

# Nestduftwärmebindung

## a useful hypothesis or just 'complete nonsense'?

David Heaf

I welcome the contribution to the discussion of sustainable beekeeping presented in the Summer 2019 issue by Wally Shaw, Wales BKA's Technical Officer. Despite his choice of article title – Sustainable Beekeeping (All you need to know and didn't like to ask) – I was disappointed to find nothing in the article about how the three main themes of sustainability, economic, social and environmental, apply to beekeeping. Instead, the author concentrated solely on a fourth theme of sustainability that bioethicists include with the other three when dealing with the living world, namely the husbanded animals, in this case the bees. An attempt to characterise sustainable beekeeping under all four themes can be found in to my book.<sup>1</sup> A few misconceptions might arise from Shaw's article regarding top-bar hives, especially Warrés. Therefore the present article tries to correct them and to develop our understanding of Johann Thür's concept Nestduftwärmebindung – which could be translated as the retention of nest scent and heat, and which Shaw's article attempts to rebut.

### Top-bar beekeeping

Most of his article made perfectly good sense to me, even including his criticism of the use of foundationless comb with a comb spacing larger than that commonly found in nature. He cites Warré as specifying 36 mm. The narrowest spacing I have ever found in a feral nest was in a 225 x 225 mm chimney flue where the mean distance between comb midribs was 29 mm.<sup>2</sup> Several Warré beekeepers are experimenting with 9 instead of 8 combs per box, giving a spacing of 33 mm. Shaw says that natural combs always have 31-32 mm spacing. The above observation of 29 mm obviously refutes that, as do many examples of feral combs where spacing can be as much as 40 mm.<sup>3</sup> Beekeeping, even natural beekeeping (an oxymoron), is always a compromise between nature and beekeeper convenience.

Shaw writes that inspecting combs on top-bars is a seasonal bee inspector's nightmare. But inspectors should be able to understand and inspect anything from skeps to Langs.

If a particular beekeeper does not have the necessary tools, the inspector will need a comb cutter appropriate for the type of top-bar hive, horizontal or vertical (Warré), a comb holder and a torch. For Warré combs the cutter is 'L'-shaped,<sup>4</sup> and the holder a simple 'U' frame.<sup>5</sup> Shaw rightly raises the problem of the covering of bees on the comb obstructing the view into cells. The bees are of course desperately trying to deal with the catastrophic fall in comb temperature. There is a simple way of shifting them from the area to be inspected: gently blow on it. The bees move away giving a good view into the cells.



Inspector checking a Warré comb

Given the current trend towards more apicentric beekeeping it is to be hoped that disease surveillance will eventually be modernised with the use of the non-invasive screening methods being developed, whether by microbiology, DNA analysis (PCR) or, in the much longer term, detection of disease-specific volatile organic compounds in the hive atmosphere. Foulbrood has its name for good reason!

It was top-bar hive honey producer Les Crowder who demonstrated how hard it is to infect with foulbrood a colony which does not want to be infected. When he was bee disease inspector for New Mexico he gave a comb of American foulbrood to one of his healthy colonies. It cleaned up the comb.

1. Heaf, D. J. (2010) *The Bee-friendly Beekeeper – A Sustainable Approach*. Northern Bee Books.

2. [http://www.dheaf.plus.com/beeremovals/pwllheli\\_2011.htm](http://www.dheaf.plus.com/beeremovals/pwllheli_2011.htm)

3. [http://www.dheaf.plus.com/warrebeekeeping/natural\\_comb.htm](http://www.dheaf.plus.com/warrebeekeeping/natural_comb.htm)

4. <http://warre.biobeas.com/cutter.htm>

5. <http://warre.biobeas.com/haverson.htm>

He repeated the experiment and the same happened.<sup>6</sup> This illustrates that a pathogen is a necessary but not a sufficient cause for disease.

