

Honeybees and Varroa

An historical record from 1988 - 1992 of the spread of Varroa World Wide.
Listing some of the early anti Varroa treatments tested.
Including the original design of the Thermal Cabinet used successfully in Russia
from 1977



by
A.E. McArthur MIL
Melbourne House
Regent St
DALMUIR G81 3QU
Scotland
First Published 1988

CONTENTS

Foreword

- 1 Biology of *Varroa Jacobsoni* Oudemans
- 4 Diagnosis of Varroatosis
- 4 Hive Floor Insert
- 5 Glass Jar
- 5 Sealed Brood Examination
- 6 History of the Spread of Varroatosis Worldwide
- 11 Treatments against Varroosis
- 11 Chemotherapy
- 11 Folbex VA(neu)
- 11 Formic Acid
- 12 Perizin
- 12 Apitol
- 12 Klartan
- 12 Amitraz
- 12 Apistan
- 13 Bayvarol
- 13 Lactic Acid
- 13 Tobacco Smoke
- 14 Sinecar
- 14 Malathion

- 14 Galecron
- 14 Phenothiazine
- 15 Acetic Acid
- 15 Ethylformiate
- 15 Menthol
- 15 Thymol
- 15 Carbolineum
- 15 Galecron
- 15 Bromopropylate
- 15 Api-life Var
- 16 The treatment of honey bees against Varroaosis using Formic Acid
- 16 Diagnosis
- 17 Spring Treatment
- 17 Summer Treatment
- 17 Autumn Treatment
- 17 Treatment of Swarms (after hiving)
- 17 Natural Swarm Treatment
- 18 Shook Swarm Treatment
- 19 Treatment of Sealed brood using Formic Acid
- 20 Non-Chemotherapeutic Treatments
- 20 Sacrificial Drone Brood
- 21 Sacrificial Worker Brood

22	Swarm Control Spin-off
22	Oiled Floorboard Insert with 3mmx 3mm Screen Board
23	Drone Screening
23	Open Floorboards
23	Artificial Swarms
24	Marjoram Oil & Herbal Extracts
24	Selective Breeding
25	Heat Treatment
26	Scientific Background
27	Russian Heating Cabinet
35	Summary
36	Appendix
41	Sources
43	General Arrgt of HEATING CABINET (fig 1)
44	Construction of Cassette (fig 2)
	Construction of Funnel (fig 3)

FOREWORD

This treatise was written as a response to a statement made in a Winter 1987 issue of 'Canadian Beekeeping' that there was no practical method yet devised to exploit the fact that the Varroa mite was more susceptible to high temperature than the honeybee. Russian beekeepers have been using methods and equipment to exploit this very characteristic since 1978 and have perfected the procedure to a stage where they have complete control over the mite and its population development in the hive. This work is not intended to be an exhaustive statement on the treatment of honeybees suffering from VARROATOSIS using HEAT TREATMENT. The intention is merely to draw attention to a method of treating bees which has been used successfully for many years without the need to resort to CHEMOTHERAPY and which has not been widely reported in the Western 'bee press' up to 1988.

The author has been keeping bees for around 25 years and for 20 of these years has been semi-commercially involved in the craft. He has pioneered a number of innovations which greatly simplify the management of bees in the Scottish geographical area, and has written a controversial book on SWARMING and a simple method for rearing QUEEN BEES very early in the beekeeping year. A procedure which is now becoming increasingly important as an anti-Varroa measure.

"MILESTONES IN BEEKEEPING AND THE SWARM TRIGGER DISCOVERED"

It has been wrongly accepted for many years that it is not possible to work honeybees during the winter period. However during the winter period of 1975/76 I. I. Khurst at the Apicultural Support Centre at Maikop studied the effects of disrupting the winter cluster of colonies of bees. The following season comparing results with 'control' colonies there was found to be no differences in performance.

The treatment of bees in HEATING CABINETS has been shown to have NO ADVERSE effects on the LENGTH OF LIFE of the treated bees, the PRODUCTIVITY of the colony in the following spring or the ABILITY of the bees to FEED AND REAR brood. The EGG LAYING ABILITY of the queen is also not affected.

The author wishes to acknowledge the invaluable assistance given by Miss Catherine Dickson, Honorary Librarian, Moir Library, Edinburgh and that of the staff of IBRA Library in the writing of this treatise, without which the work would have been impossible.

THE BIOLOGY OF VARROA JACOBSON! OUDEMANS

There are few beekeepers now in the world who have not either heard of Varroa or had the misfortune to find it in their hives.

The number of bee colonies and beekeeper victims is growing daily. ¹

Having a sound knowledge of the natural history of the mite is the only way that affected beekeepers will be able to survive its impact on their bees.

Most beekeepers now know that the mite was first discovered in Java on the Asian bee *Apis cerana* in 1904 by Jacobson and studied by the Dutch entomologist Oudemans. Hence the name "Varroa jacobsoni Oudemans". At that time it was believed that the mite was specific to *A.cerana* and it was treated more as a curiosity than a significant potential parasite of *Apis mellifera* species.

Nothing could have been further from the truth as we beekeepers have found out to our great cost.

The parasite belongs to the order Parasitiformes and is a member of the Dermanysidae in the subfamily Varroidae. The mature female Varroa mite is brownish, 1.1- 1.2mm long and 1.5- 1.6mm wide it is rather smaller than the bee louse *Braula caeca* but being crab like it is a different shape it also has eight legs where *Braula* has only six. The VARROA mite can be seen with the naked eye but it is extremely difficult to detect in the early period of infestation in a colony. It tucks itself between the abdominal sclerites, its classic position is locating itself between the first and second abdominal segments.

The mite is ideally shaped for holding on to the host bee and at the base of each tarsus it has a sucker and the hairs which cover the underside of the body make it virtually impossible for the bee to shake or otherwise dislodge the parasite.

The mite is also found on the thorax and head of the host, in fact anywhere on the bee where it can penetrate the membrane and suck the bee's blood. Work done at Bonn University in 1986 by A.W.Wienands and G.Madel (17) has shown beyond doubt that the parasite causes secondary infections which result in alterations in the blood constituents of the workers and drones, causing the bees to be more susceptible to the traditional viral and bacterial diseases.

The female mite enters the brood cell shortly before it is sealed and at the stage where the larva has finished spinning its cocoon she commences reproduction, the cell of course by this time being sealed. It was established quite early in the experimental work that the mite has a preference for drone larvae when selecting cells for reproduction. Research carried out in the Soviet Union by O. I.Avdeeva (18) at the Institute of Scientific, Beekeeping Research, Rvwbno and reported in *Pchelovodstvo* in 1981 seemed to demonstrate that the mites could not differentiate between drone and worker larvae outside the hive.

It was concluded that the abundance of food provided in the drone cells could have a bearing on the affinity the mites have for drones. Another theory put forward is that the mites are more or less pre-programmed to seek out drone larvae because on their original host *A.cerana* the drones are the only caste which has a long enough metamorphosis to allow the mites to develop to the full in the brood cells. Work done by Bernhard Kraus at Oberursel however indicates that the mite can indeed differentiate between the castes under experimental conditions outside the hive.

Obviously more work must be done in this sphere to arrive at a satisfactory conclusion. However Kraus also demonstrated that ether oils could have a role to play in thwarting the mite in its search for a suitable host. The shorter metamorphosis of the *A.cerana* worker caste and also incidentally *A.m.capensis*, (the Cape bee indigenous to the Fynbos regions of S.Africa and the Brazilian bee which show a similar worker development cycle time could be useful in a breeding project to produce hybrids which could offer a biological control of Varroa at some time in the future, although *A.m.capensis* and the Brazilian bee have some quite nasty genetic characteristics! When *A.m.capensis* goes queenless, 'civil war' breaks out in the colony and the worker bees virtually tear each other apart resulting in a 40- 50% loss of population before a new queen is produced in the colony.

At which time the colony behaviour stabilises. The legendary aggressiveness of the Brazilian bee has been well documented elsewhere.

It has been found by experiment that the female mite must feed on larval haemolymph before it can reproduce. Subsisting on the haemolymph of the adult bees only, has been shown to be insufficient to stimulate the females to reproduce. The critical substance which triggers fecundity is the Juvenile hormone secreted by the developing larvae. This phenomenon can be and is utilised in the fight against the mite.

The female mite does not as initially believed lay eggs, the mite is a 'live bearer' producing 5-6 larvae at intervals of 30

(2)

time being sealed. It was established quite early in the experimental work that the mite has a preference for drone larvae when selecting cells for reproduction. Research carried out in the Soviet Union by O.I. Avdeeva(18) at the Institute of Scientific Beekeeping Research, Rvribno and reported in Pchelovodstvo in 1981 seemed to demonstrate that the mites could not differentiate between drone and worker larvae outside the hive. It was concluded that the abundance of food provided in the drone cells could have a bearing on the affinity the mites have for drones. Another theory put forward is that the mites are more or less pre-programmed to seek out drone larvae because on their original host *A. cerana* the drones are the only caste which has a long enough metamorphosis to allow the mites to develop to the full in the brood cells. Work done by Bernhard Kraus at Oberursel however indicates that the mite can indeed differentiate between the castes under experimental conditions outside the hive. Obviously more work must be done in this sphere to arrive at a satisfactory conclusion. However Kraus also demonstrated that ether oils could have a role to play in thwarting the mite in its search for a suitable host. The shorter metamorphosis of the *A. cerana* worker caste and also incidentally *A. capensis*, (the Cape bee indigenous to the fynbos regions of S.Africa) and the Brazilian bee which show a similar worker development cycle time could be useful in a breeding project to produce hybrids which could offer a biological control of Varroa at some time in the future. Although *A. capensis* and the Brazilian bee have some quite nasty genetic characteristics ! When *A. capensis* goes queenless, 'civil war' breaks out in the colony and the worker bees virtually tear each other apart resulting in a 40 - 50% loss of population before a new queen is produced in the colony. At which time the colony behaviour stabilises. The legendary aggressiveness of the Brazilian bee has been well documented elsewhere. It has been found by experiment that the female mite must feed on larval haemolymph before it can reproduce. Subsisting on the haemolymph of the adult bees only, has been shown to be insufficient to stimulate the females to reproduce. The critical substance which triggers fecundity is the Juvenile hormone secreted by the developing larvae. This phenomenon can be and is utilised in the fight against the mite. The female mite does not as initially believed lay eggs, the mite is a 'live bearer' producing 5 - 6 larvae at intervals of 30

(3)

hours after the first birth. The mite ovaries hold about 25 eggs, however only 5 or 6 of these eggs develop into larvae in the oviduct. When the mite begins to feed she does so on a 1 - 2 hourly cycle. After a period of 65 - 70 hours has elapsed the first larvae are produced. This larva which has 3 pairs of legs at birth is placed by the female, not directly onto the larval host, but on the cell wall I in a particular position at the top close to the capping. In this position it is out of danger from being crushed by the honey bee larval movements as it develops. After about 30 hours in this position it develops into a protonymph with 4 pairs of legs becomes mobile and migrates to the host larva where it proceeds to feed on the larval haemolymph. They pass through another stage to become deutonymphs. Three days later they become adult Varroa mites.

