Warré Tree Hive – Warré Baumbeute

Einleitung – Warum die Warré-Baumbeute?!

Nach der Lektüre von Ian Rumsey's Texten zur Zell- und Brutnestorientierung (siehe Texte im Anhang), sowie deren Auswirkungen auf die Varroa, wollte ich dessen Erkenntnisse in die Warrébeute einfliessen lassen. Nach meinen Verständnis der Texte von Ian Rumsey lassen sich die Erkenntnisse wie folgt zusammenfassen. Die Ausrichtung und Form des Brutnestes hat Auswirkungen auf die Vermehrung der Varroamilbe. Die Milbe schlüpft von einer Zelle zur nächsten. Der Weg durch das Brutnest ist in einer Kugelform für die Milbe am kürzesten. So kann sie sich relativ schnell von einem Ende des Brutnestes zum anderen ausbreiten, ohne in Gefahr zu laufen, von den Bienen entdeckt und getötet zu werden. Die für die Milbe ungünstigste Brutnestform ist die langgestreckte Form des Brutnestes. Hier muss die Milbe den weitesten Weg zurücklegen, um sich im gesamten Brutnest auszubreiten. Der verlängerte Weg vergrößert auch die Gefahr, dass die Bienen die Milben auf diesem langen Weg entdecken und töten. Außerdem verändert sich die Wahrnehmung der Milbe, was die Verfügbarkeit und Größe des Brutnestes betrifft.

Die Zellorientierung hingegen verschlechtert die Vermehrungschancen der Milbe in den Zellen, weil der Raum überhalb der Bienenmade verengt ist und zum Zerdrücken der Milbe durch die Made führen kann.

Für eine Ausführung der oben genannten Erkenntnisse bitte ich, die im Anhang befindlichen Texte von Rumsey im Original zu lesen.

Beide Erkenntnisse sind jedoch interessant genug, um hier einen Versuch zu starten und eine Beute auf Grundlage der Warrébeute zu entwickeln, die diesen Erkenntnissen gerecht wird.

Wichtig: Diese Beute ist gerade erst ausgedacht und erbaut worden. Bezüglich der Funktionalität und Praktikabilität ist es zur Zeit nicht möglich, eine Aussage zu treffen. Es ist möglich, dass sich diese Beute als Flop erweist. Es ist ein Experiment.

Introduction – why a Warré Tree Hive?

After reading Ian Rumsey's texts about the cell orientation and natural ways of improving varroa containment (see appendage) the idea was born to combine the conclusions of Rumsey with the

Warré hive for further studying and observation. At this stage building the hive is an experiment to verify Rumsey's observations and hypothesises. Please be aware of the experimental status.

Wird die Warrébeute den von Ian Rumsey aufgestellten Anforderungen gerecht?!

Der Hauptsatz von Ian Rumsey lautet: *„A tall thin hive is therefore better than a short fat hive."*
Übersetzt: *„Eine hohe, schmale Beute ist daher besser als eine niedrige und breite Beute."*

Die Warrébeute ist an sich vertikal aufgebaut. Die Höhe der Beute ist größer als die Breite. Der Innenraum einer Warrébeute mit drei Zargen ist in etwa 90 Zentimeter hoch und 30 cm breit. Das besondere Maß der Warrébeute jedoch veranlasst die Bienen die Waben nicht durchgängig von oben nach unten zu ziehen. Somit sind die einzelnen Waben 30 cm breit und 19-20 cm hoch. Hier ist also die Höhe geringer als die Breite. Das äußert sich auch in der Ausrichtung der Zellen, die sehr unterschiedlich ausfällt. Es gibt Zellen des Spitze des Sechsecks nach oben, schräg nach links oder rechts, oder waagrecht liegen. Nach Ian Rumsey werden in einer echten vertikalen Behausung überwiegend Zellen gebaut, deren Spitzen des Sechsecks liegend / horizontal ausgerichtet sind. Das ist allen Anschein nach in einer Warrébeute noch nicht der Fall.