### Warré top-bar hive

Shaw believes that using top-bar hives turns the clock back. However, he may not have been aware that the Frenchman Émile Warré's People's Hive is exactly contemporaneous with the UK's National Hive. A precursor of the National was adopted by the Ministry of Agriculture in 1920, and it became a British Standard in 1946.<sup>7</sup> There even seems to be a ring of similarity between the terms 'People's Hive' and 'National Hive'. And, of course, the Warré hive is several decades more modern than the Langstroth. Warré developed his hive early last century and the first editions of his book *Apiculture pour Tous*,<sup>8</sup> which contains plans of the hive, came out shortly after WWI. Based on experiments with 350 hives, he evolved his own from direct experience of the frame hives of Dadant, Voirnot and de Layens, all fairly common in France at that time. The 5th edition of his book, as well as presenting the top-bar version of the People's Hive, also contains the frame version, which is slightly larger. He presented both versions, he said, in order to respect the freedom of his readers. By the 12th edition, the one my wife and I translated in 2007 and published for free on the Internet, he had come down firmly on the side of the top-bar version. Since 2007, Warré's book has been translated into eight more languages.



A Warré apiary

### Post brood comb honey

Shaw sees as a further problem of top-bar hives the fact that honey is harvested from brood comb and this may be detrimental to honey quality. I have examined this claim else

6. Crowder, L. & Harrell, H. (2012) Top-bar beekeeping: organic practices for honeybee health. Chelsea Green, Vermont. p. 120.

7. <http://www.dave-cushman.net/bee/hist.html>

8. <http://warre.biobeas.com/bfa.htm>

where and thus will not use space here to present the other side of the picture.<sup>9</sup> Furthermore, in twelve seasons of harvesting post brood comb honey, I have not found any deterioration in honey quality. Customers often prefer this honey to honey spun out of supers, and they come back year after year to buy it. I have customers as far away as Leipzig who asked to buy my honey, which is treatment free, and are willing to pay the exorbitant postage to get it.



Warré honey

Furthermore, Wales' biggest organic honey packer says that his honey from African top-bar hives sells well.<sup>10</sup> Before I took up beekeeping we used to buy his honey by the seven pound tub.

Tim Malfroy, a commercial beekeeper in New South Wales, whose hives are of the Warré type and whose annual honey production weighs several tons, and exceeds the Australian Organic Standard and the International Demeter (Biodynamic) Standard for apiculture,<sup>11</sup> has found that his 'post brood polyfloral' honey is in great demand by restaurateurs in Sydney,<sup>12</sup> and 500g retails at \$AU 32.00 (£17.70).<sup>13</sup> He recently won an Australia wide award for the quality of his Warré honey – a gold medal at the delicious produce awards – which is judged by the leading chefs of Australia.

In 2015, Jennifer Hawkins of the Cardiff University School of Pharmacy and Pharmaceutical Sciences discovered that of 220 honey samples from beekeepers round the UK only

9. [http://www.dheaf.plus.com/warrebeekeeping/honey\\_from\\_brood\\_comb.pdf](http://www.dheaf.plus.com/warrebeekeeping/honey_from_brood_comb.pdf)

10. <https://www.tropicalforest.com/>

11. <http://www.naturalbeekeeping.com.au/aboutus.html>

12. <http://www.malfroygold.com.au/wildhoneyproduct.html#PBPoly>

13. <https://featherandbone.com.au/products/malfroys-gold-wild-honey-blue-mountains-world-heritage-post-brood-polyflora>

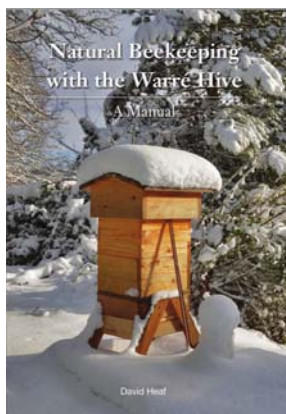


Malfroy's Gold Post Brood Polyfloral Honey

two beekeepers, one of them in Wales, supplied honey with antimicrobial properties comparable with Manuka honey.<sup>14</sup> These beekeepers were using Warré hives. A particularly striking feature of these honeys was their pollen content being an order of magnitude higher than the rest of the samples.<sup>15</sup>

My Warré honey is more turbid than honey from the supers of my only National hive. The pollen grains show clearly when a bright light is shone into it from the side. When it granulates it does so with a fine, creamy texture which I attribute to the pollen providing a high number of crystallisation nuclei.

With the growing popularity of beekeeping with the Warré hive, Northern Bee Books asked me to produce an illustrated manual which they published in 2013.