The male mites take a total of between six to seven days to sexual maturity. The female takes eight to ten days until she is sexually mature. The male is yellow to grey/white and much smaller than the female. The mating takes place in the sealed cell and the male dies shortly after mating because he cannot feed. The mouth of the male is modified to pass sperm and for this reason it is unable to take food.

The young females already mated leave the brood cell on the emerging bee as do the parent females. The Varroa mites are obviously extremely inbred but unlike most other species do not seem to suffer the same detrimental effects of this phenomenon.

Observations have shown that the new females parasitize the adult bees for approximately four to thirteen days. It has also been established that the females reproduce primarily in only one cell in each breeding cycle. They remain in the cell I with their eggs. The life span varies depending on the season, in summer they live for approximately two months, in winter they live five to eight months. There is only minimal mite reproduction during the winter period due to the very small amount of brood reared in the overwintering colony. It has been found that contrary to popular belief that brood is always present in the honey bee colony throughout the 'dormant' period. The overwintering mites subsist mainly on the haemolymph of the adult bees during this period. Mites can also survive at least 5 days away from host.

There is a contradiction of the normal good beekeeping code in the development of the disease, Varroaosis, because it is the most populous and prolific colonies which tend to succumb to the disease most rapidly. This is because the more brood that there is in the hive relative to the increasing numbers of mites the

(4)

more opportunity the mites have for reproduction without having to compete for hosts, and the faster the mite population grows. The mite population can quickly go exponential after the third year from initial infestation. Starting from perhaps five mites initially in the first year, in year two there may be as many as 100, in the third year the population can be as high or even higher than 1000. At this point the mite population is poised to explode and will do so in a very powerful bee colony, building up to over 10000 mites in the fourth season.

DIAGNOSIS OF VARROATOSIS

The diagnosis of the disease in a colony should be made as early as possible after initial infestation. If diagnosis is made later rather than sooner then there is a danger that if the disease goes undetected for too long that the colony will die despite being treated either with chemotherapy or other means.

HIVE FLOORBOARD INSERT

The recommended floor insert is really not a very accurate indicator of early infestation if used to detect natural fall of mites, because by the time a detectable natural mite fall occurs the colony could have been infested for quite some considerable time. Only where it is used in conjunction with a diagnostic substance such as formic acid etc. is the hive floor insert really effective as an early warning device. Many methods have been used to establish the initial levels of infestation in colonies. However the only sure way of establishing infestation levels accurately is to kill the colony and wash the dead bees in a spirit based fluid like refined petroleum spirit or methylated spirit to wash the mites from the mass of bees. The mites float to the surface of the fluid. This method is used in experimental work to establish the effectiveness of treatments.

The filtration method was perfected by German apicultural scientists seeking effective chemotherapy for use against VARROATOSIS, primarily at the Institute of Apiculture at Oberursel under the direction of Professor Ruttner. After experimental colonies were treated with different materials the mite fall was noted. The colony was then killed to obtain the residual mites which had survived the treatment. The surviving mite numbers were compared with the mite fall and a percentage treatment effectiveness rate calculated.

(5)

GLASS JAR

Use a glass jar having the approximate volume of a 2lb jam jar and smear the inside of the jar lightly with honey. Place this jar on the frame tops in contact with the bee cluster. Leave the jar in place for approximately 10 minutes, after which time it will contain upward of 200 bees. Place the lid on the jar and heat the jar to a temperature of 60 C approximately. Any Varroa mites present on the bees will fall from the bees and be easily visible to the naked eye.

SEALED BROOD EXAMINATION

By uncapping sealed drone brood randomly if a colony has a moderate to heavy infestation mites will be easily seen on the drone brood if they are extracted using tweezers.

A less time consuming and less labour intensive method may be used where double brood chamber management is worked: when the two brood chambers are separated any brood especially drone brood which is damaged by the chambers being split if examined closely will show Varroa mites present in the cells if the infestation is more than slight.

As soon as Varroa mites have been discovered anywhere for the first time in any country it is recommended a 'standstill' on colony movement be applied and that random apiaries in that country be thoroughly examined using diagnostic treatments to establish the extent of the infestation. Unfortunately experience has shown that when Varroa mites are detected in any country for the first time it is generally too late to arrest its spread throughout that country. This was found to be the case in Finland, Greece, Germany, Holland, Denmark and more recently the United States. As soon as the disease is discovered in some apiary, looking elsewhere for it invariably brings to light that it has already been present for some time.

THE HISTORY OF THE SPREAD OF VARROA WORLD WIDE

In 1904 Varroa was discovered in Java on *Apis cerana*, the Asiatic honeybee. Nothing much was heard of the mite for some time afterwards. It is now widely accepted that the mite had been a parasite of *A.cerana* throughout Asia, India, Pakistan and all tropical areas where *A.cerana* existed for probably millions of years

In 1944 the mite was discovered on *Apis cerana* in Singapore.

In 1951 the disease was recorded present in South and S.E.Asia.

In 1955 Varroa was discovered as a parasite on *A.cerana* in Pakistan.

In 1958 the parasite was found on *A.cerana* and *A.mellifera* in Japan where it caused the loss of around 40% of *A.mellifera* colonies.

In 1963 it was identified on *A.cerana* in Malaya and *A. mellifera* in Hongkong.

In the mid 1960's Varroa was identified on *A.cerana* in India, and in China.

In 1968 the mite was discovered on *A.mellifera* in the Philippines, Vietnam and in the Far Eastern Province of the USSR.

Heavy colony losses had been suffered in these areas due to parasitisation by the mite. It is now recognised that by 1968 the spread of Varroa worldwide was virtually unstoppable because of the vast traffic in bees throughout the world and the failure of world beekeeping to take on board just how virulent and dangerous the disease really is.

Also in 1968 Bulgaria reported mite infestation in its apiaries.

This was the first time a sighting had been reported at the 'western' end of Europe. This infestation is reported to have been caused by Queen imports from the USSR.

In 1970 the USSR was officially declared an infested country.

The Soviet satellite countries quickly followed as victims of the disease.

(7)

In 1975 Rumania and Poland became infected with Varroasis.

In 1977 West Germany's experience should have served as a salutary warning to the other as yet non infested nations. When the first isolated outbreak of Varroatosis occurred in the Taunus region around Oberursel. Instead of declaring an immediate 'Standstill' on the movement of bees into and out of the area the German authorities attempted unsuccessfully for over a year to contain the disease, without banning the movement of bees.

Ultimately the scientists had to admit that the mite had beaten them. However by this time, early 1978 migratory beekeepers had come and gone to and from the infected area carrying the mites with them. By 1984 the whole of Western Germany had been colonised by the Varroa mite. Western Europe was by this time doomed, and all the land locked countries soon were added to the rising list of infestation areas.

In 1978 Hungary and Yugoslavia also became infested as did Greece, Turkey and Libya. The Libyan infestation is reported to have been imported on Queens sent to that country from Rumania. Paraguay also became infested by Varroatosis in that year. It had been long suspected by the many concerned 'grassroots' beekeepers, but hotly denied by a minority of beekeepers of international repute, who later were shown to have a vested interest in not banning queen bee imports, that it was possible to transmit Varroatosis by imported Queen bees and their worker attendants

The Paraguay incident confirmed unequivocally that Queens can and do carry the Varroa mite because the disease came into Paraguay on Queens imported from Japan.

In 1979 Czechoslovakia also became Varroa infected.

In 1980 the disease turned up in Finland, Austria, Tunisia and Syria.

In 1981 France became a victim, as did Italy in the summer of that year.

In 1982 the disease was reportedly brought into Holland by German tourists bringing bees with them on holiday on trailers to take advantage of the oil seed rape nectar flows in their holiday areas.

In 1985 Israel was officially declared Varroa infested having of course been victim to the disease for some time before its clinical diagnosis.

(8)

In 1987 Denmark, long thought to have escaped the disease, discovered that Varroaosis was widespread throughout the country.

In 1987 Varroaosis was also discovered in the United States in many States simultaneously, sending a massive shock wave through that country. Varroaosis had been expected to arrive with the Brazilian bee moving up from South America but not till at least 1990. Canada must now surely be right in the firing line for the discovery of Varroaosis in the near future, probably being already present in that country.

The only countries officially Varroaosis free at this present time are Australia, New Zealand and Ireland. Apart from Australia and New Zealand both of which countries long before Varroaosis reared its ugly head had banned the importation of bees, no other country can be completely certain that it will remain free of the disease. Ireland is also in the aforementioned category and probably already has the disease.

The author has repeatedly in the Scottish national press and the British beekeeping press since 1979 tried to focus beekeepers and politicians on the dangers of foreign queen bee imports due to Varroaosis but unfortunately the grassroots beekeeper both in England and Scotland failed to protest en masse.

Apathy won the day. And lost us the war!

At time of writing this original report in 1988 Varroaosis had not yet been discovered in the U.K. However considering the number of importations from countries like Israel and America in the recent past I predicted that the disease would be discovered in Britain in the summer of 1988 if beekeepers look for it diligently enough.

VARROATOSIS WAS DISCOVERED IN ENGLAND, IN NORTH DEVON ON SATURDAY 4TH OF APRIL 1992 AT COCKINGTON IN AN APIARY OF THE TORBAY BEEKEEPERS ASSOCIATION DURING A DEMONSTRATION OF THE SMOKE TEST FOR THE DISEASE BY MARGARET SAFFREY.

Since it takes about 3 - 4 years for Varroaosis to become clinically observable, the disease was most certainly already in England at least in 1988! By the end of April 1992 the whole of the south coast of England was designated as an infestation area. The mite was undoubtedly brought into the country on the last of the queen bees which had been coming into Britain for years from the USA before the VARROATOSIS find in October 1987 in that country resulted in the banning of American imports.

The present government did beekeeping in Britain no favours during the years from 1985 up to the time Varroaosis was discovered here. I have correspondence from the then Ministers at the MAFF discounting my pleas for a ban on QUEEN BEE imports in the light of swarms of the Brazilian bees which had been found and killed in California as far back as 1985. The Brazilian bee was known to carry the parasite at that time.

The American authorities however subsequently admitted that Varroaosis had been widespread in the USA but undetected for at least four years prior to the discovery in 1987 and that they, and I quote "had been caught with their proverbial pants down" by the disease.

Despite the fact that far-sighted beekeepers abroad had anticipated that the disease was already present in the States by at least 1985.

It is an undeniable fact that the authorities in almost every country which is now infested with Varroaosis grossly underestimated the ability of the mite to spread. Yet in Britain the Government steadfastly refused to implement a total ban on the import of foreign Queen bees despite the pleadings and protestations of most of the major beekeeping associations to impose such a ban. As each of the Queen bee exporting countries fell victim to Varroaosis they were banned from exporting queens to the U.K. After 1987 New Zealand was the only country which was authorised to export queens to Britain, until 1990 when the British Government relaxed the ban and allowed queen bees to be imported from the Canary Islands.