Der Clou der Warrébeute ist, dass die Zargen sich ohne Draht trennen lassen, da die Bienen durch das bestimmte Verhältnis von Breite und Höhe (30 cm Breite zu 20 cm Höhe) dazu angeleitet sind. Dies ermöglicht dem Imker die komfortable Imkerei mit Stabilbau ohne die Matscherei, die sonst mit Stabilbau der Fall ist. Bei der Anpassung der Warrébeute an die Anforderungen von Rumsey, soll dieser Vorteil erhalten bleiben. Daher war die Idee nicht fern, dass Verhältnis beizubehalten und nur die Maße von Höhe und Breite zu vertauschen. Somit erhält man eine Zarge, die 30cm hoch und 20 cm breit ist. Sowohl die Beute als Ganzes, als auch die einzelne Zarge ist somit vertikal ausgerichtet. Ziel des Experimentes ist, herauszufinden, ob ...

a.) ... das beibehaltene Seitenverhältnis bei Vertauschung der Maße von Höhe und Breite zum gleichen Ergebnis führen, nämlich die Teilbarkeit der Zargen ohne Verwendung von Draht

b.) ... die Orientierung der Sechsecke durchgängig in allen Zargen horizontal ist. Also die Spitzen des Sechseckes nach links und rechts zeigen. Und somit die These von Rumsey unterstützen, dass vertikale hohe Höhlungen immer zu einer solchen Zellorientierung führen

c.) ... ob die Völker mit der Position und Form des Brutnestes, sowie der Ausrichtung der Zellen weniger Schwierigkeiten mit der Varroa haben

Does the Warré hive fulfill Ian Rumsey's requirements for a good hive?!

The main thesis of Ian Rumsey is: *„A tall thin hive is therefore better than a short fat hive."*

The Warré hive is a vertical hive (it is called a vertical topbar hive for this reason as well). The orientation of the hive itself is thus vertical. But the comb inside the hive box is not vertical. The comb is broader than tall. This makes a horizontal comb inside a vertical hive. In Warré hives all orientation of cells can be found. In a „real" vertical hive, there should be horizontal cell orientation mainly. Thus the hive has to be modified to fulfill the requirements of Ian Rumsey.

One of the main advantages of the Warré hive is, that the beekeeper can lift the hive box off, without the need to use a cut wire. This is much less messy and enables easy fixed comb beekeeping.
That the bees don't interconnect the hive boxes is due to the special measurements and ratio of height and width of the hive box.

To retain the easiness of lifting off the hive box, I try to swap the measurements of height and width, but keep the ration of the both. I use 30cm (11.81 inch) for the height now and 20 cm (7,87 inch) for the width.

This way the whole hive is vertical as well as the comb inside the hive box. The experiment shall verify that...

a.) ... the swapping of the measurements of height and width but retaining the ratio will end in movable hive boxes. Thus the ratio is the reason for not connecting (Golden Cut, Fibanocci etc.)

b.) ... orientation of comb in a true vertical hive is horizontal most of the times. The tips or sharp edges of the hexagon shall show to the left and right.

c.) ... the effectiveness of the brood nest form and orientation, as well as cell orientation when it comes to varroa containment.

Die Anpassung der Warrébeute / Modifying the Warré hive

Die folgenden Bilder zeigen, wie ich die Anpassungen vorgenommen habe.
The following pictures show how I modified the hive.

Abbildung 1: Rückgrat der Beute / spine board for the hive

Weil die Höhe der Zargen größer als die Breite ist, war von Anfang an klar, dass die Beute sehr instabil stehen wird. Daher habe ich direkt ein „Rückgrat" gebaut, an dem die Beute angelehnt oder festgebunden wird. Dieses Rückgrat besteht aus zwei Dachlatten.

Because the hive box is taller than wide, it was apparent from the beginning, that some sort of support was needed. So I constructed some sort of a „spine board", which later supports the hive.

Abbildung 2: Boden / floor

Den Boden der Beute befestigte ich direkt an dem Rückgrat der Beute, damit die Zargen einen guten Stand haben. Die Konstruktion des Unterbaus habe ich jedoch zu kompliziert vorgenommen, hier ist eine einfachere Version zu empfehlen, als das Dreieck.

The hive floor I fixed at the spine board, because this way the hive boxes have a good stand. The triangular construction is too difficult, this can and should be solved more easily.

Abbildung 3: Herstellung der Zargen / build of the hive boxes

Um die Zargen herzustellen habe ich vier Bretter versetzt aufeinander genagelt. So erhielt ich eine lange Röhre, die ich anschließend in die einzelnen Zargen zersägte.

