horizontal hives. In other parts of the Iberian peninsula and further north of the Pyrenees in southern France, upright hives are more characteristic, as they are in northern Europe (Crane 1983). Erup & Armbruster (1958) suggested that there may be a link to the bee boles common in parts of northern Europe and well described in the British Isles by Crane (1983).

Archaeological evidence for the *keeping* of bees in sub-Saharan Africa is missing. However, the rich diversity and complexity of bee-keeping suggests its ancient establishment. The complex historical cultural and economic links throughout the continent make it difficult to resolve the origins and diffusions of the many bee-keeping practices that exist. Research to address this complex issue is only beginning and the lack of early materials makes the task particularly difficult. Unlike many domesticated animals in Africa, the task is not likely to be assisted by a closer study of the genetics and biology of the bee population. The swarming and absconding behaviour of the African bee make for close introversion among the wild and exploited population.

Crane (1983) postulated a link between bee-keeping in Ethiopia and that found in Egypt and other parts of the Mediterranean. This is possible given the restricted distribution of horizontal, cylindrical clay or dung hives. However the direction of influence is at present unknown, though the first record of bee-keeping in Egypt dates from about 2400 BC. In terms of complexity, Ethiopia has the more complex traditional system compared to Egypt. As mentioned earlier, there are clearly links between Egyptian bee-keeping and that found in Morocco and the bee walls of Spain. This is likely to be the result of multiple influences, the major one of which would be the Moorish invasion of the Iberian peninsula. Other types of beehive are found in North Africa, such as bark and log hives. Given the more restricted use of such hives in southern Europe, it is possible that these originated in sub-Saharan Africa. Such hives are mentioned by early Roman writers (Crane 1994) and it is conceivable that they are of considerable antiquity, predating the desiccation of the

Sahara. The spread and present-day distribution of log and bark hives has some link to the vegetation. The miombo woodland of eastern and southern Africa, characterized by *Brachystegia* and *Julbernardia*, is where bark hives are most abundant and little traditional bee-keeping is found to its south (H. Hastings, pers. comm.).

Scott (1952) describes thatched conical hives that were usually placed singly in trees of Dracaenas in Ethiopia. He also mentions one occurrence of an apiary of such thatched hives on a low wooden platform which he states is a method used in southwest Arabia. Such an apiary has also been described more recently in Ethiopia by Fichtl & Adi (1994) and in southern Chad by Gadbin (1976). This illustrates again a bee-keeping link between Arabia and parts of east Sudanian Africa. Ethiopia seems to be a centre of diversity in bee-keeping, being influenced and perhaps influencing regions to its north and south. Ancient trade routes in various regions may well have had an influence on sharing bee-keeping technologies, particularly with lighter, more portable hives. Wainwright (1992) has noted possible ancient trade in bee products from Africa to the Phoenicians and the Chinese. Various trade routes across the Sahara would also seem to have included bee products (Curtin 1985, Lovejoy 1985) and may have driven further diffusion and innovation in bee-keeping practice.

It would seem that there may well be some links between the origin and diffusion of bee-keeping and of cereal cultivation. The distribution of cereal complexes approximates well with that of various different hive types and bee-keeping practice. Of the hives used, those made from trees in the form of logs or bark seem to have the widest distribution. Perhaps those made of logs are the oldest tree type, which were replaced in many areas owing to the weight advantage of the bark hive. The density of hives made of tree material has probably been reduced where woven hives have been introduced. Woven hives have a reduced weight and in some areas a lower labour requirement and impact on the environment. In systems where land ownership is related to user rights over trees, hives woven from plant material or crop residues have a particular advantage. The present distribution of log, bark, and woven hives is rather mixed and complex in many areas. However, their distributions suggest that log and bark hives were diffusing in much the same way as cereals such as sorghum and millet, and later in southern Africa also with finger millet. They suggest also a pre-Islamic diffusion through the continent. Woven hives seem to be more recent and their distribution and usage by different peoples has some relationship with the spread of Islam in West Africa and suggests a trans-Saharan influence.

In central Nigeria, log and bark hives have a provenance suggesting a spread linked more with the pre-jihad era prior to the early nineteenth century and are found used among those previously known as the "pagan peoples". Thus, while the Hausa term for the log hive, *kongo*, is used among some peoples in central Nigeria, many have there own term. The woven hive, of various sorts, is spreading in central Nigeria in the wake of other hive types and may be referred to by the Hausa loanword *kango*. The possible role of Fulɓe speakers in diffusing the woven hive in its region of distribution should not be underestimated. Indeed, a description of the local economies of Nigeria, published 50 years ago, notes that the pastoralist Fulani

appear to be more concerned about bee-keeping than the mainly Hausa agricultural population in the north of Nigeria (Forde & Scott 1946). The woven hive is often particularly suited to seasonal bee-keeping which can be especially well integrated with pastoralist transhumance.

