Morphometric Assessment of Honey Bee Colonies for Breeding Purposes to Improve Performance

After a few years of keeping bees, one has usually collected bees from various sources including swarms of unknown origin – one's own bees may have swarmed and mated with local drones. Gradually one begins to realize how different each colony is in terms of behaviour and honey production, etc. It is then one should begin to assess one's stock over a period of a couple of seasons. Queens should be reared from the 'best' colonies and the 'bad' ones culled and replaced. A knowledge of queen rearing is obviously required and this should be obtained from reading the appropriate books (your association library may contain suitable titles) or, better still, attending a queen rearing course.

Although the indigenous British black bee (*Apis mellifera mellifera*) was not completely wiped out by the *Isle of Wight* disease during the first quarter of the last century, the strain has been much diluted by the importation of foreign bees since that time (and before). Apart from the risk of importing exotic diseases, the importation of foreign species of honey bees dilutes the genetic pool. However, evidence based on mitochondrial DNA demonstrates that stocks of honey bees unique to Britain and Ireland survive to the present day[1]. It is important to rear bees able to survive and prosper in our fickle climate, which the British bee evolving over millions of years was able to do. Bees have survived conditions as bad if not worse than we have experienced during the last few years. It would be interesting to know which 'type' of bee survived and which 'type' succumbed. My own limited experience (and information from other beekeepers) suggests that the yellow Italian type bee was worst affected and the black native type bee was least affected. Certainly one should not lament the loss of bees from disease or harsh seasons. It is part of the natural selection of evolution that culls unsuitable bees. The reasons for the increase in colony losses in recent years have yet to be established.

In listing the qualities required by our bees, honey production would be of paramount importance for why else do we keep bees? Even after a bad season we are always optimistic – next year will be better! But honey production depends on a number of factors: disease resistance, longevity, ability to winter on minimum stores, etc. Old beekeeping books suggest the British bee could winter on minimum stores compared with today's figure of 40 lb. Honey production was often high, but this was probably the result of greater forage – the reduced background forage of recent years and the introduction of crops such as oil seed rape must be accommodated by the evolutionary process. Besides factors affecting honey production, other factors must be considered. Unlike the skeppists of yesteryear, we do not want our bees to swarm excessively. It is increasingly important in this litigious age that we do not annoy the public with our hobby. **We** know the benefits of bees to pollination, but the public does not welcome Kamikaze pilots in their gardens! The *BBKA* campaign to increase government funding for research generated much positive information resulting in greater understanding and appreciation of honey bees. However, having to pay a pest controller to remove swarms from buildings etc. is not appreciated.

Pictures of beekeepers of the past working without protective clothing suggest that bees today are much more aggressive. This no doubt results from having hybrid or cross-bred bees – the African x Brazilian (‘*Killer bees*’) cross is a case in point. Although modern bee suits give excellent protection, their use can isolate the beekeeper from the mood of their bees and lead to an acceptance of aggression. But few of us have hides like leather, are masochists, wish to be cured of rheumatism, or want to dress like space astronauts! We may develop some immunity but we don’t want to be attacked every time we examine our bees – and our neighbours certainly don’t. It is not true that bad-tempered bees are necessarily better at honey production (although they may be better at guarding). Conversely, docile bees are not necessarily better at honey production. But docility is one of the qualities to breed into our bees.

The *Bee Improvement and Bee Breeders Association (BIBBA)* has for many years encouraged the breeding of native or near native bees. The following is extracted from a *BIBBA* leaflet.

Principles of Selection.

1. It is a waste of time breeding from racial hybrids as they are incapable of reproducing their qualities with any degree of consistency. It would take many years of selective breeding from such bees to make any significant progress.
2. Well-selected strains of bees of pure race out perform even the best racial hybrids.

Assessment of breeding stock is made as follows:

Performance. Here one must be wary of being influenced by performance resulting from hybrid vigour which would not be reproduced in succeeding generations.
Behavioural Characteristics. Bad temper, following, swarming, etc.
Morphometry. Measurements can be made which will indicate whether they are true for their race, capable of reproducing their desirable qualities, or whether the bees are crossbred, only capable of reproducing their qualities by remote chance.