The Glasgow and District Beekeepers in Scotland raised a petition in 1985 which was supported by 95% of the local Scottish Associations. The petition was sent also to England however only a very few of the English beekeeping associations supported the petition for reasons best known to themselves. In the light of the present situation regarding Varroaosis it would appear to have been something of a death wish. This petition was presented to the incumbent Government representatives in Edinburgh on 1st May 1986 to no avail. Queen bee imports into Britain had been banned from Australia due to Kashmiri Bee Virus having been discovered on honey bees there. A few irresponsible British beekeepers continue to import Queen bees from New Zealand despite the fact that Kashmiri Bee Virus is known to be present in that country. Explain that piece of inconsistent bureaucracy - if you can! The rest is history, the irresponsible few also continued to import Queen bees into Britain from the Southern States of North America.

Judging from the past history of the spread of Varroa any country not an island has little chance of remaining clear of the disease.

Britain and Eire 'blew' their chance of, as islands, remaining free of Varroa because they allowed queen bee imports into their countries from exporting countries which already had Varroa, albeit unofficially during the period of the queen bee importations.

It goes without saying that the most effective vector for the spread of Varroa worldwide has been beekeepers and apicultural scientists. There is an obvious lesson to be learned here, namely that in man's tampering with Nature no matter how clever we may think we are, traps lie in wait for the unwary who either do not do their homework properly or do not listen to the voice of common sense.

The author made an intensive study of the Varroa situation worldwide during the abortive attempts to secure a government ban on the importation of queen bees into Britain and has continued to do so up to the present time.

In the ground work for the ANTI-VARROA LOBBY as it was called research work from all over the world was compiled to establish a cast iron case for the ban.

Many apiculturists have looked long and hard at the long term measures against Varroa and concluded as I have that there is no future for beekeeping and honey production in the continuous use of chemotherapy which carries over into the saleable honey and wax. As a diagnostic measure in the early stages of infestation chemotherapy will give a rapid result in the search for the disease. Thereafter chemotherapy will only offer a downward spiral, ultimately damaging the quality of the saleable honey and wax as the residues from the chemical treatment builds up in the colonies and the 'hive furniture'.

The people who buy our honey do so because it is in their opinion a pure, wholesome natural unspoiled food. What will beekeepers do with their honey if the public refuses to buy it because they consider it a health hazard? We've had 'mad cow disease', salmonella in eggs, listeria in cheese. What price a cocktail of chemical residues in honey? The beekeeper who can state categorically that he does not treat his bees with any kind of chemotherapy will rank high in credibility and sell more honey!

The correct way forward lies in the intelligent and persistent use of biological/zoo technical methods which do not contaminate wax, honey and other hive products, against the mite, which unfortunately is with us for the duration!

TREATMENTS AGAINST VARROATOSIS

Chemotherapy

A great deal of time, effort and finance has been invested into the search for a safe chemotherapeutic cure for Varroa. To date none has been found which completely eradicates the mite from the adult bees, and at the present time there are no chemotherapeutics at all which can be used to treat the larvae in the cells against the parasite. Except FORMIC ACID.

A few treatments have come close to giving the desired results in eradicating the disease, among them K79, developed in Germany. This treatment was a systemic which was fed to the bees in small amounts and distributed around the colony by trophallaxis, mutual feeding. K79 was found to be almost a panacea dealing not only with Varroa but also virtually every other disease of the honey bee. Unfortunately it was found to be carcinogenic and never was released for general use.

The most effective treatments at the present time are those which have been authorised for use in Germany and are: FOLBEX VA NEU which is a FUMIGANT was one of the first treatments on the market in Germany and is a modification of the treatment used in the past against *Acarapis woodi*, which causes acarine disease. It is applied as a SMOKE STRIP. This treatment results in heavy contamination of wax and honey. The active ingredient BROMOPROPYLATE/DIBROMOBENZONPHENOL does not decay with time and this treatment is gradually being superseded. The temperature limit for use is 10 C.

FORMIC ACID, again first used in Germany is a VAPOUR treatment and mats soaked in it are laid on the frame tops of the brood nest or on the floor board insert. Initially it was recommended that the treatment only be applied when there was no surplus honey on the hives. This limitation has now been removed and FORMIC ACID which occurs naturally in honey anyway is no longer considered a contaminating agent of honey and may be used even if there is honey on the hive. FORMIC ACID went out of favour for a few years in Europe as the newer 'wonder drugs' flooded the market. However FORMIC ACID is now being viewed as an extremely cost effective measure in controlling VARROATOSIS and is being widely used in preference to the extremely expensive PROPRIETARY brands of anti-Varroa substances.

There are a number of different ways in applied to colonies and swarms, 'shook' methods will be discussed in a separate which FORMIC ACID may be or natural. These section (see page 16)

PERIZIN is used in SPRAY form and offers the same type of treatment as K79 did in the past. It is a systemic treatment which when sprinkled on the bees is imbibed by them and distributed round the colony by the mutual feeding phenomenon. The PERIZIN treatment appears to be easy to apply and offers excellent prospects as a quick diagnostic method as well as being an effective treatment against Varroasis. However PERIZIN contaminates the wax and is dangerous to the bees if applied in excess. The active ingredient COUMAPHOS does not decay with time. The long term application of PERIZIN seems to be resulting in mites which are becoming immune to it. According to Dr. Treppenhauer of ALVETRA in Neumunster in Germany. It is only effective if used on broodless bees. Temperature limit is 5 C and the application is done over 14 days at 7 day intervals.

APITOL is a systemic like PERIZIN and it is applied in the same manner. The active ingredient is CYMEAZOL HYDROCHLORIDE. The temperature limit is 10 C and it is applied twice at 7 day intervals.

KLARTAN is also a systemic similar to PERIZIN the active ingredient is PYRETHROID FLUVALINATE. It contaminates honey. It is widely used in France. It is non-dangerous to bees and thus could be applied in excess, resulting in carry over into the saleable honey. Due to this is considered by the German Veterinary Authorities as dangerous to human health. PYRETHROID FLUVALINATE can attack the human nervous system and also cause allergic reactions.

AMITRAZ is applied using a fine spray diffuser. The active ingredient DIMETHYLANALINE decays rapidly in honey but leaves residues. Of all the presently used treatments used against Varroaosis AMITRAZ is deemed to be the most dangerous, due to the amounts of the substance which finds its way into the hive products.

APISTAN is a contact strip treatment the active ingredient is PYRETHROID FLUVALINATE which as already stated contaminates wax. Research done in Switzerland into the specific use of APISTAN has indicated significant carry over into the wax of the combs.

(13)

The strip is hung between the frames and can be applied successfully even when brood is present. They are left in place for a period of 4 weeks the critical temperature for APISTAN is 10 C.

BAYVAROL is a contact strip much like APISTAN it is also a PYRETHROID based treatment.

LACTIC ACID in the form of a fine spray at a concentration of 12 - 15% solution in amounts of 150ml/hive is applied to all of the bees on the combs at the beginning of September 3 times at 2 - 5 day intervals. Depending on degree of infestation and size of colony. This treatment is repeated again in the spring in late February and March depending on the weather. The lactic acid treatment can be carried out at temperatures of 4 C twice with a five day interval .Care must be taken not to make the hive excessively damp. This form of treatment is most effective on broodless bees.

TOBACCO SMOKE as a diagnostic treatment consists of burning 2 - 3g of ordinary pipe tobacco in the smoker and blowing this smoke into the hive in the evening after all flying has ceased. The entrance is blocked after the insertion of a greased floorboard insert. A piece of newspaper about 14ft square is lit and crumpled into the smoker. When the paper is almost burned quickly sprinkle the tobacco over the burning paper, working the smoker bellows until tobacco smoke is produced, make a small gap in the entrance plug and work the smoker bellows gently for around two to three minutes. Close the hive entrance completely and leave for a about an hour. Remove the entrance plug and withdraw the floor insert and check for dead mites.

There are new products coming onto the market continuously. Two such products were featured in the August 1991 issue of 'Neue Bienen Zeitung' the magazine read in what was East Germany, CEKAFIX - KONZENTRAT, (Organophosphoric acid ester) which is a systemic treatment similar to PERIZIN. And BEROVACID which can be applied as a smoke strip or as a lozenge which is caused to smoulder in the hive, the active ingredient is BROMOPROPYLATE which as already mentioned contaminates wax quite severely. These treatments are listed as being considerably cheaper to APISTAN, BAYVAROL, KLARTAN, PERIZIN and FOLBEX VA (NEU). According to the manufacturers of Cekafix (personal communication 12/5/92) the Varroa mite is gradually becoming immune to PERIZIN and in Bavaria many beekeepers are now turning to CEKAFIX.

The *above* mentioned treatments are not automatically approved by all beekeeping authorities, some treatments are allowed in some countries but not all treatments are so far allowed in all countries.

Most of these treatments must be administered at a time when little or no brood is present and also at a time when there is no danger of contamination of the honey to be offered for sale.

Continuous treatment by the *above* materials ultimately results in contamination of the wax of the combs, which could build up to levels which would ultimately kill the honey bee larvae in the cells more surely than the Varroa mite.

A number of other treatments *have* been used in different countries with varying degrees of success. The undernoted list of substances is not intended to be exhaustive.

DUSTING POWDER

SINECAR, used in Rumania in powder form quite extensively. Field trials in Germany found it to be only 50% effective.

MALATHION, used in Greece at a strength of 1% proved to be moderately successful. However it causes sterility in queens, kills bees and results in massive residues in honey and wax.

FUMIGANTS

GALECRON, manufactured in Japan is not particularly effective at 6% as a fumigant. However as a 0.4% GALECRON solution results of approaching 99% were achieved.

VAROSTAN, another Japanese product is not particularly effective either as a diagnostic or a treatment.

DELACAN, also not *very* effective against Varroa.

PHENOTHIAZINE, is moderately effective producing results of between 33 -76%. However it also kills Queens and workers. It is a dangerous contaminant in honey.

(15)

ACETIC ACID, as a vapour treatment is quite effective for the treatment of spare brood comb without bees for a number of diseases. However as a 10% solution it produces about a 50% success rate.

ETHYLFORMIATE has a minimal effect on Varroa.

MENTHOL although quite an effective treatment against ACARINE has little effect on Varroa

THYMOL has been used in the USSR giving good results. However in German experiments with the substance results were deemed inconclusive.

CARBOLINEUM is a highly aromatic oil made from 20% by wt Naphthaline and its derivatives and also 1% by wt Phenol and derivatives. The treatment gives 90 - 98% success with minimal bee mortality.

SPRAY TREATMENT

GALECRON at a concentration of 2% is extremely toxic to bees. However at a 0.25% solution it gives a 90 - 99% success rate, with low bee mortality.

BROMOPROPYLATE has been field tested and shown to be quite effective as a 3% emulsion giving between 73 -100% success however it also kills around 5% of the bees being treated.

APILIFE -VAR

This preparation is widely used in Italy and consists of an aromatic treatment using a 9x5x1cm thick absorbent board (Vermiculite plate) soaked with a 20 g solution of thymol (76%), eucalyptus oil (16%), menthol (4%) and camphor (4%). This treatment is pretty strong stuff and is only to be used after the saleable honey has been removed from the hive the recommended time in the hive is a period of two weeks.

