

Research 3.2. Existing Wisdom

A.Migrating Beekeeping

The only discernible advantage of traditional hives over the ZEST is that they can be more easily bundled up and carried off to another site where they can collect honey and provide pollination services. Is it wise though, to do so?

In the U.S.A. migration is carried out three times during a year in big trucks on long roads between Florida, Washington and California. Accidents happen and diseases are spread.

It is not finally proven that all this trucking about is bad for bees, but there is strong circumstantial evidence to that effect. It is certainly true that diseases are spread rapidly by migrating bees and is likely to be exacerbated by the stress of doing so.

The primary reason for migrating beekeeping is the capital cost of the hives. An income from pollination can be obtained by moving them 3 times in a year so the capital cost of the hives can be recovered and livings made.

If an economical hive such as the ZEST hive was available, it would be more expensive to move bees than to provide permanent colonies at each of the migration sites. A ZEST is about a third of the cost for the same comb face area than for traditional hives.

Diversity under planting of bee forage for when the pollination crop was not in flower would resolve the negative effects on bee health of living in a short term monoculture crop. Almond and citrus groves could be under planted with a variety of bee forage plants for before and after the pollination crop flowers, but not during. It would be a simple matter to take the honey once a year. The ZEST hives would be non-migratory not only for the financial reason that they are too cheap to bother moving, but because it cannot be picked up and moved without falling apart. This is a big deterrent. If a cheap, not easily moved hive such as the ZEST hive was designated as a national standard this would raise beekeepers confidence in it.

This would bring positive results for bees, beekeepers and fruit farmers requiring pollination services. If the farmer provided the ZEST hives which are "letalone" he might even be able to sell the honey taking rights rather than having to pay for pollination services.

B.Swarm Control

Hive management includes the concept of "swarm control". Swarms are seen as a bad thing, because it reduces the honey take as bees are lost. Swarming is caused by c), g), h) and k) in the "bees want" list in Chapter 2 (objectives) the Brief.

- c) Fill the Universe with their kind.
- g) Be kept busy doing productive things such as drawing wax.
- h) Not be overcrowded, but to have a compact brood nest.
- k) Not to have pollen or honey blocks preventing the Queen laying eggs.

In a world where bee colony numbers are declining, the concept of “swarm control” has become a misnomer. We now need an easy “swarm inducing” system in place that does not reduce the honey take and becomes a seamless part of a positive management technique. For this go to the Queen out-breeding section of the Management Chapter.

C.The Search for the Holy Grail “Hygienic” Bee.

Considerable time and effort has been, and continues to be, devoted to the task of breeding "hygienic" bees that can dispel varroa naturally, but there is nothing to show for it. Indeed, if anyone can show me any species that has evolved to rid itself of a parasite, I will show you a cheerful chiropractor. It always seems to be just one more research grant away. Selective breeding of animals has value when contained by fences, but when they cannot be, it has none. Artificial selection based on the perceived "hygienic" behaviour of clearing out brood killed by freezing is not logical.

The criteria for selection by breeding is the speed at which the bees clear out killed brood, but the varroa mite does not wish to kill the brood (like any sensible parasite), but lives on it. The speed at which the bees clear out the dead brood is not a measure of "hygienic" behaviour. It is a measure of all the variable factors associated with one colony over another, such as strength, season, position of frame, need for frame space, age profile and other diseases present.

Let us assume for a moment that it was possible to breed a "hygienic" bee that cleared out pupa infected with varroa. It would need to be bred in an isolated apiary of which there are few.....and mostly abroad. How could this "hygienic" bee then be introduced into the outside world of beekeeping?

If simply released, the first cross colonies will be infected with “unhygienic” qualities brought by “unhygienic” wild drones, which will die out without treatment. A colony cannot be half alive or dead. A colony must be treated or it must not. If it is treated natural selection cannot take over. If it is not treated it will die. Natural selection requires the survival of the fittest. There is no sign of that happening and every "cross" will reduce the "hygienic" quality, if indeed it ever truly existed.

Would other bee colonies therefore be culled before the "hygienic" bee was introduced into an area? To ensure that there were no other “unhygienic” feral colony drones to "cross out" any "hygienic" qualities. Would there be a two year moratorium on honeybees in that area? The logistics of such a "hygienic" bee introduction program would be immense and bound to fail. Recalcitrant beekeepers would need to be shot at dawn together with their bees.

