ECTD_289

TITLE: Prevention and treatment of diseases and pests of honeybees: the world picture

SOURCE: New Zealand Beekeeper: 7(10): 5 - 8

DATE: 2000

Reproduced with permission

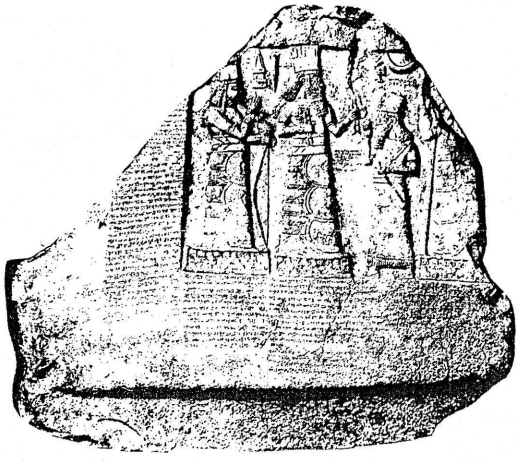
Prevention and Treatment of Diseases and Pests of Honey-Bees: The world picture

1. The world spread of honey-bees before and after man's intervention.

The different species of honey-bee (apis) evolved in the Old World - in Africa and Asia - before the end of the Pliocene period about two million years ago.[9] Mammals, including primates, evolved much later. Chimpanzees have been observed getting honey from bees' nests by using various tools they made for the purpose, 10 so it seems likely that when man (Homo sapiens) evolved perhaps 250,000 years ago, he also hunted for bees' nests, harvested the combs and ate the contents. When bees were kept in hives, however, they could be moved from one place to another, and this provided opportunities for bee diseases and parasites to spread to bees in other places.

One type of movement was 'migration', in which beekeepers gave their bees access to extra honey flows. This was already done in the Ancient World,[13] although through quite small distances. If, as was usual, more than one beekeeper used the same migratory site, pathogens and parasites could be transmitted between bees owned by different beekeepers.

A later, and more significant, type of movement of hives was the transport of colonies of Apis mellifera to regions without honey-bees. An Assyrian relief from the 700s BC (Figure 1) records that a certain Mesopotamian ruler 'was the first to bring bees that make honey from the mountains, and to keep them in his garden'.[11]



Relief from the mid 700s BC showing Shamash-res-usur, the ruler of Assyrai who first took bees there and kept them in his garden (Istanbul Archaeological Museum).

The transport of Apis mellifera outside the Old World came much later and had very wide consequences. At the end of the middle Ages honey-bees were taken from Spain or Portugal in Europe to several groups of Atlantic islands previously without them:[12]

	from	*to*
1400s	Portugal	Madeira and Santo Porto
1454	Spain	Canaries
1554	Portugal	Azores.

The transport of honey-bees from Europe to new continents probably started in the 1500s, and it was extended further and further afield until the 1800s:

	from	*to*
possibly 1500s	Spain	Mexico
1617	England	Bermudas
1622	England	what is now USA
1776	Scotland	Canada
1822	England	Australia
before 1830	unknown	Costa Rica
1839	Portugal	Brazil
1839	England	New Zealand.[25]

In all the above receiving countries, the bees were kept in traditional hives until movable-frame hives were introduced there in the late 1800s. After movable-frame hives were in use, the bees were also taken to Pacific islands, for instance:

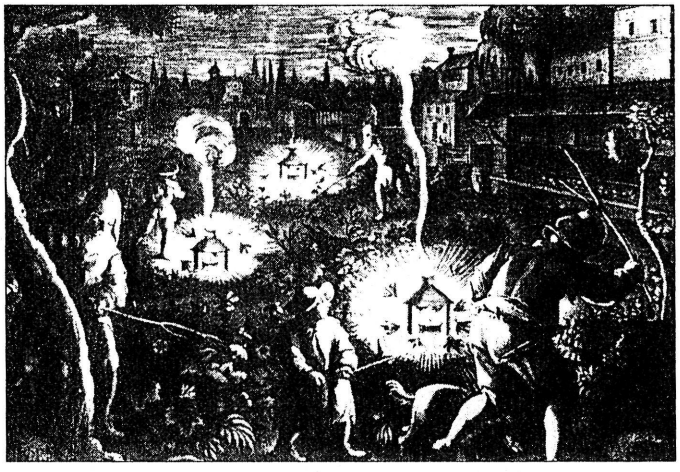
	from	*to*
1857	USA	Hawaii
1962	New Zealand	Nuie