The above mentioned treatments are by no means intended to be exhaustive and are not authorised in all countries. It is obvious in the on going battle against Varroa that many more materials will be developed and tested in the future, in the hope that a 'one shot' simple to use 100% effective cure for the disease will be discovered.

THE TREATMENT OF HONEY BEE COLONIES AGAINST VARROATOSIS USING FORMIC ACID

Formic Acid treatment has the advantage of being able to be applied at temperatures of 0 C, as well as being one of the cheapest and most cost effective treatments against Varroatosis to date. The optimum hive temperatures for vaporisation are between 18 and 22 C. The treatment is carried out with the hive entrance open in the late afternoon/early evening.

CARE MUST BE TAKEN WHEN WORKING WITH FORMIC ACID, PROTECTIVE GLASSES AND RUBBER/PLASTIC GLOVES SHOULD BE WORN. CONTACT WITH SKIN REQUIRES COPIOUS AMOUNTS OF WASHING WITH CLEAN WATER.

DIAGNOSIS

Use 40ml 85% FORMIC ACID by soaking an absorbent pad (beer mat) in the acid. The easiest way to soak the pad is to place it in a strong plastic bag of suitable size and pour the recommended quantity of formic acid into the bag. Allow about 15 minutes for the pad to saturate. Just prior to inserting the pad still in the plastic bag cut 4 - 6 slits on each side of the bag in way of the pad. Place a spare shallow box on the hive and insert the plastic bag containing the impregnated pad into the shallow super pinned to a spare shallow frame with or without comb. Carry out the operation in the late afternoon or early evening. Ensure that there are no through draughts in the hive which could cause vapour loss and reduce the effectiveness of the diagnosis. A clean insert must be placed on the hive floorboard just before the formic acid pad is inserted in the hive. The insert should be oiled using vegetable cooking oil, margarine, vaseline or any other greasy substance which will hold the fallen Varroa mites fast and not contaminate either hive products, hive furniture or the bees themselves. The insert should ideally be housed in a special insert board covered with 3x3mm mesh screening through which the mites will fall and by which the bees are protected against coming into contact with the insert. The insert should remain in the hive overnight and checked at some time the following day. The time scale is not critical if the insert is protected by the mesh screen. If the insert is not protected by a screen the bees could carry any dead Varroa mites out of the hive and give a false diagnosis. If the result of the test is negative remove the formic acid pad and insert .. If a positive result is obtained the Ministry of Agriculture Fisheries and Food must be notified. Proceed with treatment as for summer or autumn as described in the following paragraphs.

SPRING TREATMENT

As for Diagnosis

SUMMER TREATMENT

Although Formic Acid is the only chemotherapeutic which is not considered to be a honey contaminant (it occurs naturally in honey) as promulgated in the Schweizerische Bienen Zeitung (Swiss Beekeeping Journal) issue 112(1989)7 pages 393-397 however it is recommended that it only be applied in summer in emergency, that is if a heavy infestation is diagnosed in a colony for the first time during the summer period. Use 85ml 85% Formic Acid on the recommended pads, with floorboard insert in place. Set the pad in its slit plastic bag under the insert mesh on the floorboard. Leave the pad in place for 7 days. Leave the insert in place for another 7 days.

AUTUMN TREATMENT

Use 50ml 85% Formic acid. Carry out the treatment over a period of 21 days. September is an ideal month for the 'heather' beekeeper, otherwise August is probably best but any time after the final honey harvest has been removed is suitable. Renew the pad every 7 days. Use the mesh insert. The pads may be placed above or below the brood nest i.e. on the floor or propped up at the side wall of an empty shallow crate. Or pinned to an empty frame in an empty shallow crate as for diagnosis.

TREATMENT OF SWARMS (after hiving)

The formation of broodless colonies early in either 'shook swarms' or natural swarms is an method of maintaining viable colonies year by minimum of labour input.

Method: Insert at least two well filled combs of stores in the new hive. Place a frame of open brood between the store frames to act as a trap for any Varroa mites which may be infesting the swarm and as 'anchor' to stop the swarm from absconding and fill the rest of the brood box with foundation or drawn comb.

NATURAL SWARM TREATMENT (swarm has a queen already present)

Install swarm in the new hive with a crown board directly on top of the new frames.

If this is not done the bees will rise into any space left above the frames and begin to build comb, making for a lot of unnecessary work to get them into the previously prepared brood box below. Give the bees 4 - 5 days to settle with the donated brood. Insert the screened insert with a pad soaked in 70ml 85% Formic acid on it under the 3x3mm mesh as previously described. Leave the pad in place for 5 days to allow the acid to evaporate. Remove the plastic bag and the frame of donated brood after 5 days. The brood will of course be sealed by this time and will also have mites on it if the swarm was infested. Keep the pad for reuse. Soak the brood comb in water at 55 C for around an hour. After cooling, the comb may be donated back to the bees which will cannibalise the larvae and eject the dead mites. If the colony is fed well with sugar in syrup form or in the commercial 1 kilo bag with the contents thoroughly soaked to a soggy consistency until the first nectar flow the bees will build up well.

SHOOK SWARM TREATMENT(no queen present)

Having obtained a queen for the SHOOK SWARM cage her in a suitable device, a match box will do. Insert the queen in the cage with perhaps 5 - 12 attendant bees from the colony from which she was removed. Set up the new hive as per the hive for the NATURAL SWARM. Lodge the cage with the new queen into the frame of open brood under the top bar of that frame and remote from the Formic Acid pad (if a matchbox is used it must be open just enough for a bee proboscis to penetrate). Close hive up as for NATURAL SWARM and apply formic acid treatment. Remove the paper insert and the sealed frame of donated brood as for NATURAL SWARM.

Such colonies if made up early in the spring will not require any further treatment until late autumn when a further 21 day treatment with formic acid should be carried out before the start of the winter as described in AUTUMN TREATMENT PROCEDURE. The months of August or September are an ideal time. Merely insert a formic acid soaked pad (50ml 85% formic acid) every 7 days over the 3 week period. Insert a clean floor insert every 7 days. The effectiveness of formic acid lies in the rate of evaporation but it can be used at an ambient temperature of freezing point. Formic Acid impregnated plates can also be purchased ready to use. In Germany these plates are called ILLERTISENER PLATES.

A breakthrough in research in early 1992 and announced by Dr Ingemar Fries of Sweden at the VARROA SYMPOSIUM organised by IBRA in Imperial College London on 21st November 1992; is that FORMIC ACID may be used to kill the Varroa mites in the BROOD CELLS. The procedure is very simple: remove all combs which are full of SEALED BROOD and place them in an air tight container (an empty brood box is ideal) pour 50 ml 85% formic acid on to the floor of the container and leave for an hour. The acid vapour penetrates the cell capping, kills the mites and does not affect the honey bee larvae. The combs can then be placed in any colony of the beekeepers choice.

The timescales given for the treatment are those recommended by European beekeepers. However it is recommended that the individual beekeepers using FORMIC ACID experiment with dosages and timescales to establish the optimum for their region. Ambient conditions should always be noted until the beekeeper has established the optimum dosage and temperature for successful treatment in his/her area. It should be noted that FORMIC ACID treatment may cause queen loss if not carried out correctly. In the case of beekeeper anxiety over possible queen loss the queen may be removed to a small queen holding nucleus during the first few days of the treatment. After the queen has been reintroduced to her colony the holding nucleus should also be treated against Varroaosis.

In Germany in the autumn of 1990 it was noted that many colonies were robbed out during this period. This could have been due to the FORMIC ACID treatment masking hive odour. It is therefore recommended that the entrance of hives being treated at this time be closed in sufficiently to safeguard against robbing.

Work done in Liebefeld in Switzerland and reported in the Schweizerische Bienen Zeitung in June 1992 indicates that a continuous vaporisation in the hive of a weak solution of Formic Acid at a strength of 500 ppm (parts per million), 0.5 ml/litre is able to maintain a colony mite population at below lethal levels. This is almost a copy-cat procedure used years ago by R.O.B. Manley against Acarine. He inserted a bottle of Methyl Salicitate with a wick in it to allow the substance to evaporate slowly and continuously into the hive atmosphere. New methods and ideas are coming through steadily and we can learn from the other Varroaosis infested countries.

NOTE: FORMIC ACID HAS NOT BEEN AURTHORISED FOR USE BY THE BRITISH MINISTRY OF AGRICULTURE, FISHERIES AND FOOD. THEREFORE IT IS ILLEGAL TO USE IT TO TREAT BEES AGAINST VARROATOSIS IN IN BRITAIN.

THE INFORMATION GIVEN REGARDING THE USE OF FORMIC ACID IN THIS PUBLICATION IS THEREFORE PURELY ACADEMIC.

NON-CHEMOTHERAPEUTIC PROCEDURES

Sacrificial Drone Brood

As is now quite well documented the Varroa females must imbibe larval haemolymph before they can reproduce and also that they prefer drone larvae to serve as host for their young.

Both Russian and German beekeepers *have* exploited this situation for a number of years now and *have* succeeded in exercising some degree of control *over* the development of the mite population by encouraging the bees to rear early drone brood in the hive in spring. This can be done by introducing a comb with predominantly drone cells into the middle of the brood nest in late autumn or winter of the previous year or early spring before brood rearing really gets underway. When these combs *have* been laid up and the brood has been sealed the comb can be *removed* and destroyed. If this procedure is carried out correctly at the right time and perhaps repeated using a second drone comb it will go a long way to keeping the mite infestation levels below 'lethal' levels. Especially if it is used in conjunction with the HORN 'OpenFloors' method (see page 23)

It has been found that if a sealed brood comb with Varroa mites is immersed in water at 55 C for a period of 1 hour the mites will be killed as will of course the brood. However this comb may then be given back to the bees. The brood will be eaten, the mites will be ejected and the comb is thus *saved* for further use.

A variation of the drone comb method is also now widely used in Russia and Germany: Using 2 fully drawn worker brood combs. Cut the bottom half of the comb away leaving a gap above the bottom bar.

Insert these combs into the hive at the side of the brood nest between the outermost comb containing brood and the first comb containing only pollen and honey around the middle of April.

The bees will draw new comb to fill the gap however the new comb will be drone comb. When this comb has been laid up and sealed the bottom half with its drone brood can be cut away and destroyed. This type of management will trap a large percentage of the mites during the active year. It has been established that almost 85% of the mites in a colony are in the brood cells. Thus cutting out drone brood as recommended will go a long way to reducing the mite population.

Sacrificial Worker Brood

The same procedure as for the drone brood can be used also with worker brood. In conjunction with 'Open Floors'. The queen should be caged on one comb with free access to both sides of in which to lay. All sealed brood should be removed from the hive and destroyed or fumigated or treated as described in the caged queen method below, at this time leaving only unsealed brood. It is best to carry out this procedure at the commencement of the final nectar flow of the season, in Britain this would be the bloom period of *Caluna vulgaris*, in August, where bees have access to the plant. Otherwise the final flow will be from the late summer forage in July. A study by Zamazi (15) has indicated a strong relationship between the season and the VIABLE progeny produced by the female Varroa mite. This VIABILITY appears to increase as the prosperity of the colony increases and reaches 80% in mid/late summer. Therefore using the procedure mentioned timed to the relevant late summer flow in any particular country many mites and their progeny which would constitute the next generation of adult mites for the spring of the following year will be eliminated. When the original unsealed brood has been capped it should also be removed and destroyed or fumigated. When the caged comb is fully laid up, mark it and remove the cage. Thus using a 7 day cycle over a period of 21 days many mites will be eliminated.