These three aspects of selection **together** provide the basis for successful breeding.

The native British honey bee is identified by its dark colour, narrow tomenta, long abdominal hair, short proboscis and wing venation (Cubital Index and Discoidal Shift or Angle). Of these, CI and DS are perhaps the easiest for the amateur to give sufficient information for an assessment to be made. In recent years, DNA analysis has been used to reveal the ancestry of honey bee stocks, but is outside the scope of the average beekeeper.

Nowadays, there are computer based methods for wing venation analysis:

DrawWing www.drawwing.org
Beemorph www.hockerley.plus.com (free for 30 days).
CBeeWing www.cybis.se/cbeewing/download/index.htm (free trial version).

A sample of 30 bees (workers) is required. These should be taken alive from the hive and killed in the freezer. A wing from each bee is removed – either the left or the right wing, but they should all be the same. These are mounted on 35 mm glass photographic slides using strips of double sided tape. Three rows of five wings can be mounted on one slide (i.e. half a sample). To use the computer program, the mounted wings are scanned using a slide scanner and saved in a computer file. The file is opened and the curser is positioned sequentially over the vein junctions on each wing and the mouse clicked on each point. When all the wings in a sample have been recorded, the two wing indices will be plotted as a graph.

When all (or most) of the points lie below the 2.0 cubital index line and are in the negative discoidal shift area, the sample is of *Apis mellifera mellifera*. Morphometry does not distinguish between true native bees and bees of the *mellifera* subspecies that have been imported – DNA analysis would be required. When the points are widely dispersed, the sample shows a crossing of two or more sub-species of bees. A sample of the Italian bee (*Apis mellifera ligustica*) would have points above the 2.0 CI line and in the positive DS area.

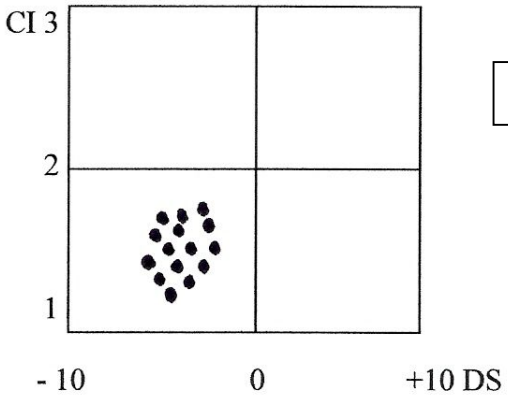
This can only be a brief outline of morphometric measurements. Attending a practical morphometry course is worth a thousand words[2]. It should be emphasised that such measurements are not used in isolation, but always in conjunction with an assessment of performance and behaviour. Assess your colonies over a period of time, cull the worst queens and breed from your best. It is essential that a written record of colony performance is kept. Morphometry will enable you to decide whether the qualities you want in your bees will be reproduced with a degree of consistency. Work with other beekeepers in your area on a breeding programme – in this way, some control over matings can be achieved. Do not introduce foreign strains of bees. Remember, if you buy a hybrid queen you will always need to buy replacements from the supplier. Even more important is the effect of cross-matings on temper. We should not tolerate bad tempered bees - and the public will not.

I recommend reading *Breeding Techniques and Selection for Breeding of the Honeybee* by Friedrich Ruttner[3]. Much of the information about morphometry comes from Germany and a detailed account of the methods is included in this book. Many years ago, Germany faced the same problems that we now experience and bee breeding has undoubtedly brought about significant change.

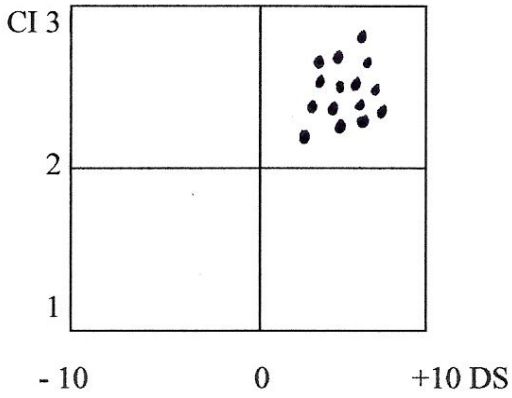
References:

1. *Honey bee conservation in the 21st century* by Dr Dorian Pritchard: *Bee Craft* March 2006.
2. *BIBBA* runs morphometry courses: www.bibba.com
3. Published by *BIBBA*.