To build the hive boxes I used four wooden boards nailed onto each other. This way I got a long wooden pipe. I used a saw to cut the pipe into several hive boxes.

Abbildung 4: Hölzerne Röhre / wooden pipe

Abbildung 5: Absägen der Zargenstücke / cutting the pipe into hive boxes

Dazu habe ich jeweils 30 cm abgemessen und die Zargen von der hölzernen Röhre abgesägt.

I measured 30 cm / 11.81 inch and cut the hive boxes of the wooden pipe.

Abbildung 6: Zargen / hive boxes

Abbildung 7: Zargen aufeinander gestellt / stacked hive boxes

Das ist definitiv hoch und schmal!

This is definitely tall and thin!

Abbildung 8: Beute mit Dach / hive with roof

Die Beute in der Gesamtansicht und mit einem einfachen Dach versehen.

Overview of the hive with a simple roof on top.

Abbildung 9: Dach im Detail / detail of roof

Das Kissen der Warrébeute habe ich aus einem Stück der hölzernen Röhre realisiert. Es wird mit Heu gefüllt werden. Bei dem Dach habe ich eine einfachere Version gewählt. Durch die Seiten wird ein Spanngurt geführt, so dass das Dach mitsamt der Beute fixiert werden kann.

The quilt I made of a shorter hive box, closed with a lid and a simple roof. Through the sides I push a lashing strap that fixates both hive and roof.

Abbildung 10: Pfosten als Ständer / poles as rack

Zwei Pfosten habe ich eingegraben und eingeschlagen, die später das Rückgrat halten sollen und somit eine freistehende Beute ermöglichen sollen. Unten habe ich zwei Ziegelsteine verwendet und einen angenagelten Querbalken, auf den das Gestell / Rückgrat zu stehen kommt.

I used two dugged and rammed in poles which later hold the spine board. Two bricks and a piece of timber are used as a base the spine will placed onto. The timber is nailed to the poles.

Abbildung 11: Rückgrat an den Pfosten befestigt / spine board in place

Das Rückgrat oder den Rahmen der Beute nagelte ich dann an die Pfosten. Ich habe das Holz mit Feuer angekohlt, damit es nicht rottet. Daher ist es jetzt schwarz.

The spine board was nailed in place. I used a blowtorch to burn the wood to make it resistant so it doesn't get rotten to fast. This is why it is black.

Abbildung 12: Aufgestellte Beute / hive in place

Die Beute ist aufgestellt. Die vom Wetter stark beanspruchten Teile (Boden und Dach) wurden mit einer bienenfreundlichen Farbe angestrichen. Schöner, trockener und windstiller Standplatz unter Bäumen.

The completed hive. The roof and floor which are stressed most got a beefriendly painting. The lashing strap is in place. Calm, dry and shady spot below trees.

Abbildung 14: Detail des Bodens / detail of floor

Abbildung 13: Detail Dach / detail of roof

Die Beute ist aufgestellt und wartet nun geduldig auf die Bewohner. Wahrscheinlich wird sie erst im Jahr 2009 mit einem Schwarm besiedelt. Ich habe die Zargen von oben nach unten durchnummeriert, damit ich die zueinander gehörenden Zargen besser zusammenstellen kann. Aufgrund dessen, dass ich von Hand säge, sind die Schnittkanten sehr „individuell“ (sprich schief).

The hive is now in place and awaits the bees to come. Most probably the bees will move in by a swarm in 2009. I numbered the hive boxes, so I can reassemble the hive in the proper order, which is necessary because of the cutting by hand. Which in turn produces asymmetric edges.

Das war es bis jetzt. Das Experiment kann beginnen. / That's all for now. Let the experiment start.