The following procedure has been used successfully in Germany and Switzerland and it has the advantage of not destroying the original brood in the colony:

DAY 1 Using a cage which holds a complete brood comb, place queen on a clean (cleaned by the bees!) empty worker brood comb inside this cage. Mark all frames of unsealed brood at this time. The sealed brood is not removed!

DAY 7 Remove queen from 1st comb and mark this comb. Place queen on a 2nd caged worker comb. Remove all of the frames of previously marked unsealed brood (now sealed) at this time.

DAY 14 Remove queen from 2nd comb and mark this comb. Remove 1st comb which will now be sealed and fumigate the brood. Place queen on a 3rd caged worker comb.

(22)

DAY 21 Remove queen from 3rd comb and mark this comb also. Remove 2nd comb which will now be sealed and fumigate as for 1st comb.
Release queen and let her run free in the hive.

DAY 28 Remove 3rd comb and fumigate it.

The great advantage of this method according to Dr Maul in Germany is that as well as eliminating up to 90% of the mites a selection pressure is exerted on the mite - resulting in the elimination of the mites which tend to breed soon after emerging from the host cells. Thus selecting for a mite which has a much slower breeding cycle and therefore a lower population level potential.

SWARM CONTROL SPIN-OFF

The timing of the above 7 DAY CYCLE could be adapted to become a useful tool for SWARM CONTROL as well as a Varroa control.

Thus at the first inspection where eggs are noted in queen cells, mark the frames of all of the unsealed brood. Leave the sealed and unsealed brood in the hive. Cage the queen on the new empty comb as in the recommended 7 DAY CYCLE. The original unsealed brood will be capped by the end of the 1st 7 day period and by removing it a large number of mites will be eliminated. The original sealed brood left in the hive will have emerged with its complement of Varroa mites within 11 days. The mites will be trapped by the 2nd and 3rd caged combs inserted. By the time the queen is released on the 28th day all idea of swarming will be gone. If done systematically the 7 DAY CYCLE will effectively replace the present cumbersome 9 DAY CYCLE for swarm control. The great advantage of the 7 DAY CYCLE is that after the procedure has been carried out, no more swarm control inspections are required. If a new queen is introduced every other year the colony will be kept in tip top condition.

It must be stressed that the above procedures alone will not eliminate the Varroa mite from colonies, however neither will the 'hard chemical' procedures. The aim is to maintain the Varroa infestations below lethal levels and using the above procedures will help achieve this goal.

OILED FLOORBOARD INSERT WITH 3X3mm MESH SCREEN BOARD

If the recommended Varroa insert is greased or oiled, and used in conjunction with the above sacrificial brood procedures according to both German and Russian research up to 80% of the mites on the adult bees can be eliminated.

DRONE SCREENING

Work done in Russia indicates that the Varroa mite favours the adult drones at the height of a nectar flow. This factor could be utilised to 'screen' out much of the adult drone population at these times by fitting special floorboard which would allow the hive to be rotated through 180 degrees with the original entrance at the rear of the hive and the new front entrance fitted with 2 queen excluder strip to deter any flying drones from re-entering the hive.

OPEN FLOORBOARDS

Research done by Horn in Germany over a five year period using hives with 'OPEN FLOORBOARDS', (that is floors with rectangular holes cut in them, these holes then being covered with wire mesh indicated that this caused the bees to cease brood rearing - earlier in the autumn and start brood rearing later in the following spring. This means that the Varroa mite has less time to breed and must therefore spend more time on the adult bees where it is most vulnerable. By modifying the recommended oiled/greased Varroa insert to maintain the wire covered hole open, many viable mites falling from the winter cluster accidentally will be taken out of circulation before the bees begin to breed in the spring.

Horn recommends that the hives with the open floorboards be set close to the ground on perhaps building bricks to eliminate draughts. He also recommends that the hive be wind and weather proof to maintain an even micro-climate within the hive. He also recommends a sheet of polystyrene or some other such insulation be placed under the roof of the hive. Absorbent material must not be used, otherwise dampness will result. The roof insulation should remain in place until the end of the catkin bloom period when it should be removed. Horn proved that despite the later commencement of brood rearing in the colonies on the open floors, these colonies built up more strongly than colonies on the traditional floors. This was due to the heavy losses of adult bees in early spring as a result of premature brood rearing.

ARTIFICIAL SWARMS

Karl Pfefferle, a German commercial beekeeper, in his book recommends the use of 'SHOOK SWARMS' in spring and autumn. These shook swarms he states should be headed by a current year queen, the swarm being shaken into a special nucleus box and treated with some suitable decontaminant treatment against Varroaosis.

These young colonies must be well fed with either sugar in some form or other or given combs of stores containing pollen as well as honey and be set up in apiaries remote from untreated colonies otherwise they will quickly become re-infested by the mites. A device to accelerate the development of such colonies would be the donation of combs from strong colonies in other remote apiaries containing eggs and fumigated sealed brood but completely free of adult bees, by transporting these frames in heated bee tight box maintained at a Relative Humidity of 45 - 60%.

MARGORAM OIL and HERBAL EXTRACTS

A report in the "Neue Bienenzeitung" January 1992 issue claims that Margoram oil is an effective substance against the Varroa mite. The oil is mixed into the wax of the foundation and the odour from it is claimed to disorientate the mite in its search for suitable larvae to parasitize. The substance is non toxic and natural and does not contaminate the wax or honey. Bernhard Kraus the German biologist of the Beekeeping Research Institute at Oberursel, who makes the claim for Marjoran oil also maintains that 70% of the mites normally lay only once in their lifetime and if they can be deflected from their function by the oil this will have enormous implications for the treatment of colonies infested with the disease.

The work being carried out on aromatics by Kraus was actually pioneered by in Russia as long ago as 1980 by Endel Linask in Moscow, who has had great success with a variety of different aromatic substances not toxic to either bees or humans. Linask used mint, thyme, aniseed and vanilla, among other substances.

Research carried out at the Institute at Oberursel in Germany by Bernhard Kraus has demonstrated that if Margoran oil is mixed into the wax of brood foundation this appears to completely disorientate the mite in its search for a suitable host. No amounts of the oil per comb were cited.

SELECTIVE BREEDING

An Austrian beekeeper Alios Wallner noticed over a period of time that some of his colonies seemed to always exhibit a lower Varroa infestation than others of the same size in the same apiary. In May 1991 while inspecting a colony on a double brood chamber he noted that as expected there were Varroa mites in the drone cells which had been damaged when the chambers had been on a drone pupa.

While watching the mite be became aware of a bee about 2 cm away from the mite. Suddenly something quite extraordinary occurred. The bee rushed toward the mite and without any hesitation grasped it in its mandibles. The bee then remained quite still for a time after this attack and Wallner was able to observe that the bee had caught the mite horizontally in its mandibles. It had been caught by the front end and about a third of the rear section was projecting out of the bees mandibles.

Wallner wondered if there could be any connection between the behaviour of this bee and the low infestation in particular colonies.

He started examining the dead mites on the floor insert in the low infestation colonies and found that many of these mites showed signs of damage and mutilation. He then checked the colonies which always exhibited high levels of infestation in the same way and could find no damaged mites.

Wallners findings have been checked and confirmed using photomicrographs by Professor Ferdinand Rusicka at Vienna University. By making this accidental observation Wallmner has established that there is a possibility to breed a more Varroa resistant honeybee.

The best that can be hoped for in the treatments SO FAR discussed is varying degrees of success in the REDUCTION of the mite populations. The parasite once established in a colony can rarely be completely eliminated. This is a fact long since discovered by specialists working with parasitic diseases.

HEAT TREATMENT

This form of treatment offers the beekeeper what in the West was considered to be the impossible; the facility to completely free a Varroa infested colony of honeybees of mites with resorting to chemotherapy. Being a fluent speaker of the German language competent in Russian has permitted the author to gain first hand access to the work done by scientists in both of these countries and also to the reference work used as basis for experimental procedures against Varroatoxis.

Much time, effort and finance has been invested into treatments for Varroa especially in Germany and Russia, the latter having suffered Varroatoxis earlier than most countries in Europe. The Germans have done much sterling work into chemotherapeutic measures against Varroatoxis but to date the authorities there have only approved a few treatments as meeting the stringent regulations imposed on beekeepers and their saleable honey.

Non chemotherapeutic treatments such as drone brood sacrifice in early spring as well as removing worker brood are practiced widely in Germany. Russian beekeepers have also used chemical treatments. however a procedure using HEATING CABINETS which has not had a great deal of coverage in the Western bee press has been used to great effect in the USSR it is extremely effective and NON CHEMICAL.

This non chemotherapeutic method offers Western beekeepers a treatment for their bees which they have been seeking, a treatment which is safe to bees and their produce alike.

European research workers actually had access to the early reports on HEATING CABINETS even quoting the literature concerned but for some reason seemed to miss the crucial points in the procedures using thermal means to eradicate the Varroa mite. The thermal treatment was probably neglected because it was reported to kill bees. However so also does any form of treatment or management if it is either not properly applied or if it is not properly understood. At the risk of incurring their wrath, in my opinion the European apicultural scientists suffered both of the above mentioned lapses up to 1991 when a new design based on heat treatment was produced in Germany.

SCIENTIFIC BACKGROUND

It has been known for a many years that the most effective time to treat bees suffering from Varroaosis is when there is little brood in the colony. This of course is during the dormant winter period. From the experience of both German and Russian research work it is now accepted, that contrary to popular belief. There is brood in the bee colony, however small the amounts, at all times of the year even in the 'dead of winter'. It has also been accepted that treating honeybees against Varroaosis while there is brood in the colony is not particularly effective because to date there is no treatment with which it is possible to kill the mites infesting the brood in the sealed cells. Armed with this knowledge researchers have devised various treatments which are effective in varying degrees. It has also been accepted that none of the present chemotherapy procedures are 100% effective against the parasite.

In 1975 research, stimulated by reports from Japan in 1973, started at the Maikop Apicultural Research Institute by

V.N.MELNIKOM on treating Varroa infested bees using heat proved to be worth further investigation. By experiment it was established that at temperatures of 46 - 48 C the Varroa mites could no longer hold onto their hosts. Further work established that with an exposure time of 12 - 15 minutes at this temperature range the bees could be made completely free of the parasites.

Honeybee tolerance to a range of humidity levels between 50 - 65% at various temperatures has been investigated by Kommissar (7) and Khmara et al (16) and it is indicated that humidity levels within these limits are not particularly critical to the survivability of the bee.