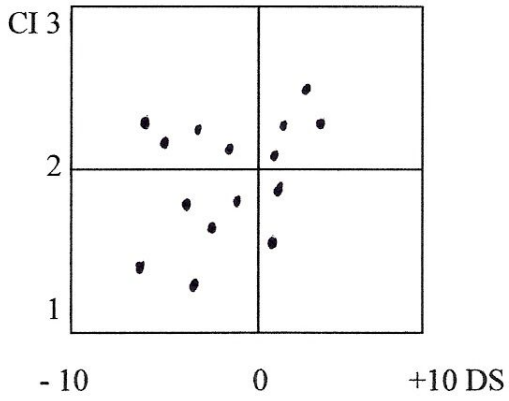
The type of graph generated by the computer program will vary. The following graphs show typical results. The positions of the points indicate the sub-species and the tightness of the grouping indicates the degree of purity.



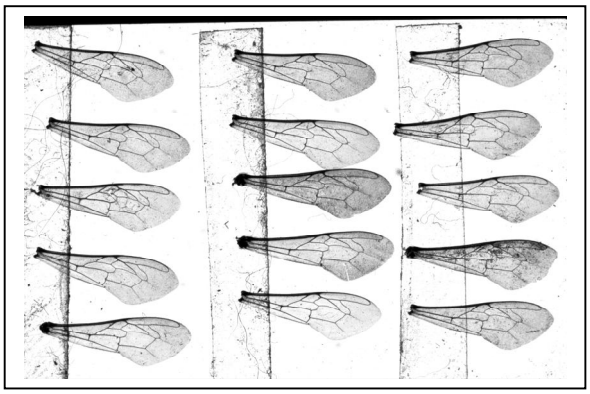
Dark European – *Apis mellifera mellifera.*



Italian – *A. m. ligustica.*



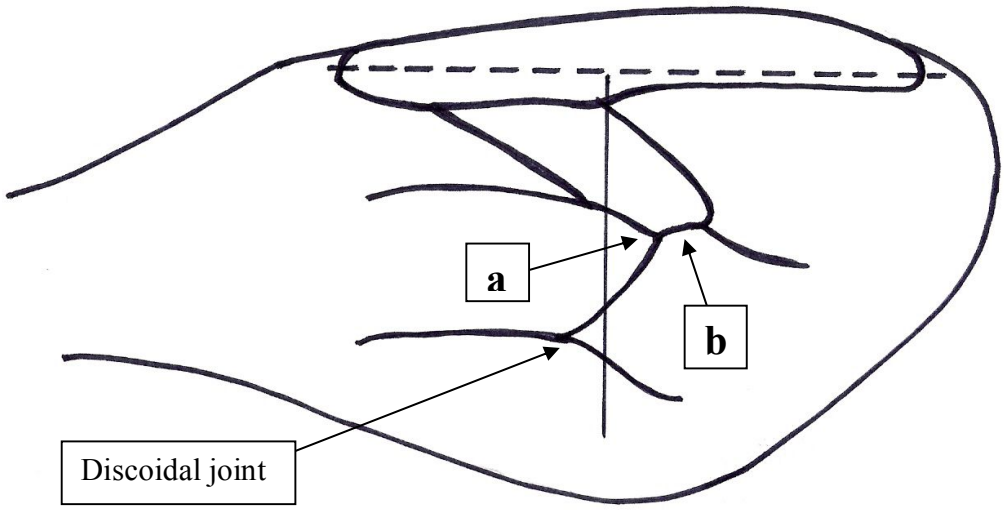
Hybrid.



Wings mounted on glass slide.

The cubital index is the distance **a** divided by **b**. A figure below 2 indicates a native-type bee.

The discoidal shift is measured by the position of the vein joint in the lower right hand corner of the discoidal cell in relation to the perpendicular line. When the discoidal joint is nearer to the point of attachment of the wing it is negative. When the discoidal joint lies on the perpendicular it is classed as zero and when it is on the other side, towards the tip of the wing, it is classed as positive.



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