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TITLE: Look at it this way

SOURCE: Outlook on Agriculture: 26(1): 3 - 5

DATE: 1997

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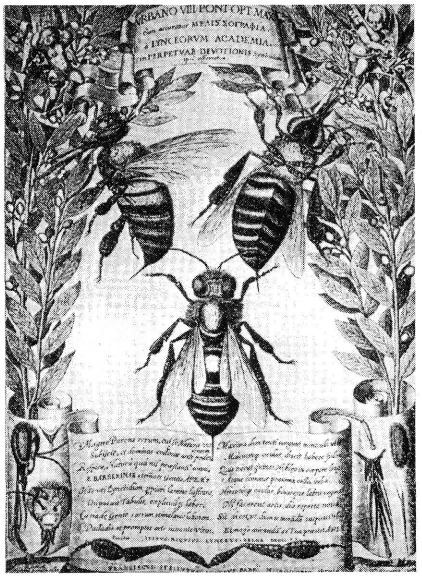
Orl Hort in Agriculture 26(1):3-5 (1997) 270

Look at it this way

*The **Look at it this way** section of the journal features contributions from distinguished scientists on contentious and current issues in areas such as development, population growth, agricultural production and policy.*

The occasion and place where scientific advances were made — or published — have sometimes depended on events quite unconnected with the work itself. This is well illustrated in the history of research on bees. The European honey bee *Apis mellifera* was of great interest from ancient times onward, because it produced honey and also because of people's admiration for its social community: with orderly working and all its members loyal to the large ruler or leader bee.



Broadsheet presented to Pope Urban VIII in 1625, showing three honey bees seen through the newly invented microscope. From the only known perfect copy, in the Accademia dei Lincei in Rome.

The honey bee was the first insect to be drawn under the microscope, in 1625, and this came about because the Inquisition of the Roman Catholic Church was then suspicious of scientists in Italy. Galileo had made his earliest compound microscope in 1610, and in 1624 he gave one to Prince Federigo Cesi, founder of the learned society in Rome named Accademia dei Lincei. In an attempt to assuage the Church, the microscope was used to draw three (worker) honey bees which were the emblem of the Barberini family, because the Pope, Urban VIII, was Maffeo Barberini. The bees were 'accurately delineated' in dorsal, ventral and lateral views, with enlarged details below, on a broadsheet which was presented to the Pope at Christmas 1625 'as a token of everlasting devotion'. However, the manoeuvre failed to appease the Pope. When Galileo was later examined before the Inquisition he was 'vehemently suspected of heresy' and ordered to be incarcerated.

Until a few hundred years ago it was assumed that the large ruler bee in the colony was — like most human rulers — male. In 1586 a book by Luis Méndez de Torres in Spain stated clearly that the ruler was female, the maestra [mistress] which engendered all the bees in the hive — maestras, drones and ordinary bees — according to the different cells in which she placed the 'seed'. The dissemination of this fact was hindered by poor communication of scientific knowledge between countries, and later by delays in publication. Between 1669 and 1673, after his *Biblia naturae* was published, the Dutch naturalist Jan Swammerdam studied the external and internal anatomy of the honey bee, and showed that 'the king, as commonly called, was female, the drone male'. Among his superb anatomical drawings, Plate XIX showed the reproductive apparatus of the female (the queen), including ovaries, ovarioles and oviducts. But Swammerdam suffered from dropsy and died in 1680 when he was only 43, and the honey bee drawings were not published until 1737/38. In 1740 Réaumur in France cited Swammerdam's newly published work, and also 'observations made more than a hundred years ago' - probably those in Spain - which showed that the king or ruler was female. In England, the Reverend John Thorley described in *Melisselogia, or The Female Monarchy* (1744) how he watched a queen bee (referred to as such) lay eggs as she ran across his hand.

There was a delay of 300 years in publishing a description written by John Evelyn around 1665: of 'dances' by bees on the surface of a clustered swarm, which indicate the location of a suitable nest site discovered by scout bees (*tanquam exploratores*) for the swarm to settle in. The section on apiaries in Evelyn's *Elysium Britannicum*, which described the dances, was

published in 1965, after Martin Lindauer's detailed studies on the dances of scout bees (1955).

The pollination of plants by honey bees was first described clearly by Arthur Dobbs in 1750, after he retired to Castle Dobbs in Co. Antrim. He described his own observations, saying that the bee:

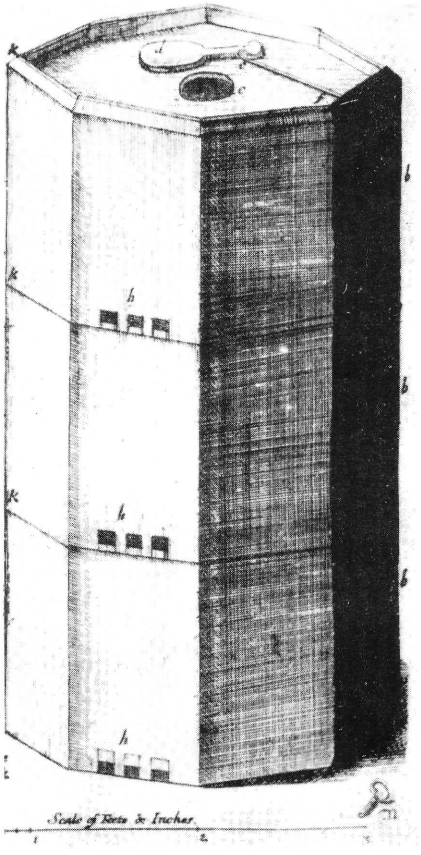
> carries the Farina [pollen] from Flower to Flower, and by its walking upon the *Pistillum* and Agitation of its Wings, it contributes greatly to the *Farina's* entering into the *Pistillum*, and at the same time prevents the heterogeneous Mixture of the *Farina* of different Flowers with it; which, if it strayed from Flower to Flower at random, it would carry to Flowers of different species . . .