There was much less movement of the Asian hive bee Apis cerana. It is believed that 'some centuries ago' nomadic people took hies of Apis cerana from the lower Indus valley across Baluchistan to parts of Persia near the Gulf.[14]

In 1985/86 Apis cerana was transported along the Indonesian chain of islands, across the Wallace Line and as far as Irian Jiaya, the western part of the island of New Guinea. In 1987 the bee reached the eastern part, Papua New Guinea,[3] and the Australian Quarantine and Inspection Service was alerted to monitor its possible entry into the country.[28] The reason for the alert was the possible contact of Apis cerana with Apis mellifera in Australia and the consequent transfer of mites that can parasitize both species: Varroa, Asian mite, and Acarapis woodii.[7] (trachaes mite acarine Isle of Wight Disease). In addition, Kashmir bee virus infecting Apis cerana can also infect Apis mellifera.

2. The world spread of honey-bee diseases and pests

We know that bee diseases existed, and were treated, in the Ancient World. For instance, between 330 and 30BC Aristomachus in Greece said that the following help should be given to bees which are sick: 'first, all the diseased combs should be removed and entirely fresh food placed for the bees, and then they should be fumigated.' Disorders recognised in Ancient Greece included starvation, dysentery, and failure to rear brood. Book IV of Aristotle's Historia animalium (40.626b) referred to 'a diseased condition indicated in a lassitude of the part of the bees and in malodorousness of the hive', which may have been the bacterial infection later known as European foul brood. In Ancient Rome, Columella recommended the use of light traps near the hives at night in autumn to attract wax moths, and Jan van der Stratt illustrated this activity around 1590 (figure 2).



Flemish beekeepers in their apiary at night, with lanterns to attract wax moths (Jan van der Straat, c 1590)

We do not know much about the spread of bee diseases until recent centuries, when the main cause was the transport of colonies - and later of queens with attendant workers - to distant regions where honey-bee were already present. (When the initial transport had been made, there were no honey-bee to be endangered.) In my other lecture I mentioned effects of some fairly recent introductions of a new race of honey-bee into an area already populated by one race, and some of these introductions have been associated with the spread of diseases or parasites.

However, the arrival of the greater wax moth in the USA around 1800 - presumable with bees sent from Europe - was

documented in some detail. The moth was apparently introduced after 1805. Its appearance was reported by the Boston Patriot in 1806, and within two years it had infested so many hives around Boston that 80% of the apiaries were abandoned.[35] Affleck[1] dated its entry earlier: in the Boston area about 1800, Connecticut 1805, Philadelphia 1812, Ohio 1827. The large number of honey bee nests in trees provided further opportunities for the moth's rapid spread, and in 1831 JVC Smith referred to its ravages throughout the country.

There losses stimulated experiments in designing hives which might reduce wax moth damage. Many such hives had a sloping floor board or other device for removing detritus containing eggs of the wax moth from the bottom of the hive. Nearly 600 patents for 'new' hives were listed in the US Patent Office Index[20] from 1810 onwards, 74 of them before Langstroth's patent in 1852, which also made a similar claim.[19]

Between 1875 and 1880 the wax moth started to infest colonies in Queensland, Australia, and in 1883 Carroll reported that apiculture in this colony has sunk to a very low condition indeed... only a very few individuals... managed to save a few stocks amidst the general devastation'.[21]

When bees come into contact with other bees already carrying disease pathogens or mites, the likelihood that they themselves become affected depends partly on environmental conditions. In general honey-bees in temperate zones - which must survive through a winter period - are more subject to diseases than those in the tropics which can fly all round the year. But bees in the tropics are more prone to attack by predators and other enemies. Since 1982 various members of staff of the International Bee Research Association have published maps and tables every few years, showing the reported distributions of honey-bee diseases and parasites.[5, 29, 30, 34.]