Cover of 'Natural Beekeeping with the Warré Hive – A Manual

14. Hawkins, J. (2015) Investigating Antibacterial Plant -Derived Compounds from Natural Honey. Downloadable from <http://orca.cf.ac.uk/77005/1/2015HawkinsJphd.pdf>

15. [http://www.dheaf.plus.com/warrebeekeeping/bee\\_guided\\_pharmacognosy.pdf](http://www.dheaf.plus.com/warrebeekeeping/bee_guided_pharmacognosy.pdf)

### Small cell theory

Shaw devotes a couple of paragraphs to the proposition that small cells in the brood nest help bees cope with pests and disease. In March, I updated my 2015 *Beekeepers Quarterly* review of peer-reviewed papers on this subject in relation to Varroa by including two new papers.<sup>16</sup> The number of papers reporting that small cells, i.e. about 4.9 mm diameter (between parallel wall centres) as opposed to about 5.3 mm diameter, are no help is currently in the majority by eleven to six.

Underpinning small cell theory is the idea that worker cell size was changed from about 4.9 mm to about 5.3 mm following the introduction last century of artificial foundation.<sup>17</sup> The underpinning was knocked from under the theory when Francis Saucy, now editor of *Revue Suisse d'Apiculture*, discovered from a publication by one of its proponents that they had made a 'fatal error' in calculating worker cell size from the area of a patch of comb.<sup>18</sup> The error exactly accounted for the discrepancy between the 4.9 mm and 5.3 mm sizes. Furthermore, literature reviews back to Swammerdam by Eric Zeisloff and myself show that natural worker cell average size averaged across many investigators was 5.3 mm.<sup>19</sup> And today, ongoing measurements of feral colony combs as well as foundationless combs from Warré hives show the same 5.3 mm.<sup>20</sup>

*Nestduftwärmehindung* – retention of nest scent and heat

In this German term, the Austrian beekeeper Johann Thür conceived the following:

In order efficiently to utilise this costly, life-supporting and life-giving heat, nature has enabled the bee, a super-organism comprising colony and comb, to keep the heat in, to retain it. This retained heat is a mass of warm air, impregnated with scent, and thus germ-free. It suppresses harmful bacterial activity and hinders the occurrence of diseases. [...] The warm air is not lost downwards, because it is lighter. And it is kept in at the sides and above, through the cul-de-sacs in the naturally constructed comb. Only the used air of respiration drops

16. [http://www.dheaf.plus.com/warrebeekeeping/do\\_small\\_cells\\_help\\_bees\\_cope\\_with\\_varroa.pdf](http://www.dheaf.plus.com/warrebeekeeping/do_small_cells_help_bees_cope_with_varroa.pdf)

17. Erickson, E.H., Lusby, D.A., Hoffman, G.D. & Lusby, E.W. (1990) On the size of cells – Speculations on foundation as a colony management tool. *Bee Culture*, February 1990, 98-101.

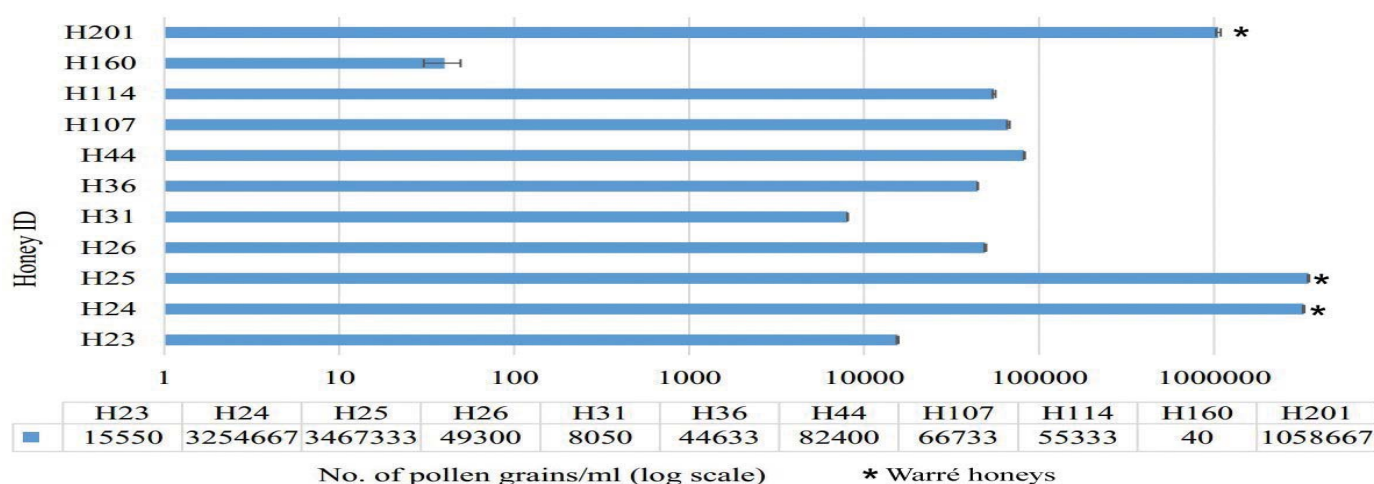
18. Saucy, F. On the natural cell size of European honey bees: a "fatal error" or distortion of historical data? *J. Apicultural Res.* 53:3, 327-336. <https://www.tandfonline.com/doi/abs/10.3896/IBRA.1.53.3.01>. Or see shorter version in *American Bee Journal* letters:

<https://tinyurl.com/y56a6jym>.

19. [http://www.dheaf.plus.com/warrebeekeeping/natural\\_cell\\_size\\_heaf.pdf](http://www.dheaf.plus.com/warrebeekeeping/natural_cell_size_heaf.pdf)

20. [http://www.dheaf.plus.com/warrebeekeeping/cell\\_size\\_measurements.htm](http://www.dheaf.plus.com/warrebeekeeping/cell_size_measurements.htm)





Pollen in honeys. Image by Jennifer Hawkins

downwards, laden with carbon dioxide, and at the open bottom margins of the comb it is exchanged with fresh circulating air. These open comb lower margins can be regarded as the mouth of a central breathing process that, with the help of the bees sealing the margins, breathes just the right amount of fresh air and organically prevents an excess penetration of cold air.

For a fuller presentation of this idea, the retention of nest scent and heat, please see my translation of two chapters from Thür's book.<sup>21</sup>

Shaw argues that *Nestduftwärmebindung* is 'complete non-sense' and can be rebutted with one word, 'homeostasis'. However, it is clear from the short extract above, and in Thür's chapters that homeostasis is implicit in Thür's concept *Nestduftwärmebindung*. An alternative, more free translation would be 'maintenance of the nest atmosphere', which sounds to me just like homeostasis. Contrary to what the name might suggest, homeostasis is never a static thing. There can be huge inputs and outputs of a particular parameter in the system. The point is that in the beehive, the bees maintain a particular parameter, be it temperature, CO2 or humidity, within limits of varying degrees of narrowness.

The maintenance of heat is usually easily understood by beekeepers. In a typical feral nest, the combs are stuck to the top of the cavity, usually in unbroken fixings, and attached to the sides of the cavity by fixings that are sometimes interrupted by what Tom Seeley calls peripheral galleries.<sup>22</sup> Round the tops and edges of the combs there is no bee space. Bee space was an invention, not a discovery, by Rev. L. L. Langstroth, for the convenience of the beekeeper. The gaps between natural combs, which are largely cul-de-sacs, help the bees keep the nest warmth in during the large part of the year, especially in the UK, when thermal loss, rather than thermal

gain, presents the greater challenge to colony survival.

Were the air flows of 50-400 L/min that Shaw cites (from an unnamed source) to be those that apply to the nest, then Thür's *Nestduftwärmebindung* hypothesis would indeed be hard to substantiate. Any beekeeper is familiar with the vacuum-cleaner like sound of a colony drying down nectar on a summer evening after a good flow. One need only put one's face to the entrance to feel the blast of warm, moist fragrant air. But those flows quoted above are almost certainly hive entrance flows and do not reflect the actual state of affairs in the brood nest, least of all in its core. As Shaw admits even the lower value is typical only for summer, the higher being for a heavy nectar flow. Furthermore, the values very likely apply to hives managed for unnaturally large populations and honey stores, through a combination of swarm suppression and supering. The values are less likely to apply to colonies in their natural or near-natural state. It is worth noting in passing that this could hold true for a significant proportion of apiological research which is done on managed colonies of bees raised and kept long-term in frame hives with thin walls. If so, the results would be a science of artefacts.