Dobbs had retired to Ireland after contributing astronomical observations to the Royal Society between 1722 and 1730, explaining in 1750 that he turned to the study of bees only because:

> my view of doing good by making discoveries in the great world has been disappointed, [and] upon my retirement into this little corner of it, amongst other amusements I have been contemplating the inhabitants of the little world: particularly that most useful and industrious society of bees.

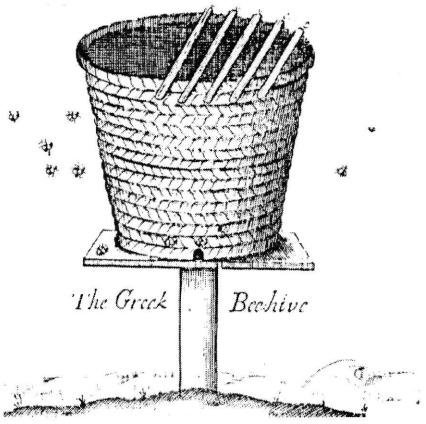
Dobbs had been active in politics as well as science, and in 1754 he sailed to America to serve as 'Governor of his Majesty's Province of North Carolina'.

Many important advances in beekeeping resulted from developments in hive design. The earliest hives were used horizontally: bees flew from a flight hole at the front end, and the beekeeper took out honey combs after removing a closure at the back end. But in northern Europe traditional hives were placed upright, and it was more difficult to harvest honey combs from them. In the mid-1600s, as a result of several chance encounters in Oxford, certain educated beekeepers started to make and use improved hives of tiered modular wooden boxes. The Reverend William Mew in Gloucestershire, who left home in 1649 to attend the Westminster Assembly of Divines, had devised a two-tier wooden hive. When his son Samuel went up to Oxford University, he gave a 'Model or Description' of this hive to the mathematician Dr John Wilkins, Warden of Wadham College, who set up such a hive in his garden in the early 1650s. Christopher Wren had entered Wadham in 1646; by 1654 he was a Fellow of All Souls and in that year made one of his first architectural drawings, of a three-tier hive based on Mew's.



Christopher Wren's 1654 drawing of a tiered hive, based on Mew's designed in 1649 or earlier. From Hartlib's The Reformed Common-wealth of Bees *(1665).*

In Mew's hive and its successors, the bees' activities could be observed through small glass windows in the walls. In 1654 Dr Wilkins gave one of the hives to John Evelyn (whose drawing of it was finally published in 1965), and Evelyn's diary for 13 July 1654 stated that King Charles II 'came on purpose to see and contemplate [the hive and bees] with much satisfaction'. Samuel Pepys wrote about his own visit on 5 May 1665, and the hive 'in



George Wheler's drawing of a Greek top-bar hive, from A Journey into Greece *(1682).*

which you may see the Bees making their honey and combs mightily pleasantly'.

Knowledge of a still more advanced type of hive reached France and England as a result of the awakening interest in Greek antiquities during the late 1600s. In 1675/76 Dr Jacob Spon from France and George Wheler from England undertook what was perhaps the first systematic travel in Greece to find surviving works of art. After visiting Hagio Kyriani monastery on Mount Hymettus, Spon wrote briefly in 1678 about the hives used by the monks. In 1682, Wheler described them in much more detail because he was 'inquisitive' about them: unlike the upright hives he knew, with these hives the monks 'never destroy or impair the Stock of Bees in taking away their Honey'. The hive was like a waste paper basket with wooden bars laid across the open top, and the bees built a separate comb down from each bar. As a result 'a Combe may be taken out whole, without the least bruising, and with the greatest ease possible'.

The Greek monks must have spaced the top-bars at the distance apart which matched that of the bees' combs in a natural nest. Last year in Greece I was told that beekeepers who still used similar hives gauged the centre-to-centre distance between top-bars by the combined width of two fingers or, alternatively, by the distance between the two thumb joints. Either gives a rough guide for the combs in a nest of European honey bees, and a similar method may well have been used in the 1670s. Neither Spon nor Wheler appreciated the significance of this distance, and a lack of understanding of the comb spacing slowed down the development of hives for nearly two further centuries.

Today's movable-frame hive embodies both the above advances: tiered modular wooden boxes, and 'movable' combs at the correct distance apart. Its principles were established in 1851 by the Rev. L. L. Langstroth in the USA, who extended the top-bar by adding end-bars and a bottom-bar to make a movable frame. Langstroth well understood the importance of the frame spacing, and although he had probably never seen Wheler's report on the Greek top-bar hive, he owned Robert Golding's 1847 book which described this hive, and also details of the hives of tiered wooden boxes, including Wren's in 1654.

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