An intriguing form of woven hive is the upright woven skeps described among the Serer in Senegal (Ndiaye 1976). Their orientation makes them almost unique in Africa for such conical hives. The hives of closest resemblance are found in northern Europe, particularly in Denmark and the Netherlands. Given that Senegambia has been one of the oldest known sources of bee products exported to Europe, it is possible that a link exists between the two hive provenances. It is difficult perhaps to speculate on the direction of possible diffusion of this hive. However, it is worth noting that, in Europe, the Danish bee-keepers are unique for their tradition of hand-pressing the honey, a practice common in Africa.

The rarely studied conical mud-built hives correlate with the distribution of two ancient West African grains, *Digitaria exilis* and *D. iburua* (Portères 1946, 1976, Harris 1976). The main centres of cultivation of the latter are closely tied to more recent reports of mud-built hives, particularly for *D. iburua*. The most easterly cultivation of both cereals is close to the Jos Plateau, Nigeria, similar to the range of the mud-built hive. This would suggest a common development in the region of both the cereal culture and bee-keeping. In the same way that the *Digitaria* species are thought to be the most ancient of West African cereals, it may be postulated that the mud-built hive is the oldest form of beehive in the region. It has managed to stay prevalent in those areas where the people were able to avoid various forms of cultural imperialism over the centuries (Isichei 1983).

The double-chamber variants of mud-built hives are found close to the present northern limit of the mud-built hive type in central Nigeria. The area is in the hilly region of Kauru and on the western and southwestern fringes of the Jos Plateau. This is the present boundary of the Benue–Congo and Chadic language groups (Crozier & Blench 1992). It is also an area noted for its complex relationship of trade and intermarriage among the hill communities (Sharpe 1982), factors that are perhaps conducive for innovation.

4. Traditional bee-keeping in Africa

4.1. Bee-keeping techniques

Traditional bee-keeping in Africa is complex and highly diversified. In some areas, on a regional or local level, it is absent, particularly in the forest zone of West and Central Africa, and in others there are a large number of different hive types and management practices. Studies to date have only begun to unearth the rich traditional knowledge of African bee-keepers. All African bee-keepers have some knowledge of how to attract swarms to colonize hives. This may relate to the positioning of the hive and in many areas bee-keepers place their hives high in trees where swarms are often found to settle (Mutsaers 1991). Bee-keepers often prefer

to place their hives in certain trees (e.g. *Daniella oliveri*, *Terminalia spp.*, *Parkia biglobosa*).

African methods of attracting bees to hives are numerous. This may include the practice of certain rites or the placement of bee attractants in the hive, often plants or mixtures of plants and frequently aromatic. Some bee-keepers are known for their ability to make potent attractants and one bee-keeper from Tahoss on the Jos Plateau, central Nigeria, travels about 20 km to get one such attractant from a bee-keeper in another village. Taylor (1942) mentions that these recipes are also a jealously guarded secret around the Zaria area, where he describes the ingredients as including fruits of *Swartzia madagascariensis*, *Bauhinia reticulata* (probably *Piliostigma reticulatum* or *P. thonningii*) pods, *Cassia goratensis* (*Senna singueana*) and inflorescences of *Cymbopogon giganteus*. These are pounded and dried and used as a fumigant. Cow dung is often used as a raw material in hive construction and is commonly regarded as a good attractant for bees. In Ethiopia, hives constructed only of cow dung are found (Fichtl & Adi 1994). More usually it is used as a plaster to smooth the sides of a hive woven from plant material or around the bee entrance holes.

Another interesting management practice, which seems rare in Africa, is migratory bee-keeping, where colonized hives are moved in response to changing honey flows in the vegetation. It has been practised in Egypt, where hives have been moved by raft along the Nile (Crane 1983), with basket hives carried as headloads around the Mount Oku area in Cameroon, and in Ethiopia (Fichtl & Adi 1994). A movable clay hive has also been used around Gashish on the Jos Plateau. This practice may well be more prevalent than present reports suggest.