Trials were conducted to discover if the laboratory work was repeatable in the 'field'. This proved to be the case. The following procedures are the results of extensive work done by beekeepers and scientists to evolve a procedure using HEATING CABINETS which was acceptable to both bees and beekeepers.

THE RUSSIAN HEATING CABINET

The procedures used like any other procedure have certain, in basic 'ground rules' which MUST be observed.

The cabinets can be of various designs and many different sizes have been tried, The operator after experience with a particular design will probably wish to alter the design to suit his particular needs.

The choice of materials is also a matter of preference and wood, plywood, formica, hardboard, chipboard, sheet metal etc may be used. The material choice will be dictated ultimately by the need for mobility, durability, thermal efficiency and cost.

The cassette design illustrated has been tested and proved for a number of years in many beekeeping enterprises throughout the USSR without loss of either colonies or queens unless in cases where the infestation levels were so high that the colony was too far gone to save. It is a well established fact that honey bee colonies in their fourth year of infestation by Varroa are almost at the point of collapse and can rarely be saved. The design has been arrived at to accommodate the optimum number of bees which can be safely treated, and ease of manually loading the cassette with bees and locating it in the heating cabinet.

The heater recommended is a 'Sentinel' monitored unit having a power of between 1 - 1.5kW

The heaters effect can be enhanced by the fitting of reflectors angled at approximately 40 degrees to the horizontal, located on the base of the cabinet around the heater. The 'Sentinel' being a bell activated by a thermo switch which closes at the unacceptably high temperature of 50 C. This is fitted instead of the thermostat which was included in the earlier design , to remind the operator to switch the heater off .

The main constituents of the equipment are:

1. CABINET
2. CASSETTES (ideally .. 5 - 6 per cabinet)
3. HEATER
4. FUNNEL (with shroud which fits snugly into the top of the cassette while loading the bees)

The basic cabinet design is shown in FIG 1. Ideally it should be double skinned for thermal efficiency with a 3 cm air gap. It is fitted with two 450 mm square observation windows, one front and one rear. One of these windows should either be hinged or sliding to facilitate access to the base of the cabinet for inserting the heater and for cleaning.

The side walls are fitted with two small access holes covered with flaps to make them as 'heat tight' as possible.

These access holes are positioned to give manual access to the cassette containing the bees from the outside of the cabinet.

A sliding removable mesh floor (mesh O. 5 x 0.5 mm) is fitted under the cassette at 450mm from the base of the cabinet to catch the mites as they fall during the treatment. This sliding floor should be withdrawn and scorched after each treatment to kill the on mites on it. A flat sheet of paper should be placed on the mesh to catch the mites as they fall and also to shield the bees from scorching, due to effects of direct heating.

The roof of the cabinet may be hinged or not, depending on the choice of the operator. A hinged lid is worthwhile, it can't get mislaid during the treatment procedures. A soft seal under the lid rim will ensure a higher thermal efficiency. Four slats are fitted at not less than 150mm above the removable floor and pitched 150mm apart to form a landing for the cassette during the treatment. The cabinet is equipped with two easily visible thermometers as control thermometers, to back up the 'Sentinel' monitor.

There are TWENTY FIVE 12mm diameter ventilation holes in the roof of the cabinet, spaced around the periphery and diagonally across the roof, this ensures sufficient ventilation during the treatment.

There are also TEN 12mm diameter ventilation holes at the bottom edge of each of the cabinet sides.

The cassette illustrated in FIG 2 i.e. constructed as a framework of 4 - 5mm diameter wire, elliptical at the base and rectangular at the top.

A wire mesh basket of 2.5x3.0mm mesh made from wire of no greater diameter than 0.5mm with a base dished inward 20mm is fitted snugly into the frame of the cassette and anchored firmly to the wire of the cassette frame.

A beetight rectangular flanged lid of similar mesh also dished 20mm inward is fitted onto the top of the cassette and held in place by a rubber strap stretched round the periphery of the flange.

The length of the cassette is 530mm as shown in FIG 2.

The total surface area of the mesh basket is 0.742 sq.m. It has been designed to accept a 1.5 - 2.0kg weight of bees (approx. 15000 - 20000 bees). This has been found to be the optimum amount of bees to treat in cassettes. The bees should always be weighed to check the number prior to treatment.

The heater as stated should be electric and between 1 - 5kW in power it should have a good circular reflector or one should be fitted around the selected heater at the base of the cabinet.

The heater must possess particular characteristics. It must be able to maintain a temperature of at least 46 C in the cabinet. It must be monitored by a 'Sentinel' bell set to ring at 50 C. It must have a LOW INERTIA, that is it must not cause the temperature in the cabinet to rise more than 1 - 2 C after has been switched off by the operator. It must also be able to bring the temperature of the cabinet back up to the working temperature of 46 - 48 C within a period of 3 - 4 minutes, after the cassette has been loaded when the temperature of course falls. The temperature in the cabinet MUST NEVER EXCEED 50 C for any length of time while the bees are being treated.

The funnel should be made of either stainless steel or good quality tinned steel and well polished inside to cause the bees to slide into the cassette easily.

(30)

The cabinet must be thoroughly 'heat soaked' to a 50 C and its temperature stable at the working level before a cassette with its load of bees is inserted.

The whole cabinet assembly must be thoroughly tested for effectiveness using a dummy 1.5kg load in the cassette to prove the function of the cabinet and ensure that the operator understands the routine involved in using the cabinet, before live bees are introduced into it.

The 'Sentinel' thermo switch should have a design range of 39 - 55 C, and must be placed centrally under the cassette position and above the sliding mesh floor carrying the paper insert and with free space around it so that it senses, the CABINET ATMOSPHERIC TEMPERATURE rather than a residual structural temperature.

The observation windows in the cabinet are placed to view the mite fall and condition of the bees. As previously stated the bees MUST not be allowed to form a cluster during the treatment in the cabinet. The cassette containing the bees in the cabinet MUST be manually bumped periodically using the access holes in the sides of the cabinet to cause the bees to spread out all over the mesh of the cassette. This 'shock' treatment does not adversely affect the bees, however it causes the VARROA mites to fall from the bees' body. At 46 - 48 C the mites cannot maintain their hold on the bees and each time the cassette is shaken more mites fall. They also can be seen falling, and with experience the operator is able to rid the bees being treated of all the mites infesting them.

The bees MUST NOT have been fed sugar syrup for at least 12 hours prior to the treatment.

The bees may also be transferred MECHANICALLY into the cassettes and SUCTION CABINETS have already been used for this purpose in the USSR. Further developments have been made in the design of the cabinets and FAN HEATERS blowing heated air downward through the cassettes are now quite widely used in the cabinets. Cylindrical cassettes with central wire mesh partitions to increase the effective surface area for the bees to cling to are also used in some present designs and these are rotated at EIGHT REVOLUTIONS PER MINUTE. This replaces the need to manually bump the cassettes during treatment. However it is recommended that the MANUAL transfer of the bees using the FUNNEL illustrated in FIG 3 also the STATIC HEATER and the CASSETTE in FIG 3 should be used until the method has been perfected.

The early procedures used in the HEAT TREATMENT method were carried out with the bees in their hives still on the combs.

However although this was found to be reasonably effective it did not give the results which can be achieved by removing the bees from the combs and transferring them to a cassette. Although a recent German appliance design appears to have overcome this failing in the "in hive" treatment.

The HEAT TREATMENT method has been used successfully since 1977 without. Any adverse effects being noted, Queens may be either left with the bees being shaken into the prior to the treatment to a separate cage cassette or removed if the operator so desires.

Bearing in mind that none of the CHEMOTHERAPY methods guarantee 100% freedom from the mite, and that the accepted philosophy with chemotherapy is, that so long as the VARROA mite population is maintained at less than 'lethal' levels the colony will be in no danger.

By employing the HEATING CABINET method the operator can OBSERVE mite fall within the 12 - 15 minute time limit of the treatment and establish when the mites cease to drop from the bees.

Signifying 100% freedom from infestation!

By achieving 100% mortality of the mites the colony is given a fresh, clean start after each treatment. Thus it is possible to consider a treatment cycle on a 'ONCE EVERY 2 YEARS' basis.

Research into the population dynamics of VARROA JACOBSON!

OUDEMANS has shown that the mite population is only in danger of going 'exponential' in the 3rd or 4th year of infestation.

STARTING from INITIAL infestation. A colony of bees treated successfully with HEAT starts again with no mites. Therefore a 2 year treatment cycle is not only feasible but extremely sensible after the operator has become fully experienced with the method.

Especially if the other apiaries in the vicinity are treated against Varroaosis at the same time to eliminate possible re-infection from neighbouring colonies.

The virulence of VARROATOSIS and its ability to spread rapidly and the fact that to date the brood of the bees cannot be treated has caused a hindrance to the 'build up' management of colonies where the system of transferring brood from stronger to weaker colonies was practiced. However by good management weaker colonies, natural swarms and shook swarms, which may be treated

safely by the HEATING CABINET method at any time of the year, may still be brought up to strength using the stronger colonies for reinforcement BUT instead of transferring brood between colonies the transfer of combs of eggs should be undertaken. Any adhering bees should of course be shaken off and a check made to ensure that there is no sealed brood or stray mites on the comb.

There are a number of conditions which must, be fulfilled before bees, can be treated in the CABINET and the correct preparation is necessary

1. Select and prepare the colony for treatment at least a day in advance
2. Prepare the HEATING CABINET some hours before the bees due to be treated.
3. Shake the bees into the cassette using the funnel. (The shroud on the funnel should fit snugly into the top of the cassette)
4. Carry out the HEATING PROCEDURE observing the bees at all times when they are in the CABINET to ensure that they DO NOT FORM A CLUSTER at any time in the cassette during the treatment.
5. Remove the bees from the HEATING CABINET and place them in a place where' the temperature is around 10 - 15 C still in the cassette for around 15 - 20 minutes to cool down before reinstalling them in their- hive. When they begin to form a cluster, or small clusters in the cassette this is the time to return them to their hives.
6. Before installing each new cassette with its load of bees to be treated into the cabinet, this should be checked internally for dampness and condensation and the inside of the lid wiped dry if necessary. By opening the lid of the cabinet with the heater on a through flow of fresh air will help remove any residual dampness.
7. Before returning the bees to their hive all the frames should be removed and the inside of the brood chamber thoroughly scorched with a blow lamp. The frames and comb should also be lightly flamed to eliminate any stray mites which may have escaped the CABINET. Any sealed brood should be destroyed.
8. Return the hive to the apiary. The treatment should be carried out in the autumn around October or November although Russian beekeepers carry out the treatment

also in December and February, January being the only month in which no treatment appears to be carried out, according to the literature. They report treatment being carried out successfully at ambient temperatures of 3 - 6 C. and recommend 7 C as being the optimum for quiet bees.

No more than 1.5 - 2kg of bees should be treated at, one time.

Where a very strong colony is to be treated, the colony must be split and treated in separate cassettes. It is recommended that a cassette be weighed prior to being inserted into the cabinet to ensure that it is not overweight, too many bees in the cassette will endanger the success of the whole operation. If the criticals are observed the operation is completely safe. It is not necessary to find the queen prior to the treatment, but she may be caged the previous day when preparing the colony for treatment if the operator so desires.