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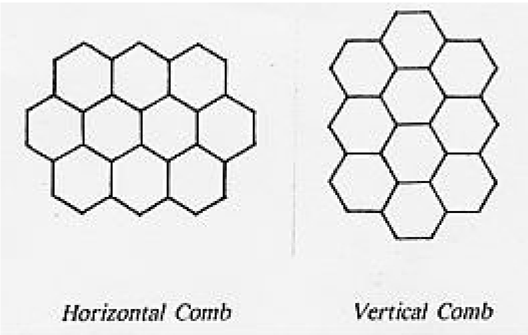
Anhang /Appendage

INVESTIGATION INTO NATURAL COMB

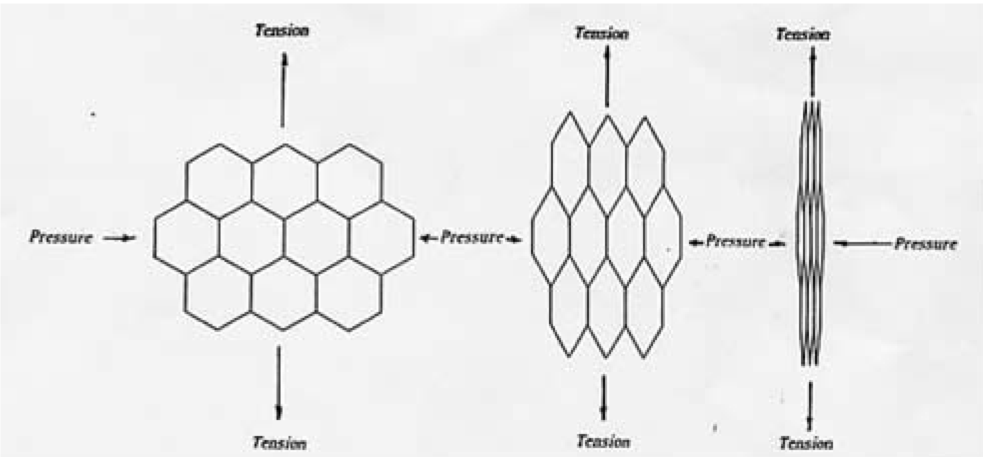
Horizontal and Vertical Comb

Horizontal comb is said to occur when the apex of the hexagon cell is at the top. Vertical comb has the apex of the hexagon at the side and is in fact horizontal comb rotated through 90 degrees.

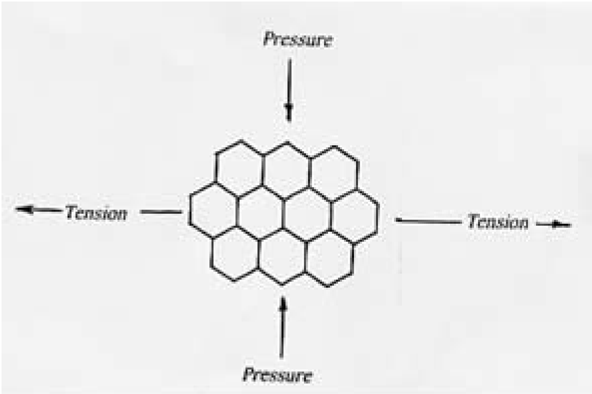


The shape of the hexagon enables it to withstand externally applied tensions and pressures in contrasting degree, dependent upon the orientation of the apex.

From the diagram below it may be seen that tension applied vertically and pressure applied horizontally would flatten and elongate horizontal comb.

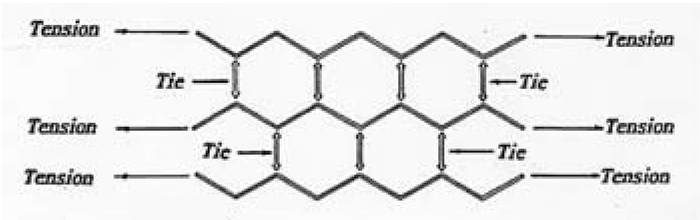


However a reversal of these tensions and pressures would permit the hexagon to more readily retain its shape.



This is due to the horizontal zig-zag component of the hexagon matrix being restricted regarding stretching and flattening as the vertical ties prevent the parallel zig-zag components moving apart in an opposite direction.

A state of equilibrium is obtained and the hexagon shape is maintained.



It is clear therefore that to avoid cell distortion in natural comb the hexagon cells must be orientated in such a way as to withstand the internal tension exerted within the brood nest area.

Ian Rumsey

Cell Orientation

To understand the finer points concerning natural comb construction, let us consult the master of this art, the designer of the structure, the manufacturer of the actual material, namely the bee, and also compare their knowledge and ability with our own mechanical theory. Two different types of mind may obtain the same solution.