Catcher boxes are placed high in a tree where bee swarms are normally found. When a swarm enters, the colony can then be transferred to the hive. Forms of catcher boxes have been seen in Nigeria, where a small pot is used, and in an area of the Bamenda Grassfields, North West Province of Cameroon where an innovative system was developed in response to increasing theft of honey and hives. Bee-keepers have transferred their log hives to the compound and placed them in a separate room of the kitchen hut or have even built new rooms for this purpose. The "beeroom" can contain up to 50 hives. Each is built into the wall with the bee entrances to the outside of the hut so the bees enter the hives through the wall. Having solved the problem of theft, the bee-keeper is now faced with colonizing the hive. As only few swarms would enter the hives as they are, small wooden boxes or small raffia or log hives of about 50 cm × 30 cm × 30 cm are used as "catcher boxes". They have an opening at the rear end and the bottom part is partially or totally movable. These are set up in places where it is known that swarms are likely to settle. When a swarm has colonized the catcher box and brood has been placed in newly built combs, the box is sealed and carried to the beeroom. There it is attached to one of the empty log hives. The log hive has a special opening for the catcher box at the top near the bee entrance. The bottom of the catcher box is partially removed and fitted to the log hive. The gaps are closed and sealed with mud. In this way, the catcher box becomes an integral part of the hive, sitting on top of it near the bee entrance. During harvest the catcher box is never touched. It

is believed that the queen moves there during harvesting when smoke enters the hive and that this prevents absconding.

In Ethiopia, Fichtl & Adi (1994) describe the use of a queen cage made of bamboo which assists in moving a swarm into a hive. The queen is identified in a swarm and is caught and placed in the queen cage. Van der Burgt (1903, quoted in Irvine 1957) mentions Rundi bee-keepers catching a queen and transferring it to the hive after which the swarm will follow.

The occurrence of bee-keeping varies to some extent within a region, some peoples are bee-keepers while the neighbouring peoples may well not be. Again within the same ethnic group there may be some villages which have bee-keepers while others may not. Traditional bee-keeping is almost exclusively carried out by men, though Irvine (1957) noted that women may use ground hives.

4.2. Hive types

Most studies seem to assign a particular hive type to a particular ethnic group. However, other evidence shows that the story may not be so simple as a number of peoples have several different hive types used either perennially or seasonally in a complex system. Such evidence suggests that bee-keeping development in Africa does not follow a linear evolution of the type described by Crane (1983) in regard to European bee-keeping.

The literature has been able to show the innovative nature of much African bee-keeping and it also shows that hive types do not simply replace a more "modern" hive for a more "primitive" style. Indeed, the oversimplification of such substitution is further illustrated by the co-existence of both honey-hunting and bee-keeping, and also of conservative and non-conservative forms of hive management within the same village in various parts of Africa. Rather, it suggests an increasingly complex system of bee-keeping (which is also not isolated from the wider livelihood system) that is integrative and syncretistic. Thus, there is a "hybridization" of much bee-keeping technology and management practice. An improved understanding of both African bee biology and of this adaptive process helps grasp the history and future development prospects of bee-keeping in Africa.

4.3. Hives constructed from trees

The hive types of widest distribution in Africa are constructed from wood, usually in the form of cylindrical bark or log hives. Both hive types are found throughout the continent, in North, West, East and southern Africa. Neither have been recorded much south of 25°S, in Egypt or in much of Central Africa (though this may be partly due to lack of evidence).

Emin Pasha gives an early description of the use of bark hives when coming across them among the Dinka of East Sudan in 1888 (Irvine 1957). They are found in most African countries where bee-keeping is practised and are particularly prevalent in the miombo woodlands which are characterized by *Brachystegia* and *Julbernardia*. Bark hives form horizontal cylinders, usually around 1–1.5 m long and 30–45 cm across, to which end pieces are added. They may also be sealed and insulated with grass and cow dung.

The trees from which the bark is taken vary. The Acholi of Uganda tend to use bark of *Terminalia*, whereas in much of the remainder of eastern and southern Africa bark of *Brachystegia* and *Julbernardia* is used. Harris (1940) also notes that bark hives are generally made from *Brachystegia* and *Julbernardia* trees. In Nigeria, though bark hives are present, they seem to be rare (Jessen 1967). In West Africa, the Yalunka of northeast Sierra Leone use the bark of *Daniellia oliveri* which is prevalent in the moister savanna zone. Pobéguin (1906) describes how the same tree is used in Guinea and in other parts of francophone West Africa. The wood of *Daniella oliveri* is resistant to termites, adding to the potential longevity of such hives. The tree extends from Senegal to Sudan, Uganda and Zaïre (Keay 1989).