In 1922 and 1923, respectively, the USA and Canada enacted legislation to prevent the import of honey-bees, in order to keep out the tracheal mite Acarapis woodii, identified in 1921. This mite did not reach North America until much later, but certainly by 1984.[18] in 1959 Jeffree[27] published a study on the world distribution of this mite. He showed that infestation of colonies with it was linked with certain meteorological factors, especially: a small difference between summer and winter temperatures, and annual patterns of rainfall and day length characteristic of areas at latitudes between 40° and 70° (Figures 3 and 4). The few places satisfying these conditions included New Zealand and Tasmania, the lower part of the St Lawrence basin in North America, and part of the Indian Himalayas where, in fact, the presence of the mite on Apis cerana had been reported at Katrain in 1957,[36] presumably following an introduction of Apis mellifera into the region.

Another transference of mites between Apis species is believed to have occurred in the Pacific Far East region of what was then the USSR.[8] Varroa jacobsoni had been found on Apis cerana in Java as early as 1904, but it was then regarded as of little or no consequence to beekeepers. It was recorded on the native Apis cerana in the Pacific Far East from about 1950, and after colonies of Apis mellifera were transported there in 1904 or earlier,[16] Varroa successfully infested them also. Apis mellifera queens with workers - and the mites - were later sent from the Far East to European USSR.[17] The mites spread from there to other countries through successive transports of Apis mellifera, and were reported in Bulgaria in 1967. By 1993 the mite was known to be present on Apis mellifera in 34 countries and by 1996 in 47 countries[31], it is now likely to have reached still others. In April this year the mite was found in South Auckland, New Zealand, where it may well have been present for a few years.[33]

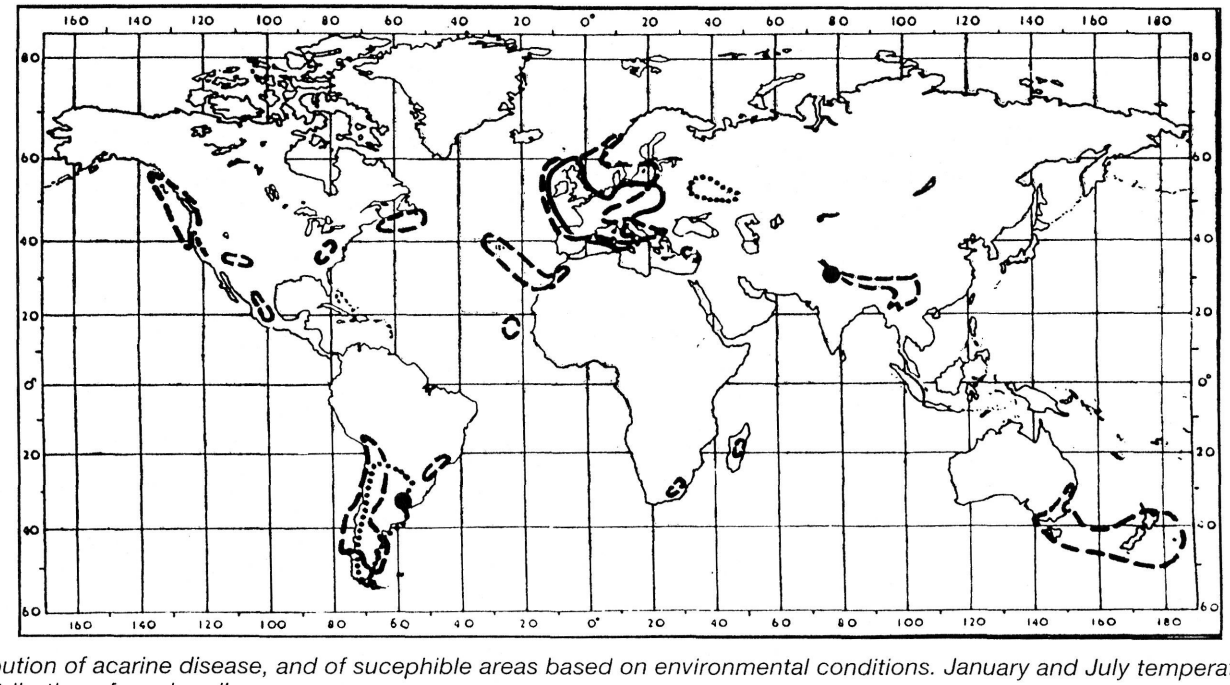
A parasite does not normally kill its host, and colonies of Apis cerana can withstand parasitization by Varroa, through grooming and in other ways. But a parasitized colony of Apis mellifera is likely to die. Beekeepers with movable-frame hives can apply various treatments to kill the mites; although this adds to their work, it enable them to continue beekeeping. On the other hand in traditional fixed-comb hives the brood nest is not accessible for inspection, and the beekeepers may see no signs of the mites' presence for several years. By then the infestation is likely to be so heavy that the colony soon dies. I remember vividly a visit to Turkey in the spring of 1985, when many traditional beekeepers took me to see their apiaries - each with 20 or more hives - only to find the bees dead or dying. Tragically, several aid programmes included the provision of bees, which were sent for instance from Romania to North Africa and from Japan to South America - and (undetected) Varroa mites travelled to new continents with the donated bees.