If a "hygienic" honeybee was successfully introduced, genetic diversity would be reduced to that of the first "hygienic" bee which would then fill the world with its kind. Such loss of genetic diversity may be a serious matter that would leave the bee population vulnerable to other passing pathogens. We may then look back with fondness on a lost world, albeit infected with Varroa.

D.The Waggle Tail Dance.

The generally accepted reason for the waggle dance may be wrong. It could just be a case of post decision rationalisation which beginners readily accept as received wisdom, before they are able to judge its efficacy. It is accepted that bees dance, since we have all seen it. There must be a reason, but if not to give direction and distance to forage then what could it be for?

Suspensions about the veracity of the waggle tail as a method of communicating the location of forage is based on a number of observations

1. Each dance can vary in direction over the dance duration.
2. When the frame is held horizontal the bees carry on doing the dance.
3. A triangular dance is sometimes seen. What is this for?
4. Direction to forage is not needed if a line is followed and then found by olfaction. Why worry about distance.
5. What is the scale of dance to distance to forage? Is it based on time spent travelling or distance covered? Bees have neither watches nor a tape measure.
6. This information is all conveyed in a dark hive. How?

The dance may **not be the direct cause of the effect** of bees foraging where they would not otherwise do so. The dance may be to attract a crowd in a noisy and dark hive by vibrating comb rather like a town crier's bell. The dance may be the precursor to giving directions to a group of dance followers by antenna touching (or some other method).

If so, antenna touching must be described as a language in which abstract concepts required for giving directions is possible, as in humans.

Human language operates at two levels. "One to one" and "One to many". Bees may do the same. "One to one" may involve 2 bees touching antenna. This is seen often, but we can only speculate about the reason if not associated with the waggle dance.

The dance, by attracting followers "one to many" would remove the element of "Chinese whispers" inherent in passing on information on a "one to one" hierarchical or cascade basis. The dancer may tell all those followers who report for forage duty by antenna touching to give directions.

Human language uses the two way process of thought-speech-hearing-thought and requires a range of sounds between speech and hearing to convey meaning. The English language has 46 phonetic sounds and is sufficient for the language of Shakespeare. Bees would probably need less.

A bee language conveyed by antenna touching may operate at the ultrasound level, but there is little evidence that this exists in honey bees, although it can be concealed in a tube such as an antenna and be undetectable. Radio waves are another option, but would require a "crystal set" structure involving vibrating hairs as a receiver and a mineral as a transducer. (def: it converts one form of energy into another, eg mechanical to electrical and vice versa). A transmitter at a distance

(perhaps the antenna pore plates) would require an electrical discharge of considerable power which does not seem available to bees. Language may be sent in another way such as *in extremis* direct "download" of experience by antenna touching. It may even be a language based on smell receipt and detection. Bees can differentiate many more than 46 (phonetic) smells.

We know that bee antenna have hairs on their antenna, as humans have in their ears for hearing. In humans these act as transducers to receive vibration impulses which are transmitted to the brain and interpreted as sound. The anatomy of bee antennae includes pore plates, hairs and a segmented exoskeleton. This structure is surely capable of conveying **abstract** meaning by an antenna touching sign language.

I am neither alone nor part of a majority among beekeepers in suggesting that the conventional reason for the waggle tail dance is wrong. An article by Caroline Williams (features editor) in New Scientist of the 19/09/2009 also raised doubts. I have a suspicion that Karl von Frisch's theory is a post decision rationalisation that has become accepted wisdom. Bee researchers certainly spend a lot of valuable time on it.

It is a conventional belief among beekeepers that the waggle tail dance is a "run", but in reality it is a "stand". See "The Buzz About Bees" by Jurgen Tautz. On page 95 Mr. Tautz states that dancers only move one or two steps to get a better grip. It is an optical illusion that it is a "run". A dancing bee has an audience of dance followers whose antenna are held rigidly at attention facing the dancer. Antenna touching occurs on the return runs. On Page 108 and 109 Mr. Tautz raises his own "surprising anomalies" in the logic of the waggle tail dance. He shows courage and a startling disregard for conventional wisdom. Good for him. If you want to know what they are.....buy the book. On page 99 he makes the point that it is not necessary for a bee to know the distance to a forage source, only the direction. If known the bee can fly till she finds it by olfaction. He says that distance knowledge is a luxury. Darwin excludes luxury.