Horizontal bark hives are also found in North Africa where they are made from *Quercus suber* (cork oak) which, when the bark is removed, is not killed as with many other species. The cork quality also helps maintain a more even hive temperature during both hot and cold weather. Similar hives are found in Spain and Portugal where they are used vertically. Hives made from cork bark are regarded as the best type of hive by the ancient Roman writer Varro (Crane 1994).

The use of log hives is not restricted to Africa. Log hives have been used in South America for stingless bees, throughout Asia with *A. cerana* and have been used upright in northern Europe for European *A. mellifera*. They have also been described by writers in ancient Rome (Crane 1994). Trees are often nesting sites for wild bees and it is not surprising that one of the preferred nesting sites of bees has been adapted for use as a hive.

An overview of several African log hive types is given by Irvine (1957), but he perhaps makes a false distinction between "hollow logs" and "specially hollowed wood". The view of Smith (1942) is that the log hives used around Buea, Cameroon, were not built specifically for the purpose but that the bee-keeper is merely exploiting rotted hollows in logs in which bees have nested. He also suggests that the bee-keepers were inspired to do so following the use of packing cases for bee-keeping by some German colonialists. While both of his suggestions would seem to be based more on his own prejudices, it is true that bee-keepers may exploit opportunities that bees provide in their natural nesting habit. For example, Villières (1987a) has described a hive in eastern Senegal formed by bricking up a hole in a baobab tree in which bees had nested. Preservation and exploitation of natural nesting sites has also been seen in central Nigeria, Cameroon and South Africa.

Log hives have been particularly well documented in East Africa, in Tanzania (e.g. Seyffert 1930, Ntenga & Mugongo 1991) and Kenya (e.g. Nightingale 1976). Various different tree species are used to construct hives. Ntenga & Mugongo (1991) found more than ten different species which bee-keepers preferred for the construction of log hives. There are different forms of log hive used in Africa. One of the most common types is made by hollowing a log from the ends to make a cylinder. This is then placed or hung horizontally in a tree. Harvesting is done either by lowering the hive or by climbing the tree and then removing an end-piece. Other types of hive are made by splitting a log prior to hollowing it out. The two pieces are then tied back together (Irvine 1957). Harvesting of such hives is often done by lifting the upper section to expose all the honeycombs. The upper section

is sometimes purposely made bigger than the lower (Ntenga & Mugongo 1991). A third form of access is through a door placed mid-way along the length of the hive. Though all log hive types seem to be well described among different peoples and in different areas in East Africa, all three forms have also been seen in central Nigeria and elsewhere in Africa.

Barth (1857–9) describes the use of hollow logs, placed in trees, as beehives among the Hausa of northern Nigeria. A number of different tree species are used to make log hives in West Africa. One hive of wider distribution in West Africa is made from the stems of the fan-palm *Borassus aethiopium* which are hollowed out and used as a horizontal cylindrical hive. This is a common hive of the Hausa in northern Nigeria and is also used further west and in East Africa.

Horizontal wooden box hives made from boards have been described from Morocco and Algeria (Crane 1983). Such hives have also been found in the region sweeping from Slovenia through the Alps of northern Italy. Crane (1983) mentions that she also found a similar hive in Corsica. Somewhat further afield, Clauss & Clauss (1991) describe the use of wooden board hives in Zambia. One bee-keeper there has also used old dug-out canoes to build such hives. The Zambian wooden hives differ from the North African types in that one plank is removed during harvesting. Irvine (1957) mentions some other hive types that seem to be made from specially prepared boxes. Wooden sticks bound together into a cylinder and covered in grass and cow dung or mud have also been seen in Zambia. Another wooden form of hive is described from Guinea Bissau where old wine barrels used by the Portuguese are utilized (Svensson 1985).

4.4. Hives constructed from other plant material

Many types of hive are made of plant material other than from trees. These may be cylindrical or conical in shape and are usually placed in trees horizontally. The construction material varies both within and between areas. In Morocco, there are woven cane hives which Crane (1994) relates to descriptions in the writings of Varro, Virgil, Columella and Pliny from ancient Rome. Grasses are also often used to build straw hives. The species of grass varies and Mutsaers (1993) lists seven types of grass that have been used in Nigeria and Niger, including stems of the crop plants sorghum and millet (Himsel 1993). Depending on the form of construction, an inner woven frame is often used to provide the shape. Basket work hives constructed from spilt bamboo or other similar material are also found. The inside of grass and woven hives are often finished with a layer of cow dung and mud.