Unlike Acarapis woodii, Varroa can thrive on Apis mellifera colonies in a wide variety of tropical climates.

3. Transmission, prevention and treatment of honey-bee diseases and parasites

I shall discuss especially the transmission of these diseases as a consequence of the development of world beekeeping. Their prevention depends mainly on two factors: keeping the bees in a suitable environment and under suitable conditions, and preventing contact between them and any other bees carrying a new pathogen or parasite which might be transmitted to them.

Contact between difference colonies of bees can occur within an apiary if hives are placed close together in a long row and



Distribution of acarine disease, and of sucephible areas based on environmental conditions. January and July temperatures.[27]
— distribution of acarine disease
. [blocked in O] limited records perhaps present
.... range uncertain

bees drift from one hive to another. It can occur in a migratory apiary to which bees are brought from different sources. But the worst scenario has followed the introduction of bees carrying a pathogen or parasite to another part of the world where the bees had been free from it.

Legislation and constant vigilance are necessary in any country to prevent the bees becoming affected by a new pathogen or parasite, and it is also necessary for the pathogen to be identified and its mode of action understood. Bees in a continental country are always vulnerable to contagion across a land border, whereas oceanic islands have a special status which I will consider later.

The most disastrous transference for world beekeeping was that of Varroa jacobsoni, and much of the worldwide spread of the Varroa mite occurred before its presence in the transmitting colonies was known. From 1967 or earlier colonies of Varroa-parasitized honey-bees were spread from European USSR to neighbouring countries, and thence to others and to new continents.

Another Asian mite is Tropilaelaps clare-i, whose natural host is Apis dorsata. It can quickly kill a colony of apis mellifera, but it has so far been spread much less widely then Varroa. The development of an effective treatment of diseased or parasitized honey-bees is possible only after its causative organism is identified, and this has necessarily been dependent on advances in various branches of microbiology. The first honey-bee pathogens to be identified seem to have been the bacteria causing the diseases known as European foul brood (in 1885) and American foul brood (in 1907); the names refer to the continent where each was most studied. Current scientific names of the pathogens are Pana alvei and Pana larvae. The fungus causing stone brood was identified in 1909, and protozoa causing nosema and chalk brood in 1906 and 1916. I have listed these and other dates elsewhere.[22]

The breeding of Apis mellifera with an increased resistance to Varroa is one possible way forward that is being explored. But I shall not discuss treatment in detail, because I think that in New Zealand you keep up to date with the scientific advances on which competent treatment can be based.[24]

4. The present important of oceanic islands in world beekeeping

Honey-bees are not indigenous (native) to oceanic islands, and colonies taken to them have had less subsequent chance of contact with other bees carrying pathogens or parasites.

In 1852 the Honolulu Agricultural Society offered a premium to the first person to import honey-bees to the Hawaiian Islands. Early consignments from eastern USA were sent round Cape Horn, but they died in the tropics. A colony sent from California reached Hawaii in 1857, and Italian bees were imported from 1880.[15] Afterwards bees infected with American found brood were taken there, and the disease spread. A period of decline followed, and from the early 1930s beekeeping was neglected. Then in 1949 JE Eckert went to Hawaii from the USA,[23] and he found that surviving bees had developed a resistance to the disease. A queen-rearing enterprise was started in 1976, and by 1993 over 140,000 queens were exported annually.