The brood-nest area is encircled with stores which supply the circumference with a rigid framework. The shape of the brood-nest, with our theory, should decree the distortional stresses and in consequence the cell orientation.

Let us take a rope, suspended say between two poles 30 feet apart. It would form a catenary, and the tighter the rope the more shallow the catenary would become. The rope would be under tension in the horizontal plain and there is no need for any intermediate vertical support to aid suspension. We will now envisage the rope as an arrangement of hexagon cells, and to withstand such tension, the hexagon would require to be orientated with the apex at the top. It would follow that where the brood-nest was much wider than it is deep a similar orientation would be required to avoid distortion. The bees understand this and build horizontal comb accordingly.

Ropes may be suspended down wells, here the tension in the rope would be vertical and hexagon cells representing the rope would require the apex to be at the side to now withstand the vertical tension. Upon this example bees building natural comb in tall narrow cavities would experience vertical tension and be expected to produce vertical comb. They comply.

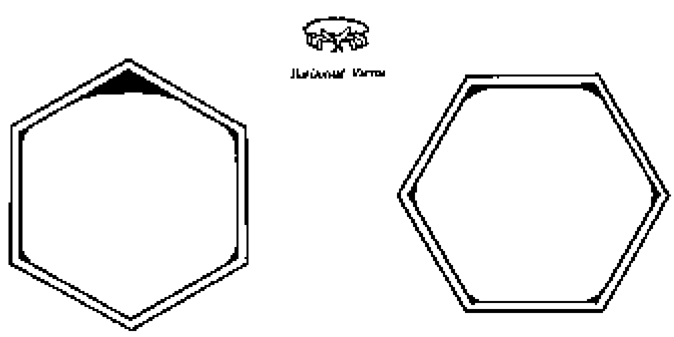
May I suggest that bees appreciated the mechanics of hexagon structures before we could count to ten.
Wax foundation, being produced as horizontal comb, prevents vertical comb being present within the hive, whereas natural comb in feral colonies very often produces brood-nests comprising of vertical comb. Feral colonies appear to survive in areas of varroa infestation; colonies containing vertical comb. Perhaps consideration should now be given as to whether vertical comb may be detrimental to varroa reproduction.

Varroa and Cell Orientation

The presence of vertical comb in the brood-nest of a feral colony is quite commonplace. The question therefore arises as to whether this type of comb is in someway detrimental to varroa reproduction.
It is general knowledge that the mite when entering the cell prior to capping, hides behind the larva which is curled up at the far end of the cell. It is also accepted that if a visiting nurse bee observes the mite in the cell prior to hiding behind the larva, the bee will remove the varroa. This is a period of danger for the varroa.

Although the varroa is deemed to have some aquatic ability regarding bee milk I feel that the attempt to pass between the larva and the cell wall would be made where the conditions were the most favourable, namely where it is dry and the pressure is least. The pressure between the larva and the cell wall is greatest at the bottom of the cell due to gravity and the weight of the larva. The pressure is least at the top.

With horizontal comb, with the apex at the top, a small triangular space occurs above the larva and the mite therefore may gain easy access. The conditions are also dry.
Where vertical comb is present and the flat portion of the hexagon is uppermost this ease of access is no longer available. Diagram refers.



Horizontal Comb *Vertical Comb*

The longer the time that the varroa takes to hide itself, the greater the likelihood becomes of a nurse bee inspecting the cell and removing the mite.

Experiments are currently being undertaken to test this theory as to whether cell infestation is less when vertical comb is present.

It is interesting to note that the pressure between the cell wall and the larva may also be increased, and no doubt cause a similar effect, by decreasing the size of the cell, or by introducing a queen mated, or bred from, a slightly larger strain.

In the insect world there are numerous instances where the parasite is aware of its host's location, which with only our senses, would appear impossible.

J.H.Fabre has been consulted and is of the same opinion.

A parasite wishing to lay its egg adjacent to its host's larva achieves its purpose because it can detect the location, age and health of the larva through the equivalent of a brick wall. The senses the parasite uses are beyond our comprehension or even acknowledgement. Although varroa are not insects, there is no reason why they should not also have this parasitic capability.