But colony ventilation does not work like a vacuum cleaner. On the contrary, as a detailed study has shown, when not drying nectar a colony breathes in and breathes out at about 2.9 breaths a minute in a way not too dissimilar to the ventilation of a vertebrate, only in the hive the expiration is active and the inspiration passive.<sup>23</sup> The tidal volume averages 147 ml which corresponds to 0.42 L/min, far lower than the Shaw's flow figures, the higher values of which probably apply to colonies under ambient heat stress. And flow rates at the edges of the inter-comb spaces are highly likely to be even lower, particularly in the cooler parts of the year when heat retention is of prime concern, especially when brood

23. Southwick, E. E. & Moritz, R. F. A. (1987) Social control of air ventilation in colonies of honey bees, *Apis mellifera*. *J. Insect Physiol.* 33(9) 623-626.

21. <http://www.users.callnetuk.com/~heaf/thur.pdf>

22. Seeley, T. D. & Morse, R. A. (1976) The nest of the honey bee (*Apis mellifera* L.) *Insectes Sociaux* 23(4), 495-512.

is being reared. So I do not think Thür's conception of the nest atmosphere is blown away by Shaw's cited air flow rates.

As regards humidity, Shaw writes: 'There are claims that high humidity (up to 80% RH) in Warré hives helps control Varroa, but we are not told the source of these claims. What is more likely is that the Warré hive and its very infrequent opening at the top allows the bees to maintain the humidity that they desire. Shaw's discussion of humidity hinges on the relative humidity needed to keep honey dry. However, absolute humidity has been found to be higher in the brood compared with in the honey stores,<sup>24</sup> and in brood cells relative humidity may need to be above 90% for optimum brood development.<sup>25</sup> Humidity, like several other hive atmosphere parameters, is very likely

finely structured three-dimensionally. Overall measurements with sensors of insufficient resolving power mask this structuring. Furthermore, it is the integrity of this

24. Human, H., Nicolson, S. W. & Dietmann, V. (2006) Do honeybees, *Apis mellifera scutellata*, regulate humidity in their nest? *Naturwissenschaften* 93, 397–401.

25. Doull KM (1976) The effects of different humidities on the hatching of the eggs of honeybees. *Apidologie* 7:61–66.

structuring that is temporarily broken when combs are removed for inspection.

**Antiseptic hive atmosphere**

In the term Nestduftwärmebindung, Thür's concept of the retention of nest scent presents the greater challenge to our understanding, even though many of us will no doubt have often savoured the wonderful aroma of a colony when opened. Thür does not enlarge on his concept. What could he have possibly meant? I will here try to offer some leads which are more of the nature of possible lines of future enquiry than existing fact. Thür appears to focus on the antiseptic properties of the hive atmosphere, so I will deal with this aspect first. It is of course very unlikely to be 'germ free', even if only because there are beneficial micro-organisms in the hive, for example the lactobacilli involved in the fermentation of pollen and the destruction of foulbrood pathogens. But there could be compounds from nectar or, more likely, propolis that are present in the hive atmosphere as vapours, aerosols or particulates. These compounds could include the essential oils found in nectar and in propolis (e.g. mono and sesquiterpenes) and the wide range of other compounds found in propo-



## www.beebasic.co.uk

*All the protection you need, and more*



**Jackets from only £40**

**Bee suits from only £50**

**Leather gloves from £14.50**

**Smokers £21**

+ bee vests, strainers, hat & veils, tools and more....



Prices subject to current VAT

FREE UK delivery on all orders

*Call us for friendly advice, a free brochure, or visit our web site*

5 Hillcrest Avenue, Pinner, Middlesex HA5 1AJ

E-mail: [sales@beebasic.co.uk](mailto:sales@beebasic.co.uk)

☎ 020 8866 3864  
9am to 6 pm except Sundays

lis, some of which have antiseptic properties, for example phenolic acids and esters, flavones, flavanones.<sup>26</sup> Whether significant amounts of compounds from nectar or propolis enter the hive atmosphere would be a matter for further research.