A typical example of a woven hive type can be found in the Bamenda area of Cameroon where the most intensive bee-keeping is practised around Mount Oku. The traditional hive is called the "Oku Hive", and it was recently reported that this hive constitutes 80 per cent of the 1,392 hives of the 58 members of the North West Beefarmers' Association. The other 20 per cent are top-bar hives, introduced within the last ten years, or pots, tins and boxes. The number of hives varies from about three to more than 100 per bee-keeper.

The Oku hive is a horizontal hive and is usually constructed mainly from raffia. It is cylindrical, has a diameter of about 30 cm to 55 cm and is about 1 m to 1.5 m

long. Two or three woven cane rings form the inner structure to which split raffia is attached. It is sometimes sealed with mud, usually mixed with cow dung, and has another two or three rings of woven cane around the outside of the structure. The bee entrance is at one of the ends and harvesting is done from the opposite end by removing a door and cutting out the combs. Usually, there is more brood near the bee entrance with the honey towards the harvesting door. Most bee-keepers take this fact into consideration when harvesting by leaving the combs near the entrance untouched. Thus conservative bee-keeping can be practised as the bees are then less likely to abscond. This management procedure is made easier during construction by placing sticks in the shape of a star about 22–24 cm from the bee entrance so that they know where to stop cutting when harvesting at night with a machete. The hives are placed in trees about 3–7 m from the ground. However, some bee-keepers will place their hives only 1 m from the ground under certain conditions, for example where there are overhanging rocks or caves with wide openings.

Many bee-keepers around Mount Oku practice migratory bee-keeping to optimize cropping of the varying honey flows. They move their hives on headload up and down the mountain, following the flowering peaks of various vegetation and in this way obtain better yields. The distance is usually no further than what a man can walk in one night. The hives are completely plastered and sealed with mud at night, so that no bees can come out, and are then transferred the same night to their new position where the mud is removed before sunrise. Fichtl & Adi (1994) have also described migratory bee-keeping using basket hives from Ethiopia.

Gnägi (1992) describes six hive types used in the Ouélessébougou Arondissement of Mali, five of which are constructed from grass, bamboo or millet stalks. The sixth type is a cylindrical bark hive. There are two types of grass hive which he distinguishes, conical and cylindrical. The conical grass hive usually has only one entrance making it necessary to disturb the brood when harvesting the honey. This makes it likely that the colony will abscond which is not a problem when the hive is used seasonally. He notes the use of a local innovation whereby the bee entrance is placed at the apex of the horizontal cone. Thus conservative harvesting, leaving some comb in the hive and reducing the likelihood of the colony absconding, is made possible. It also allows the bees to be smoked out of the hive prior to harvesting, reducing the risk of the honey harvester being stung.

The use of cylindrical hives is more common where conservative bee-keeping is practised, as Gnägi notes from Mali. Cylindrical hives make the construction of two entrances easier; an entrance for the bees at one end and a harvesting door at the other. There are exceptions to this general rule and Schweinwurth (1873) described the use of a harvesting hole midway along the length of a long cylindrical hive made of basketry. In addition to the bark cylindrical hives, Gnägi describes three other types of cylindrical hive based on the construction material, grass, millet stalks and woven bamboo. Such variation in the type of hive and in the material used is common in many areas (Himsel 1991, Mutsaers 1993). Clauss & Clauss (1991) also describe the use of a rolled woven mat in forming a cylindrical hive.

The waterproofing of hives is also an important aspect. This is often done by plastering the hive with a mix of cow dung and mud. Gnägi suggests that plastering

with the right mix is one of the critical points in maintaining the right environment for the bees to reduce the possibility of their absconding. It can also add to the potential longevity of the hive. Further east and south in Africa, banana leaves are also used to protect the hive (Irvine 1957, Clauss & Clauss 1991). The incidence of grass and woven hives seems to be much less in the region covered by the miombo woodland in east and southern Africa where bark and log hives are more common.

Though horizontal hives are the norm, examples of woven upright hives also exist. Conical upright basketry skeps plastered with cow dung have been described from Senegal where they hang from the apex of a tree. Such hives are remarkably similar to traditional skeps used in Denmark and The Netherlands (Crane 1983) and do not appear to exist in other parts of Africa. The only other upright basketry hive so far studied is found around Kontagora in western central Nigeria (Corby 1943). It would seem to be a mimicked copy of another local hive constructed from mud which is described below.

4.5. Container hives

Traditional household containers such as clay pots and calabashes are also used as beehives. Pots which have fallen out of use in the household are usually used for the hives; however, there are examples where pots are bought specifically for use as beehives.