A colony having been selected for treatment should be reduced to clustering on perhaps 5 - 6 frames and a dummy frame placed on either side to conserve heat, on the previous day.

To avoid robbing 1.2king place it is recommended that the treatment of the bees takes place early in the morning before the bees have started flying, and then again later in the evening after the bulk of flying has ceased. The minimum of smoke should also be used.

Where the bees are treated in a closed building having been moved there from the apiary. It is recommended that the area where the heating cabinet(s) are being used be maintained at a temperature of around 7 C and the lighting be dim.

However one of the important factors in treating bees using the HEATING CABINET method is that the bees being treated should not be able to escape treatment by flying from the comb when they are being transferred into the cassettes. Any escapees should be collected and treated as 'lost clusters' before the final treatment of the day is carried out.

While the cassette is in the heating cabinet as stated - should be under observation at all times and bumped periodical to ensure against the bees forming a cluster.

When mite fall ceases the cassette should be removed from the cabinet and laid somewhere warm until the bees begin to form clusters. At this point the cassette should be taken to the previously prepared and preheated hive if the operation is performed on a cold day. An empty brood box should be placed on the floor board the entrance being closed. The bees by now quite normalised and cooled are bumped into this empty brood box and the prepared brood box with the store combs is placed on top of this empty brood box now containing the bees.

The whole assembly being placed on the original stand from which the colony originally came, the entrance block being removed and the hive left until the following day, The lower empty brood box which will be clear of bees by this time, all having moved upward as is their natural instinct into the upper brood box with the store combs, may then be removed.

According to the literature it is possible to treat broodless colonies at any time of the year. Thus it is possible for the beekeeper using the method to make up shook swarms or treat natural swarms which can be completely freed from VARROATOSIS cost effectively and at will, once the HEATING CABINET has been made and the procedure thoroughly understood, without resorting to expensive and potentially contaminating chemotherapy.

This system lends itself ideally to the 'Package Bee' industry offering the facility to produce guaranteed 'VARROA' free nuclei.

SUMMARY

When HEATING CABINETS were used for the first time at Tamachin, Volgograd in 1977 the mite numbers falling per colony were 8 - 10,000. The total mite fall for that first year filled a 3 litre container to the brim. The following year less than two litres of mites were collected. At the end of the 1979 treatment, 300 colonies hardly produced a glassful of mites. In 1980 the mite fall barely reached a half glass for the 300 colonies treated.

The same favourable results were also achieved at the apiaries at Maiikop.

The treatments also resulted in colonies which were treated in autumn using HEATING CABINETS having twice the amount of brood in spring than the control colonies, and by June this had increased to three times as much as the controls.

At Tamachin using a single cabinet and 4 cassettes and working a coordinated system 30 colonies can be processed effectively in an 8 hour working day.

Although the heat treatment method is quite labour intensive and somewhat more complicated than some of the chemotherapy methods, no other procedures in the opinion of the beekeepers at Tamachin, Maikop and many other places in the USSR give the same guarantee of success.

The ability to produce a high quality pure, natural, uncontaminated honey from healthy colonies is the bonus for the extra labour input.

The use of HEATING CABINETS in the USSR has increased over the years, indicating the success of the method. Many case histories demonstrate this unequivocally and the sources are listed in the bibliography.

Much detailed work has been carried out over the years to improve the basic design, such as fans being used to blow hot air downward over the cassette containing the bees. Cylindrical cassettes with a central wire mesh partition are now being used the optimum speed of these rotating cassettes being 8 revolutions per minute. However the basic principle of the cabinet design and treatment parameters such as temperature limits, time limits for exposure and weight of bees must still be complied with.

The management system employed by A.A.Jansen (14) in Omsk, a region of Siberia, is quite typical of how the use of heating

cabinets has not only neutralised the Varroa threat, but also increased the overall efficiency of the beekeeping operation. A few years ago the number of colonies operated by Jansen and his colleagues had reduced to 60 due to the effects of Varroaosis.

Since starting to use heating cabinets the ability to increase and develop the colonies has been dramatically improved. In 1981 an increase of 55 colonies was made from an original number of and a harvest of 300 lbs. of honey achieved. In the 1984 season the average honey harvest was 134 lbs. per hive.

At the present time just under 300 hives are worked by Jansen and the management system based on a cycle of autumn heat treatment gives complete control over the colonies throughout the year.

The colonies are treated in the heating cabinets at the very beginning of October - in cold weather indoors, and on warm days in the apiary. No mention is made of treatment being carried out in wet weather. The majority of the brood is removed from the hives and destroyed - the wax of the damaged combs is recycled and the empty but intact combs are stored for use in the following year.

The brood removed can also be fed to poultry or to pigs with the loss of the comb. The bees are shaken into the wire mesh cassettes and treated in the residual heat of the cabinets after the cabinets has been dried out and heat soaked to 50 C. The heater being switched off and the decaying temperature observed. If the temperature falls below 45 C the heater is switched back on again. The bees are observed at all times during the treatment and the cassette is manually bumped to inhibit the bees from forming a Luster.

After the mite fall ceases (inside 12 - 15 minutes) the cassette with its load of bees is removed to a warm dry location to allow the bees to normalise before being returned to their hives. The empty hives are 'torched' by a blowlamp to sterilise the interior and the combs are rearranged so that a little unsealed brood is located in the centre of the new brood nest. The adjacent combs are selected for weight of stores and the brood nest restructured to give the bees stores in the optimum position for the wintering period. At this autumn treatment any poor or ageing queens are eliminated and weak or queenless colonies are united after the heat treatment procedure. The colony populations are equalised at this time and the store quota calculated as 2.5kg per 300 grams of bees. This autumn selection ensures that each overwintered colony is in optimum condition with a good young queen and adequate bees of the correct age and enough stores to carry the colony through the winter - supplementary feeding is also carried out when necessary.

Bees united to colonies in the same apiary do not desert their new colonies after heat treatment according to Jansen. The procedure helps eliminate the inefficiency in conventional beekeeping winter preparation where a strong stock of bees which is, unknown to the beekeeper, queenless being fed large amounts of expensive sugar syrup or candy which of course has to be written off as a dead loss.

The crux of the success of the procedure described is the production of new queens each year as early as possible and a start is made by creating nucleus stocks (even in Siberian conditions) in late May/early June. These queens are also for increase and for replacement queens at the culling of unsuitable and poor queens at the heat treatment procedure in the following autumn.

The incursion of Varroa as a terminal threat to beekeeping is now looked upon by many Soviet beekeepers as a stimulus to good beekeeping. The control which has now been achieved by pushing back the frontiers of beekeeping management has, dramatically increased the efficiency of beekeeping operations where the beekeepers are prepared to make that extra effort in managing their bees in order to produce the high quality pure natural product which the honey buying public is entitled to expect when purchasing honey.

Appendix

According to the recent thermal therapy research carried out in Russia a controlled temperature of 37 C and 53 - 64% RH applied to Varroa infested sealed brood without bees present killed all stages of mite development on the brood within 10 - 11 days. At 38 C and similar - RH% the kill time was reduced to 5 -6 days. Broodless colonies of bees were exposed to temperatures of 42 - 43C at 45 - 48% RH, killing all mites within 5 - 8 hours.

Bees and mites have been found to be not only sensitive to high temperature but also to low humidity. An RH of 34 - 37% at 25 - 30 C was noted to shorten bee life expectancy. In contrast to this an RH of 60% actually promoted an extension of bee life in treating bee colonies without brood using the conditions quoted the bees must be given twice the actual volume of the cluster into which to expand during heating.

An Alternative Heat Treatment for Sealed Brood

Further to the pioneering work done in Russia Dr J.H. Bergmann in Eberswalde in Germany has developed a system for killing the Varroa mites in the sealed brood cells. His method is based on ideas which he obtained in correspondence with Mrs Schonebeck - Sych in Greece. Mrs Schonebeck-Sych in Greece closes up hives for 3 - 4 hours at a time in August after the final nectar flow is over. By using an accurate thermometer and shading the hives she is able to control the internal temperature of the colony at 40 - 44 C over a period of 3 - 4 days and in this way her colonies are maintained virtually 100% Varroa free.

Bergmann in Germany attempted this procedure but found that he could not achieve a temperature above 36 C due to the bees ability to thermo-regulate the hive so well under natural conditions. Using advice from Greece he tried another tack using heating cabinets into which he places up to 100 sealed brood combs. These combs of sealed brood are subjected to a temperature of 43 C for a period of 7 1/4 hours and then returned to the hives, not necessarily to their parent colonies. Since the queen is left in the hive uncaged to carry on laying al I combs with only eggs and unsealed brood are marked at the initial brood comb removal around the 1st of July and these are treated when the brood is sealed at 7 day intervals thereafter until the 28th day.

Bergmann recommends treating swarms with Amitraz smoke strips before hiving. After hiving he reinforces these swarms with heat treated brood combs.

He claims excellent results. At the end of the final honey flow he treats all colonies with FORMIC ACID using the proprietary IIIertissener formic acid impregnated plates.

A personal communication from Mr Endel Linask, Moscow indicates a much lower temperature threshold for controlling and eliminating Varroa infestation on bees. Linask housed six Varroa infested, six frame colonies in his Moscow flat giving them free access to outside, He installed the Colonies in July 1987 and after successfully overwintering them relocated the bees in an out apiary in April 1988. The apartment was maintained at a temperature at 18 - 23 C during the whole winter period, the RH was around 35% on the coldest days. The colonies were well provisioned with stores and were fed water adlib in inverted jars on top of the ventilation grid of the nucleus box roofs. These grids were not propolised at all by the bees, as is usually the case with such ventilators. On examination in the spring the bees were found to be prospering.

Their consumption of food was 50% less than that of control colonies overwintered outside. The most interesting aspect of Mr.Linask's experiment was that every nucleus stock was completely free of Varroa mites. Considering the significance of RH levels and the criticals established for RH, Linask's feeding water adlib throughout the winter was probably a deciding factor in the bees not only surviving the relatively low RH% in his apartment but thriving.

This accidental discovery could have enormous significance for the current treatment of bees against Varroa in that by returning to the European 'Bee House' system and using thermo regulated moderately warmed and controlled RH% atmospheres could result in overwintered colonies being completely Varroa free in Spring - each and every year. The cost of heating if proper attention were paid to insulation could probably work out cheaper than chemotherapy. Especially where either many colonies were overwintered or space volume reduced to the minimum necessary to carry a particular small number of hives.

Variations of zootechnical and biological methods will continue to be discovered and combinations of these procedures could ultimately result in the deadly threat from Varroa being relegated to being merely a nuisance in the hive and chemical contamination of hive produce, due to the total elimination of chemotherapy, an historical curiosity. Hopefully!

Since this original work was written a device has been invented by two young German engineers who are also beekeepers. The device is based on the HEATING CABINET concept and unwittingly incorporates the research done by Khmara et al in Russia in 1987, who used fans to blow moistened heated air over adult bees on broodless comb and brood in comb without the presence of adult bees. Their work implied a great importance to the relative humidity of the heated moving air stream. Also it was recommended that the adult bees being treated should be given at least double the volume of the initial cluster volume while being treated. The German device appears to operate with great effectiveness without any regard to humidity or additional volume for the adult bees during treatment.