On Page 106 Mr. Tautz states:

"While the message about the location of the food source is most likely received over the antenna an important link in the procedure is missing. How do interested bees find dancers on the busy, crowded and dark dance floor?"

That link may commence by comb vibration acting like a town criers bell. It may be no more than a plea to listen by vibrating the comb. The more efficient the vibration is, the greater the audience is that seems to turn up. The most efficient dances are on open cells where a proper grip can be obtained.

On page 101 Mr Tautz refers to the experiment where dancer bees have previously flown down a deception tunnel which deceives the bee into thinking she has flown much farther than she has. He concludes that:

"It explained and settled the decade-long controversy about the waggle dance, in which it was disputed whether or not the recruited bees followed the information coded in the waggle tail dance. The tunnel enabled one to produce bees that made errors, visiting feeding sites 6m. away from the hive, but in their dance signalling a

*distance 30 times longer. Searching recruits were not found flying around where the dancing bee really came from, but in an area much further away where there was nothing of interest. **Information from the dance is (therefore) used**".*

This may not be the correct conclusion. It may mean that the information has indeed been transferred, but not necessarily by the waggle tail dance.

Harvey J. Gold said on the subject of Mathematical Modelling of Biological Systems.

"The result of a mathematical development should be continuously checked against one's own intuition about what constitutes reasonable biological behaviour. When such a check reveals disagreement, then the following possibilities must be considered:

- a) A mistake has been made in the formal mathematical development.*
- b) The starting assumptions are incorrect and/or constitute a too drastic oversimplification.*
- c) One's own intuition about the biological field is inadequately developed.*
- d) A penetrating new principle has been discovered.*

Does the waggle tail dance constitute reasonable biological behaviour to direct dance followers to forage? It is inaccurate, sequentially variable, unseen in the dark and done on horizontal surfaces, negating its association with gravity. It is less than totally believable.

The organisation seen in a colony of bees cannot reasonably be expected to be carried out by the waggle tail dance, pheromones, olfaction and instinct alone. A bee language capable of conveying **abstract** thoughts would explain much about unexplained bee behaviour.

Honey bees have had 30 million years to develop language which would improve efficiency and therefore survivability. If the laws of the physical universe and Darwinian rules do not exclude the possibility of a language it is highly likely, if not a certainty, that it has evolved.

In support of the theory of bee language there appears to be a collective memory (knowledge handed down) in a bee colony such as bees building queen cells. They may have never seen or made one before. To say that this is just instinct is to use the word as the dumping ground for the "not understood". Bees have good memory and knowledge may be passed down. This again suggests language. *Googling the key words olfaction, electrostatics, electret, chemosensillae to see that an electrostatic charge is present in the pore plates on the bees antenna. This is from a paper by Eric H. Erickson Jr. published in 1982. He speculates that it is present to attract molecules to improve olfaction. It may do this, but its presence may also bring other uses such as language transmission.*

Googling "Dynamic range compression in the honeybee auditory system toward waggle dance sounds" also reveals a paper that infers the possibility of a language capable of conveying and receiving abstract concepts, yet then struggles to fit its findings to the waggle dance as a language.

It seems that further analysis of the tactile behaviours of bee antennae on returning from foraging and dancing needs to be video analysed frame by frame in order to identify any patterns that suggest a language. Is the antenna touching after the waggle tail dance consistent, yet different from the touching that occurs at other times and other circumstances may be the first question.

To determine whether a language based on antenna touching does indeed exist in honey bees, evidence may lay in the antenna touching ritual being the same between different bees when they are conveying the same information to each other. If it is seen that a dancing bee conducts the same antenna touching ritual with more than one dance follower it should be assumed that the same ritual carries the same information regarding direction and distance to forage.

A similar assumption can be made regarding the antenna touching that occurs between a guard bee and a bee seeking entry to the hive.

Jurgen Tautz in his first class book draws similarities with bees and mammal behaviour giving them nominal mammal status. If a language is part of the bee repertoire he could have been bolder.

Less mammal, more Homo Sapiens.

Written by Bill Summers

Edited by Mrs. Susan Ferguson (BSc. Hons. Zoology)

Mr. Stuart Ferguson (BSc. Chemistry)