That the hive atmosphere may have medicinal properties is already evidenced by its use in apitherapy in Germany for treating people with serious lung problems. Patients inhale the hive atmosphere through a face mask and tube connected to the crown board.<sup>27</sup>

The hive atmosphere has been found to contain the two volatile fatty acids, formic acid and acetic acid.<sup>28</sup> Both have antimicrobial properties and formic acid is used as an acaricide. What if anything those substances are doing in the hive atmosphere has yet to be revealed.

### *Colony pheromonal structure*

Pheromones represent a further class of constituents of the hive atmosphere that are worth considering in the context of scent retention. Thür, publishing in 1946, made no reference to them. This is not surprising, as the term 'pheromone' was not coined until 1959. Shaw argues that 'the only pheromones that have high volatility are those that are used outside the hive.' Apart from the fact this statement is incorrect, as we shall see, it is clear that although the ability of a compound to enter the gaseous state, i.e. it having a satisfactory vapour pressure, no doubt affects the amount of the compound that does so, there are other factors in pheromone action such as the affinity and responsiveness of chemoreceptors on the receiver that can bring about a big response with a very small number of molecules. For example, 9-ODA, probably the best known of the queen pheromones has a vapour pressure of only 0.00000177 mm mercury (Hg) at 25°C, but if we put some of it on the end of a long fishing rod and wave it about in a drone congregation area on a sunny day, the results can be quite spectacular. How relatively low is 9-ODA's vapour pressure can be illustrated by comparing it with that of one of the alarm pheromones, isopentyl acetate, which is 4 mm Hg at 20°C, or with the more familiar substance already mentioned, acetic acid, which is 12 mm Hg at 20°C. But if 9-ODA, and the other related compounds that enhance its effect can act over tens of metres distances in the open,<sup>29</sup> we

can see how much easier it would be for them to act over the millimetre distances encountered in the cramped confines of the nest. This is not, however, intended to sideline the very important routes for pheromone transmission, namely by direct contact either bee-to-bee, or bee-to-comb.

There are at least 15 glands in the honey bee that secrete pheromones, and from some of them the list of compounds already identified runs to dozens. Altogether about 50 compounds are known to be essential to proper function of the society.<sup>30</sup> As more are being discovered, it is not unlikely that the total number of compounds involved in intra- and extra-colony chemical communication will be found to extend into three figures. Yet despite the 40 years that have elapsed since the first honey bee pheromone was identified, research into the roles of all these compounds is still in its infancy, or at best its youth. Whilst it is true that a large class of the higher molecular weight honey bee pheromones have low vapour pressures, it is clear from the foregoing example that we cannot rely on vapour pressure for playing down the role of pheromones in the properties of the nest atmosphere, including those involved in maintaining colony integrity and function. This is all the more likely for the fact that colony temperature can rise in parts to 40°C or more, which is at least 15°C higher than the temperature for which vapour pressure is commonly cited. The cosane and cosene dance pheromones are released and active in the hive atmosphere despite having vapour pressures in only the 10<sup>-7</sup> to 10<sup>-5</sup> mm Hg range.<sup>31</sup> Furthermore, there are pheromones of much higher volatility active in the nest, for example E- $\alpha$ -ocimene, a key hormone in the intimate relationship between queen and workers and between brood and workers, having a vapour pressure of 1.56 mm Hg at 25°C.<sup>32</sup>

If we keep in mind the fact that colony life goes on in the dark and the bees must rely on tactile, vibrational, acoustic and chemical signals for their communication with one another, it would appear that there is a role to play for pheromones not only in the general milieu of the nest atmosphere but also in its differentiation or structuring in three dimensions. Pheromone gradients are distributed in space and time. What comb removal and sometimes shuffling does to this structuring, if present, can only be imagined. We can be fairly sure though, that bees generally manage to put things right in a matter of hours or days.

26. Fokt, H, Pereira, A., Ferreira, A. M., Cunha A. & Aguiar C. (2010) How do bees prevent hive infections? The antimicrobial properties of propolis. In: Current Research, Technology and Education Topics in Applied Microbiology and Microbial Biotechnology. 481-493.

27. <http://apitherapy.blogspot.com/2011/07/video-treating-allergies-bronchial.html>

28. Vásaquez, A. & Olofsson, T. (2009) Lactic acid bacteria: can honey bees survive without them? Proceedings of Apimondia 2009.