Crane (1983) describes specially constructed fired-clay hives being used in Morocco. The hives are constructed in a tapered manner that allows the pottery cylinders to be put together end to end. This allows for the addition of special honey chambers, known as supers, after the establishment of the bees in the hive.

Clauss & Clauss (1991) describe the use of calabashes as beehives. Usually a single calabash is used, though they have seen one instance of a double calabash hive. In central Nigeria an upside down pot with another smaller pot as a brood chamber fixed on the side has been seen, along with other double pot types placed open end to open end horizontally. Usually such hives have one pot larger than the other, though sometimes they are the same size.

Other types of container are also brought into new use as beehives. These include old buckets, petrol cans, oil drums in francophone Africa (Villières 1987a; all three have also been seen in central Nigeria and western Cameroon), old wine barrels in Guinea Bissau (Svensson 1985) and cement barrels in Cameroon (Smith 1942).

4.6. Hives constructed from earthen material

The earliest recorded evidence of hives in Africa is of horizontal cylinders made of mud or clay which were placed in walled apiaries. These have been described from ancient Egypt and the same hive type is still in use (Crane 1983). This form of wall apiary is also found further west in North Africa and in northern Spain, and further east on the Arabian peninsula. Outside of Egypt the wall apiaries may be used as receptacles for horizontal woven cane hives covered with cow dung.

One key distinction that has been drawn between hive types is that between horizontal and upright hives. Crane (1983) has used this as the primary dichotomy

in describing hives. The tendency seems to be that horizontal hives allow for smaller but more numerous combs. The placement of brood in relation to the honey is thus affected. There seems to be a greater likelihood of combs having both brood and honey in the upright hive.

Though upright and horizontal hives can be constructed from similar materials, Crane has noted that the hive orientation varies according to geographical locality. It was thought that upright hives were originally found in northern Europe, only later being used in Asia. However, evidence from central Nigeria (Corby 1943), northern Benin (Villières 1987a,b) and the travels of Frobenius in what is now Guinea and Mali (Seyffert 1930) suggest an ancient existence of upright hives constructed from mud and thatch in West Africa.

The German explorer Frobenius described *gemauerte Häuschen* (small house masonry hives) among the Malinke in Guinea and elsewhere in Mali (Seyffert 1930). Their exact form of construction is rather unclear. Corby (1943) gives a description of upright hives constructed from mud and thatched with grass among the Kambari in the Kontagora Emirate of west–central Nigeria. The hives may be constructed on a platform high in the trees. The Kambari have two other types of hive both constructed from basketry plastered with mud and cow dung. One of the basketry hive types is similar to that used further north among the Hausa, while the second basketry type is a "hybridization" of the two forms as its form is that of the hive type constructed from mud.

The hives used by the Kambari tend to have the bee entrance on one side and a harvesting door at the other. The harvesting door is removed at night and smoke is blown into the hive in order to drive the bees to the outside of the hive on the other side. The honey harvester does not remove all of the combs, reducing the probability of the bees absconding. Hives similar to those described by Corby can also be seen among the Somba people in the Atakora Mountains in the north of the Benin Republic (Villières 1987a,b). Our own research shows a much wider distribution of this type of hive than previously thought in Kaduna and Plateau States of central Nigeria, and particularly in the hilly areas on the fringes of the Jos Plateau. The approximate southern limit of traditional bee-keeping in Nigeria does not extend too far into the forest zone (RIM 1992).

The construction of hives built of mud in central Nigeria varies to some extent from village to village. Some hives are constructed in a similar manner to the local grain stores, especially in terms of the closure of the mud ceiling, while others used a method of closure specifically for the hive. This second type has been seen among the Berom at Tahoss and the Shagawu at Gashish on the southwest fringe of the Jos Plateau. At Tahoss the hive is conical with a flat ceiling onto which a thatched roof is placed. The closure of the hive ceiling is by placement of sticks across the top of the hive which is then sealed over with mud. The preferred stick is hollow and, when split and placed inside down, forms a ridged guide on which the bees can build their combs. The bee-keepers also say that these sticks have the advantage of having an aroma which attracts the bees. The sticks are placed in an orientation across the bee entrance and, of those ten measured, have an average width of 30 mm which corresponds exactly to measurements of bee space in Nigeria (Mutsaers

1991). When harvesting, the bee-keeper is only able to see one comb after the other as he removes them. The brood is mainly placed close to the bee entrance on the other side and some combs will be left, practising conservative bee-keeping.