The device is called 'THERMO BOX' and is a closed heated air device. The heater unit completed with fan and a thermostat is located in a small cabinet which is fitted to the top of a hive (or the end, for some German hive designs). Another component for extracting the heated air being forced through the hive from top to bottom is fitted at the entrance of the hive, both components, the fan cabinet and the extractor unit are connected by a flexible tube which delivers the heated air issuing from the bottom of the hive back to the fan cabinet. The heater unit is fitted with a bee proof guard above which a perforated plate sized to operate as an air distributor is fitted and a shaped perforated plate is also fitted at the hive entrance. Thus producing a safe closed heated air system in which the air temperature can be very accurately monitored and controlled. In the experimental work to prove the effectiveness of the device OIL OF WINTERGREEN was introduced into the air stream this procedure was found to be effective not only for killing the adult mites but also the mites still in the sealed cells. This appears to confirm the findings of Bergmann and question the need to introduce OIL OF WINTERGREEN into the THERMO BOX air stream.

This invention is not cheap but it offers the beekeeper another alternative method to maintain his bees free, yes FREE of Varroa mites without resorting to the use of chemotherapy for the consumer reasons already stated. The THERMO BOX if correctly used can rid a colony 100% of Varroa mites.

SOURCES

1. I. I. Khrust "Heat Treatment of Varroasis"
Pchelovodstvo (1978) No.6 5-8.
2. O.R.Nikolski "The Need for Scientific Animal Husbandry"
I. M. Pinaev Pchelovodstvo (1981) No1 : 338
3. N.K. Pobozenski "Learning to Work with Thermal Cabinets"
Pchelovodstvo (1981) No1 : 43
4. I. Shabarshov "The Thermal Treatment System comes of Age"
Pchelovodstvo (1981) No1 : 36 - 38
5. Kan Khiraozu "A Method for Stimulating Honey Bee Queens egg
laying and the Devastation of their Parasitic mites
using Heat Treatment and a Device for carrying
this out" (1973) ,Japan Patent No 48 - 508, 6D 52
6. A.D. Kommisar "Modern Thermo-Chambers '
Pchelovods.tvo (1984) No 11 : 16 - 17
7. A.D. Kommisar "Heat Treatment of Honeybee Colonies infected
with Varroasis" A.piacta (1985) 20(4) :113-117
8. D.A. Griffiths "World Distribution of VARROA JACOBSONI a
C.E. Bowman parasite of honeybees" Beeworld 62(4)
154-163 (1981)
9. W. Ritter "Varroa Disease of the honeybee Apis mellifera"
Beeworld 6:2 (4) 141 - 153
10. N. Bradbear "World Distribution of Major Honeybee Diseases
and Pests" Beeworld 69(1) 15-39 (1988)
11. M.D.Delfinado "Mites of the honeybee in S.E.Asia"
(1963) J.Apic.Research 2(2) 113 - 114
12. M.D.Delfinado "Varroidae, a new family of mites of the honeybee
(Mesostigmatc Acarina)" J.Wash.Acad.Sc. 64(1) 4-10
13. Dr. F.Ruttner et al "Sonderheft Varroatose" Allgemeine Deutsche

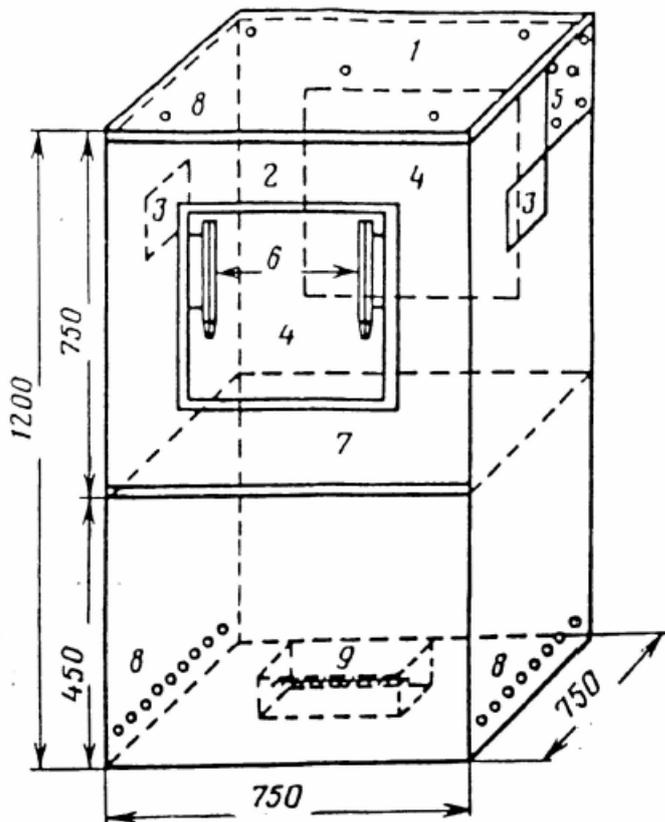
Imkerzeitung (1980) No5

(42)

14. A.A.Jansen "Non Labour Intensive Heat Treatment"
Pchelovodstvo (1985) No9 : 19
15. A.A.Zamazi "The Egglaying cycle of the Varroa Mite and the
Seasons of the Year" Pchelovodstvo (1986) No5 :16-17
16. P.J.khmara "The Viability of Honeybees and the Varroa Mite
E.B.Poluectova with Heat Treatment Pchelovodstvo (1987) No9 :14-15
G.E.Stashenko
V.G.Mitrovancv
17. A.W.Wienands "Bees, Blood and Parasites" Allgemeine Deutsche
G.Madel Imkerzeitung (1987) No1
18. O.I. Avdeeva "The Varroa Mite and Drone Brood"
Pchelovodstvo (1981) No 10
19. V. N. Shilov "The Effectiveness of Zootechnical Methods of
Combatting Varroasis" Pchelovodstvo(1980) No7 :19-21
20. E. Linask Personal Communication 27/11/88
21. S.Stolz Personal Communication 4/7/90
22. A. Borgstadt The Thermo Box (Personal Communication 7/3/92)
23. Various Authors Schweizerische Bienen-Zeitung all issues 1990-91
24. H. Horn Observations on the Overwintering Behaviour of
Honeybee Colonies in hives with Open and Solid Floors
Allgemeine Deutsche Imkerzeitung Nov.1989 pp 314-355
25. Various Authors Neue Bienen Zeitung All issues up to May 1992

GENERAL ARRANGEMENT OF CABINET FOR THE HEAT TREATMENT OF HONEY BEES INFESTED WITH VARROASIS

1. Removable Double Walled Roof
2. Basic Framework (or Double Walled Construction)
3. Access Hole for Manual Vibration of Cassette
4. Observation Window
5. Plate for Electrical Connection.
6. Thermometers (0 - 100 C)
7. Fine Wire Mesh for the Collection of Mite.
8. Ventilation holes 12mm dia.
9. Electric Heater (Minimum Power 1kw)



All Size. In Millimeters

Top closed by
bee tight lid
(mesh 2.5x3.0mm)

CONSTRUCTION OF CASSETTE

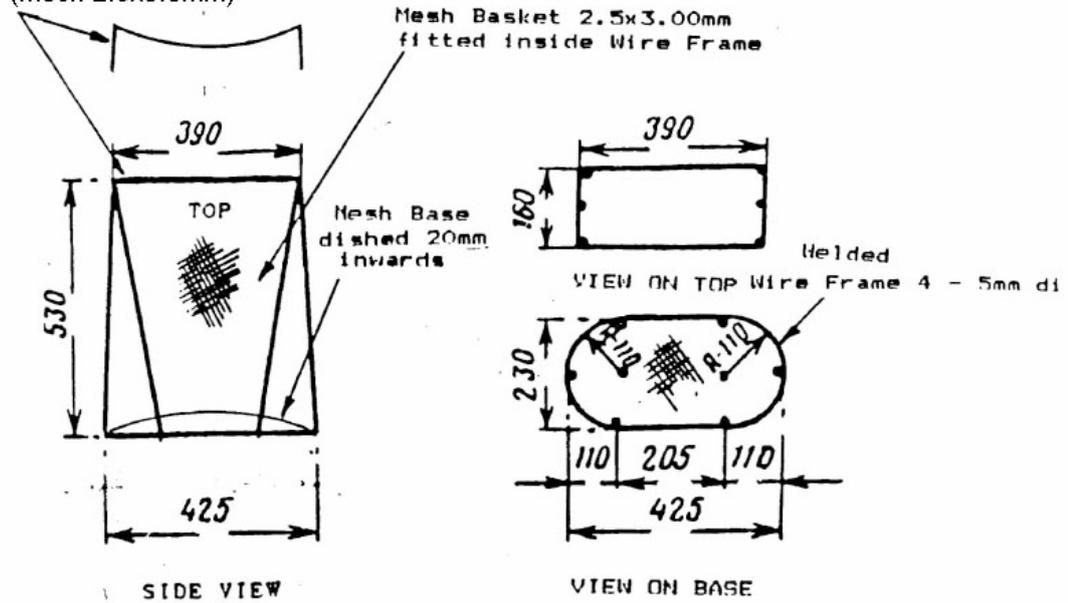
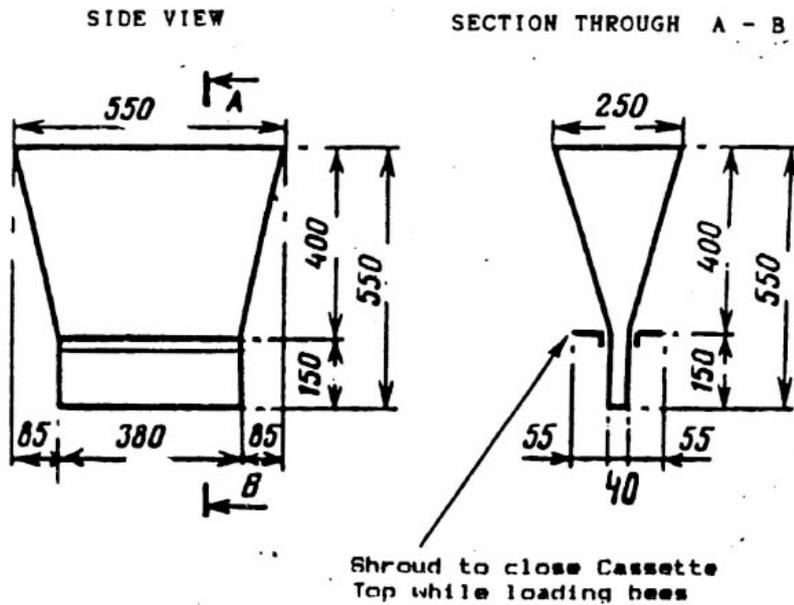


FIG 3

CONSTRUCTION OF FUNNEL
FOR LOADING BEES
INTO CASSETTE



All Sizes In Millimeters
Material - Stainless steel
or Tinned Plate