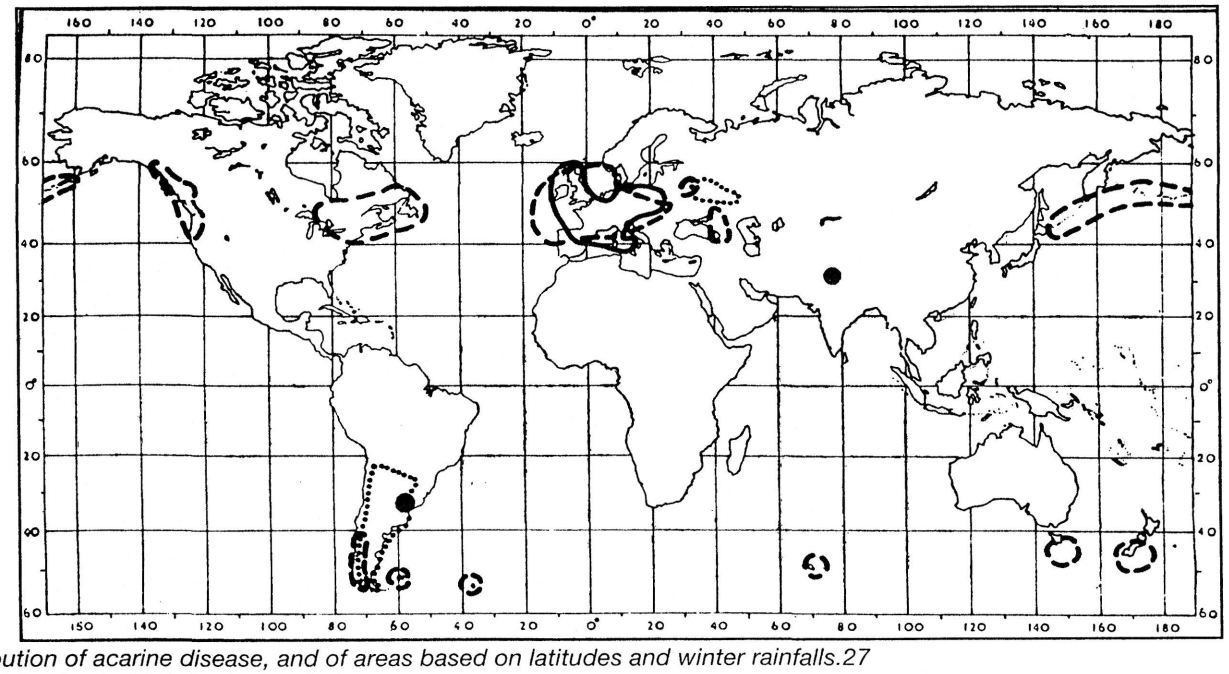
In some other oceanic islands, too, beekeepers have found it more profitable to rear and export queens than to sell honey, since this can yield a higher monetary return and involves lower freight charges. The entry of a new bee disease or parasite in a mainland country given the beekeeper extra work in treating his colonies, and his honey yield may be less. But on an island where the beekeepers' income is derived from selling bees and queens, the industry may collapse because bees reared for sale are no longer acceptable elsewhere.

Prevention of the entry of new pathogens or parasites requires action at several different levels, including effective procedures by relevant government departments. For instance in Australia, a port surveillance project was established in Victoria.[4] At three major ports, a local beekeeper has established sentinel hives in or near the main dock area, and sticky strips placed in the brood nest of his colonies are inspected frequently.

Bee products and beekeeping equipment can also transmit certain pathogens, and many countries have therefore restricted their import. Two beekeepers in New Zealand were recently jailed for attempting to import pollen from China as 'cornflour'.[6]

Apis cerana reached islands off north Australia from New Guinea by 1993, and it was detected in two incidents in the quarantine area of the port of Brisbane, Qld, in 1999.[26] On 16 September a swarm was seen in a ship from Papua New Guinea, from which five bees captured were Apis cerana. On 27 December, a nest of Apis cerana was found on the metalwork of a grader from Papua New Guinea, which contained three queen cells, and Varroa mites were found on some bees and brood. The nearest apiaries of queen exporters were 45km from Brisbane.