Varroa do not just turn up prior to capping by pure chance, and with this ability they would be aware of the position, age and health of every larva in the hive, and could map their course accordingly. If this were the case, regular manipulation of brood frames, where the frames are reshuffled rather than replaced in their former position, would confuse both bees and varroa which would be detrimental to the varroa regarding nest site location.

The confusion to the bee is difficult to quantify, but 'chewing out' may be a sign that the bees are not happy with the new brood nest shape and are rearranging matters more to their liking. Whether the penetration of this special awareness is effected by the presence of metal, such as a sheet of queen excluder, is open to further speculation. In fact queen excluder may already play an important roll in varroa reproduction in two ways.

(1) Varroa bred in drone cells that remain on the drones after emergence from the cell will be retained in the brood nest area due to the queen excluder.

(2) The queen excluder would act as a safety net for groomed varroa formally attached to worker bees operating in the upper part of the hive.

Not only may varroa have this special awareness of the bee, the bee may also have a special awareness of the varroa.

It is dark within the cell, so the bee's recognition of the varroa will not be ocular, but by this special awareness that can identify other life forms through intervening material. However, this awareness apparently will not penetrate through the life form of the larva, and in consequence the life form of the varroa remains undetected.

It is also equally possible that the varroa knows that it will be seen by the bee unless it hides its life form behind the life form of the larva. The varroa is aware of the bee's awareness, but are we aware of the varroa's awareness; I think not.

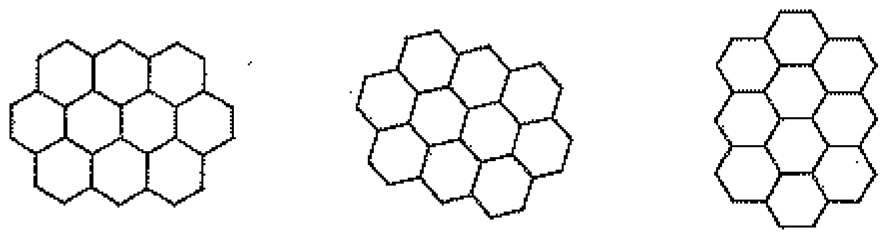
Comb Betwixt Between

Bees being bees, and nature being nature, there also occurs natural comb which is a variation between the horizontal and vertical arrangement.

As previously explained, vertical comb is just horizontal comb turned through 90 degrees, but in actual fact due to the hexagon shape, the rotation need only be 30 degrees to achieve the same result. If one took this rotation at one degree at a time there would be a further 29 variations of comb orientation between horizontal and vertical comb.

This third type of comb clearly exists, it occurs quite regularly, and appears to the eye as horizontal comb with a downward slope.

If our theory regarding distortional stresses within the brood-nest is valid, then application of this theory should provide a reason for the existence of this comb which is betwixt between. Diagram refers.



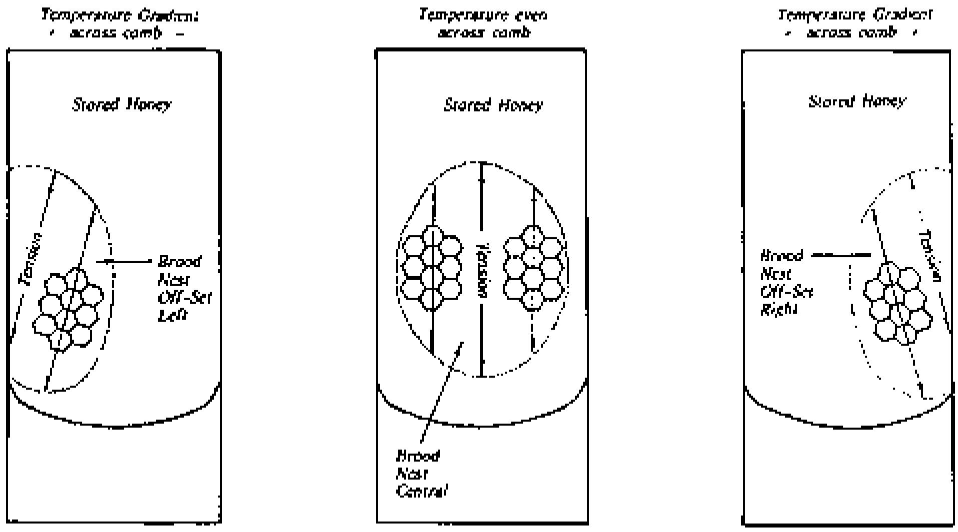
Horizontal Comb

Betwixt Between

Vertical Comb

Consider a brood-nest that is not centrally placed within the comb and is altogether over to one side, to the extent that one side of the brood-nest directly abuts the frame or cavity wall. There are no cells containing sealed stores on this side, the rigid framework surrounding the brood-nest has been broken. The stresses now inside this area are neither totally vertical or horizontal but somewhere in between.