29. Brockmann, A., Dietz, D., Spaethe, J. & Tautz, J. (2006) Beyond 9-ODA: sex pheromone communication in the European honey bee *Apis mellifera* L. Journal of Chemical Ecology 32, 657-667

30. Slessor, K. N., Winston, M. L., and Le Conte, Y. (2005). Pheromone communication in the honeybee (*Apis mellifera* L.). J. Chem. Ecol. 31, 2731-2745.

31. Thom C., Gilley D.C., Hooper J., Esch H.E. (2007) The scent of the waggle dance. PLoS Biology 5(9). 1862-1867.

32. Maisonnasse A., Alaux C., Beslay D., Crauser D., Gines C., Plettner E., Le Conte Y. (2010) New insights in honey bee (*Apis mellifera*) pheromone communication. Is the queen mandibular pheromone essential to the colony regulation? Frontiers in Zoology 7, 18.



**Concluding remarks**

In the light of the foregoing, I think that Thür's concept of the retention of the nest scent and heat, is of value in understanding how to optimise colony health. Nestduft-wärmebindung seems to be an alien concept to some frame beekeepers, to judge by the effort they put into rebutting it. I hope the present surrebuttal will provoke an interesting adduction by readers of further evidence and counter-evidence.

Colony endoscopy by Torben Schiffer, a colleague of Jürgen Tautz at the University of Würzburg, is beginning to show that our thin-walled, draughty frame hives are inhibiting species-specific behaviours of bees when compared with their behaviours in tree cavities.<sup>33</sup> The obvious analogy is chickens in battery cages.

In relation to his comparison of frame hives with top-bar hives, Shaw's concluding remark is: 'A quick fling with a top bar hive can be quite interesting for an experienced beekeeper but this is no way to form a lasting relationship with your bees.' Of course, beekeepers should be free to determine for

themselves what relationship they want with their bees, and to choose the hive that seems appropriate to them. Many beginners choose top-bar hives at the outset, often despite being told of the advantages of frame hives, one of which is that it is usually a lot easier to find a mentor close at hand. Most stay with their top-bar hives because they find top-bar beekeeping more satisfying. Furthermore, several commercial beekeepers world-wide have turned to the Warré hive, one of whom used to manage 2,000 Langstroths in the USA. I would like to see diversity in beekeeping rather than the uniformity that could arise from the straitjacket of Langstrothism. It is encouraging that existing diversity is being catered for by the hive manufacturers. For example, there are already several Warré hive manufacturers in the UK, including Thornes.

A huge step forward would be to see comparisons of the performance of top-bar hives with frame hives, particularly as regards colony health, by the various agencies in the bee disease industry, for example the UK's National Bee Unit. Such comparisons would need to be well resourced, and replicated in different localities to accommodate climatic and forage differences.

33. Schiffer, T. (2019) Beekeeping (R)evolution – a Species Protection Program Natural Bee Husbandry 12, 17-29. Open access: <https://tinyurl.com/y6pelx4v>. See also <https://www.youtube.com/watch?v=gUya5YxcmS0>.


## BEEFEED 2019

**ORGANIC FONDABEE**

- \* Certified organic fondant paste
- \* **NEW packaging: sealed bags 2,5kg / 70 x (5 x 2,5kg)**

**INVERTBEE**

- \* Certified liquid beefeed
- \* Ready-to-use
- \* **NEW packaging: - Sealed bags 1kg / 70 x (10 x 1kg)**



**FONDABEEFRUC**

- \* Certified fondant paste with higher level of fructose
- \* Developed for extreme weather conditions (Dry environment, hot or cold regions)
- \* **Packaging: - Sealed bags 1kg / 70 x (12 x 1kg)**  
- Sealed bags 2,5kg / 70 x (5 x 2,5kg)

**Main UK Distributor: PETER & MARIAN GUTHRIE**  
 Wyefield Apiaries, Tygwyn, Boughrood Brest,  
 Llyswen, Brecon, Powys LD3 OBQ  
 tel: 01874 754412 mobile: 07976 510366  
 Email: [marian@pdguthrie.co.uk](mailto:marian@pdguthrie.co.uk)

**Produced By:**