Among the Shagawu in Gashish on the Jos Plateau there are three types of hive. One is conical in shape, similar to those found elsewhere in the region. However, the other two are straight-sided and, from above, have a more elliptical shape with the bee entrance and harvesting door on the longer sides. The ceiling is again formed with sticks covered with mud. However, the sticks are more roughly cut and the type seems of less importance. They fulfil the same function of guiding the bees in the orientation of comb building. The key difference is that the orientation is switched by laying the sticks between the two sides in which the entrance and harvesting door are placed. The bees, as in all hive types, tend to build their first and brood combs closest to the entrance and the combs of predominantly honey further from the entrance. The advantage expressed by a Gashish bee-keeper when comparing the comb orientation with that of the Tahoss hive was that he was able to see all of the combs when he opened the harvesting door and choose more carefully those with much honey at either end.

The difference between the two straight-sided hives in Gashish is mainly in size. However, the size then allows for two further interesting innovations. The larger hive may have a smaller chamber of similar style constructed on top of it which has the new bee entrance, while the entrance placed initially in the lower chamber is sealed. The two chambers are connected by holes pierced in the ceiling of the larger chamber. The upper chamber is not harvested and is left for the bees. Its position near the entrance means that the bees tend then to make this their brood chamber. During harvesting the bees are smoked into the upper chamber. The smaller straight-sided hive is constructed on two pieces of wood, allowing it to be moved according to varying honey flow of trees and shrubs in the area. The hive is therefore designed for migratory bee-keeping.

Double chamber hives constructed of mud are found in other parts of central Nigeria. However, those others seen have a main chamber conical in shape and the second chamber, attached on the side rather than the top, is a small, old pot with its mouth facing in and a bee entrance tapped through the pot floor – for example, as seen in a hive, found in the Kauru Hills between Kaduna and Jos in central Nigeria. Monber, in a letter to Irvine (1957), describes "bee rooms" among the Baju (Kaje) near Zaria, Nigeria. These seem to be something similar to the double chamber hives described above. It seems that in this case a swarm which has nested in a pot placed in a tree is brought down and fixed to "a much larger pot or small room". Thus the pot is used first as a "catcher box" and secondly as a brood chamber. Monber tells Irvine of having seen over 36 litres of honey being taken from such a hive in one season. The same use of a catcher pot has been seen further east close to Jos among the Bache (Rukuba).

Many of the peoples in central Nigeria in areas where hives built from mud are found also keep other forms of hive, particularly log hives and pot hives. While, as mentioned above, a small pot hive may be integrated into a mud-built hive, only one example of a hybridization of log and mud-built hive has yet been discovered.

This was found among the Tumi in the Kauru Hills between Jos and Kaduna, in central Nigeria. The mud-built section is similar in shape to two of the hives found in Gashish on the Jos Plateau and the ceiling is made from one half of a split log hive.

The present situation in central Nigeria shows that in one village several different hive types may be used. Thus mud-built hives, log hives and pot hives, and in some areas bark and woven hives, may all be used by the same bee-keepers, without excluding the practice of honey-hunting. The heavier mud-built and log hives are often used as perennial hives whereas the others may only be used on a seasonal basis. This type of system seems to be a relatively recent development and brings together advantages of both perennial and seasonal systems. This then enables the bee-keeper to exploit the swarming tendency of *A. mellifera adansonii*, with the perennial hives providing a colony source for the seasonal hives. The bee-keeper becomes the manager of a wider bee system rather than only focusing attention on individual hive management. Such a system of perennial "bee reservoirs" with seasonal hives was advocated for use in Kenya by Nightingale (1976) based on his long experience of African bee behaviour.

5. Bee-keeping development in Africa

There is a decline in bee-keeping in many parts of Africa owing to, *inter alia*, local competition with refined sugar, theft, environmental factors and the opportunity costs when compared with other enterprises. However, the demand for good quality, organic beeswax and other bee products is on the increase. The spread of *Varroa* mite and the widespread use of chemicals has meant that the demand for wax produced by the European bee is declining. The African bee is a particularly good producer of wax and the market potential seems vast. Wainwright (1992) states that colonialism was the worst event in the development of bee-keeping in Africa. It managed to disturb ancient trade in honey and beeswax that did not revive until well after independence. Presently, an excellent basis for the revitalization and expansion in the historic trade in bee products exists throughout Africa. However, the views of many bee scientists and developers do not seem to fit well with this challenge.