To compensate for this, bees re-orientated their cell construction to the alignment of the revised direction of tension. Diagram refers.



So, why should bees build a brood-nest not centrally placed within the comb but over to one side? May I suggest temperature variation. When comb is placed so that a temperature gradient occurs across its surface, the brood-nest may well be positioned towards the warmest edge. This theory is easily proved by observing the presence of comb with such a slope and noting whether the slope is down toward the warmer position within the hive, and that the brood-nest is in fact off-set also in this direction.

Even with these structural variations being available, the queen cannot afford to lay her eggs in total disregard to the loading of the brood-nest area. An example of the queen's balanced method of brood expansion may be seen in Herrod- Hempsall's book 'Beekeeping New and Old' pages 429/430 which includes 17 photographs clearly showing this careful management.
As one might expect with these structural considerations in mind, the larger and heavier drone cells are placed along the underside of the brood-nest area thus again minimizing possible cell distortion. Has there been a lot of thought put into the manufacture of feral colony comb which takes all these factors into consideration?

Is this thought undertaken prior to actual commencement of comb construction? Does the comb construction reflect the unique environmental conditions for each feral colony? and become a permanent record of joint information that has been collected and acted upon by a group of individuals?

The evidence is there, unbelievable, or unacceptable, as it may be.

The final chapter of T.W.Cowen's book " The Honey Bee " is entitled " Wax and Comb Construction" which is concluded by a quotation by Lord Brougham. The second sentence of this quotation reads – Not a step can we take in any direction without perceiving the most extraordinary traces of design. This I feel includes the construction of natural comb.

Ian Rumsey

NATURAL WAYS OF IMPROVING VARROA CONTAINMENT

THE IMPORTANCE OF THE SHAPE AND THE POSITION OF THE BROOD-NEST

The brood-nest of a colony, when contained by queen excluder, and housed in a conventional hive, will be oval in shape with the major axis horizontal.

Feral colonies however build natural comb to the limits of the cavity they have chosen for their home. The comb shape, and in consequence the brood-nest shape, will vary considerably from that imposed upon them by beekeepers, and in some cases, in a feral colony, the brood-nest may be found to be oval, but with the major axis vertical.

This at first glance would not suggest a situation that was detrimental to the reproduction of varroa, but let us consider the matter further.

It is an accepted fact that bees will groom varroa to some degree, although the apparent effectiveness of this ability is dependent upon the position of the entrance relative to the floor, the type of floor in use, and the space available beneath the underside of the comb.

The degree of grooming experienced by varroa is proportional to the distance they travel away from future suitable nest sites before their desire to recommence reproduction occurs.

Any increase therefore in this distance would be of benefit to the bee and of detriment to the varroa.

Such increase may be accomplished in three ways -

(1). By the change of brood-nest shape from circular to oval.
(2). By the orientation of the oval brood-nest from major axis horizontal to major axis vertical.
(3). By positioning of the vertical oval brood-nest in such a way as to maximize the distance between storage comb and the brood comb.

THE SHAPE OF THE BROOD NEST

Let us first consider a fish in a square pond 2ft by 2ft providing a surface area of 4 square ft. Our fish likes eating flies and to satisfy this natural demand we will allow one fly to land randomly somewhere on the surface. The furthest distance the fish and fly can be apart is when they are in diagonally opposite corners.

The fish understands this and positions itself in the centre of the pond, so the most it must now travel is 1.414 ft.

We will now place our fish into a pond 4 ft by 1 ft thus retaining the same surface area. The distances now travelled by the fish to catch his fly have increased. Even when he stations himself in the middle of the pond he may be as much as 2.06 ft away from the unsuspecting fly, an increase of 46 percent.