The United Kingdom, where Varroa is widespread, had recently not permitted the entry of package bees from New Zealand because of the possible introduction of Kashmir bee virus. However *New Zealand BeeKeeper* for March 2000 announced that the UK would again accept New Zealand bees.[32]



Distribution of acarine disease, and of areas based on latitudes and winter rainfalls.27
— [distribution in O] limited records
.... range uncertain
--- areas based on latitude (for day length) and (log.) winter rainfall limits.
Based on to Jeffrees research parts of NZ feature in both of these maps.

I have every sympathy with beekeepers in New Zealand in your efforts to maintain your export of healthy colonies. I cannot offer any magic solution to your problems, but I know that you keep abreast of new information from other parts of the world that may help you, and that your Ministry of Agriculture is very active on your behalf. I wish you well in your endeavours to maintain the position you have held in the world market.

References

1. Affleck, T (1841) Bee-breeding in the West (Cincinnati, USA: E Lucas)
2. Australian Bee Journal (2000) National industry news. Australian Bee Journal: 81(4): 22-24.
3. Bee World (1993) Asian honey-bees detected by quarantine. Bee World 74(2): 104
4. Bettesworth, D. (1999) Surveillance for exotic disease of honey-bees. New Zealand BeeKeepers 6(6): 6
5. Bradbear, N (1988) World distribution of major bee diseases and pests. Bee World 69(2): 15-39
6. Carreck, N (2000) Father, son jailed in bee case. Bee Craft 82(2): 46
7. Crane, E (1968) Mites infesting honey-bees in Asia. Bee World 49(3): 113-114
8. Crane, E (1978) The Varroa mite. Bee World 59(4): 164-167.
9. Crane, E (1999) The world history of beekeeping and honey hunting (London: Duckworth)
10. Crane, E (1999) p 29-30
11. Crane, E (1999) p 172
12. Crane, E (1999) p 218
13. Crane, E (1999) p 347
14. Crane, E (1999) p 354
15. Crane, E (1999) p 365
16. Crane, E (1999) p 367
17. Crane, E (1999) p 369
18. Crane, E (1999) p 377
19. Crane, E (1999) p 393-4
20. Crane, E (1999) p 423
21. Crane, E (1999) p 435
22. Crane, E (1999) p 575
23. Eckert, JE (1950) The development of resistance to American foulbrood in Hawaii. J econ Ent. 43(4): 562-564.
24. Goodwin, M; Eaton, C van (1999) Elimination of American foulbrood without the use of drugs. (Napier, New Zealand: National Beekeepers' Association).
25. Hopkins, I (1911) the illustrated Australasian bee manual (Wellington New Zealand: Gordon & Gotch) 5th ed.
26. Jamieson, BR (2000) Detection os Apis cerana in the Australian port of Brisbane. Canadian Beekeeping 21(6): 130.
27. Jeffree, EP (1959) the world distribution of acarine disease of honey-bees and its probable dependence on meteorologican factors. Bee World 40(2): 4-15
28. Kaczynski, P (2000) Port surveillance project in Victoria. Australia Bee J. 81(2): 16-17.
29. Matheson, A (1993) World bee health report. Bee World 74(4): 176-212.
30. Matheson, A (1995) World bee health update. Bee World 76(1): 31-39
31. Matheson, A. (1996) World bee health update 1996. Bee World 77(1): 45-51.
32. Matheson, A. (2000a) UK to accept New Zealand package bees. New Zealand BeeKeepers 7(2): 14
33. New Zealand BeeKeepers (2000) Exotic bee disease confirmed in South Auckland. New Zealand BeeKeepers 7(3): 3-4
34. Nixon, M (1982) Preliminary world maps of honey-bee diseases and parasites. Bee World 63(1): 23-41
35. Pellett, FC (1938) History of American beekeeping (Ames, IA: Collegiate Press)
36. Singh, S (1957) Acarine disease in the Indian honey-bee (Apis indica F) Indian Bee J. 19(3/4): 27-28