Crane (1992) follows Dzierzon (1862) in attempting to define "rational" bee-keeping. Both writers, Dzierzon for Europe and Crane for the tropics and subtropics, centre their concept of rationality on the idea of intensive management and, in particular, on the use of movable frame hives following the developments of Langstroth (1853) with European bees. The assumption that apiculture has spread to Africa (Crane 1983) is based on the fact that management in Africa is in many cases very limited, in some cases zero-management is practised; whereas in Europe, management is the basis for any type of successful bee-keeping. This assumption underlies a basic error: that intensive bee management is an indicator for "rational" bee-keeping for all bees races of the world. As have many other authors, Crane assumed that lack of intensive management is a result of ignorance and the use of

inappropriate, "primitive" hives. However, non-intensive management of African bees is more a rational response to the behaviour of the bees (very defensive, absconding, swarming behaviour) and the complexities of African subsistence systems.

Furthermore, there is a great variability in the different populations of African bees, ranging from the more well known, highly defensive "mass attacking killer bee" (perhaps typified by *A. m. adansonii* and *A. m. scutellata*) to the relatively docile bee of the East African highlands, *A. m. monticola* (which can be kept around homesteads and managed without protective clothing during day time, cf. Ruttner 1992). One response to the difficulty in managing African bees was to import European bees, regarded as having better behavioural characteristics for bee-keeping. This has also proven unsuccessful.

Those management techniques that are practised, such as hive placement, have also been widely criticized. The high placement of hives is often only related to protection from thieves and bush fires by eurocentric bee experts. However, it is also a practice adapted to swarm-catching and increases the percentage colonization of hives. A ground apiary is necessary when intensive management is used. The use of a ground apiary has not proven attractive for both environmental (bush fires, pests) and social (thieves) reasons, as well as for their non-adaptation to African bee biology.

With many other authors, Smith (1958) noted in his observations of bee-keeping in Tanganyika (Tanzania) that traditional bee-keeping was "most inefficient". However, he then, in a curiously paradoxical juxtaposition, points out that the various attempts at using more "normal" European and American hives had been unsuccessful. Fichtl & Adi (1992) mention that traditional bee-keeping in Ethiopia, despite its antiquated appearance to eurocentric bee-keepers, is actually a very efficient undertaking. No capital investments are necessary to obtain sufficient honey yields. If the harvest must be increased, additional baskets will be prepared and hung up in trees. The biology of the bees does not require sophisticated management methods like nucleus making and queen rearing. The volume of baskets ensures that sufficient swarms will be produced to replace the bee colonies spoiled during traditional harvesting. Gnägi (1992) has also made this point for bee-keeping in Africa in general and for Mali in particular.

Since most colonial officers, development workers and scientists assumed wrongly that the management practices of African bee-keepers were less advanced for the African bee than the complicated management practised elsewhere, they tried to develop advanced and "modern" methods of bee-keeping in Africa. Almost all recent interventions such as introducing movable frame hives, or developing adapted hives like the highly promoted Kenyan Top-Bar Hive (KTBH) have been disappointing (Crane 1990). As hives they depend on intensive management, the antithesis of the rational exploitation of the African bee.

DeBold & Fondell (1996) follow Gentry (1984) in discussing stages in the development of the bee–human relationship as characterized by a continuum from "bee killing" through "bee-having" to "bee-keeping". This reflects the same linear evolutionary perspective of Crane and others. They suggest that there is no conservative bee-keeping in the Central African Republic. However, they also note the

lack of success in introducing the KTBH. This is rightly put down in part to the prohibitive cost of the materials required, as well as such factors as the relative fragility of the KTBH and its need to be placed closer to ground level where it is accessible to bee-keepers and thieves alike. Unfortunately, they fall into the trap of also blaming "cultural factors" for the lack of impact of bee-keeping development programmes.

A better understanding of the biology of the African bee and the heterogeneity in its population is clearly necessary if we are to understand traditional bee-keeping management systems and their development. This then requires a development dialogue among bee-keepers and scientists, not only on hives and their management but also on bee-keeping systems and their relationship to livelihood systems in Africa. Working with bee-keepers, with their current technology and with their innovations, can begin to take the sector forward (Clauss & Clauss 1991, Gnägi 1992). However, until more bee-keeping development programmes free themselves from the hegemony of a false "modernization" and "rationality" based on an understanding of the European *A. mellifera*, the African bee-keeper will not be effectively served.

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Note

1. The survey covered 75 per cent of the country, but did not include the north owing to the instability in the area at that time. The information came from the *Ethiopian Bee-keeping Newsletter* **1**(2), and was described briefly in *Bee-keeping and Development* **30**, 8, March 1994.

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