A pond 8 ft long and only 6 inches wide increases this distance by 183 percent which is quite an advantage to the fly.

Clearly the longer and narrower the pond becomes the greater the distances the fish may have to swim to obtain his fly.

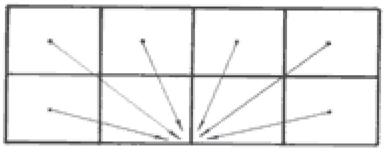
Returning to beekeeping, we will now consider a circular brood-nest with one worker cell waiting to be capped. One varroa is introduced, placed randomly within this area. The distance between the cell and the varroa may be as great as the diameter of the circle, or much less.

Let us now compare this with an oval brood nest of the same area but 4 times longer than it is wide. Like the fish in a retangular pond, the varroa will find that the maximum travelling distance has increased together with the possibility of being groomed.

It is therefore illustrated that varroa may more readily infest a worker brood cell situated in a brood nest that is circular, rather than one which is of oval construction.

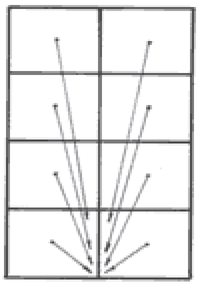
BROOD-NEST ORIENTATION

Fig 1



A

Fig 2



B

Let us now consider the orientation of the oval brood-nest. We will assume that the eight squares in Fig 1 represent a frame of comb in the brood- nest and Fig 2 is the same frame rotated through 90 degrees. In Fig 1 the distances from the centre of each square to point A are measured and compared with similar measurements taken to point B in Fig 2 .It will be found that the distances to point B are 40 percent greater than those measured to point A.

This 40 percent figure applies when the rectangle is twice as long as it is deep. When the rectangle is three times longer than it is deep and similar measurements are taken this percentage increases to 60.

Where the bees are evenly distributed throughout the brood area and the varroa are evenly distributed amongst the bees, it would be reasonable to suggest that a brood frame which is twice as long than it is deep, when rotated through 90 degrees, would enhance the distances varroa require to travel to reach drone brood when they are located at the bottom of the frame.

The increased distance of 40 percent lengthens the time the varroa is liable to be groomed which would increase the varroa drop accordingly.

This benefit may be further enhanced to 60 percent by increasing the depth/length ratio from 2-1 to

3-1. An oval brood-nest therefore when orientated with the major axis vertical would again be of advantage to the bee.

HIVE SHAPE

Finally let us consider the shape of an actual hive which consists of a brood box 2ft x 2ft and 1ft deep, a super also 2ft x 2ft and 1ft deep, with queen excluder in between.

We will assume that the bees are evenly distributed throughout the hive and that the phoretic mites are evenly distributed amongst the bees. Under these circumstances the centre of the brood-nest may be taken to be half-way up the brood box, 6 inches above the floor level. The centre of the mass of bees may be taken as 1ft above floor level. The distance between these two masses is 6 inches and is indicative of the average distance between the phoretic mites and the brood-nest.

Keeping the hive capacity the same, let us now envisage a brood box 1ft x 1ft and 4ft deep with a super also 1ft x 1ft and 4ft deep, positioned on top, again with queen excluder in between.The distance between the centre of the brood-nest and the centre of the mass of bees has now increased from 6 inches to 2ft. The travelling distance of the mites to possible nest sites has increased by 400 percent, again to the detriment of the varroa.

A tall thin hive is therefore better than a short fat hive.

So to summarize. The shape of the hive increases varroa travelling distances and in consequence increases grooming opportunities in three ways.

(1) Provision of an oval brood-nest instead of circular.
(2) Orientation of the oval brood-nest so that the major axis is vertical.
(3) Provision of a tall narrow volume for colony occupation.

There may be in fact a fourth and even a fifth advantage.

If varroa have a sense of awareness of the location of suitable nest sites, this awareness must have some limiting range and a falling off of accuracy at its upper limit, so the distance between host and parasite is of importance.

Also viewing suitable nest sites ‘end on’ to the oval brood-nest would result in a smaller surface area being scanned which would reduce the attraction and increase multiple mite cell infestation as it would appear, to the mites, that fewer cells were available for occupation.

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