Waxing lyrical

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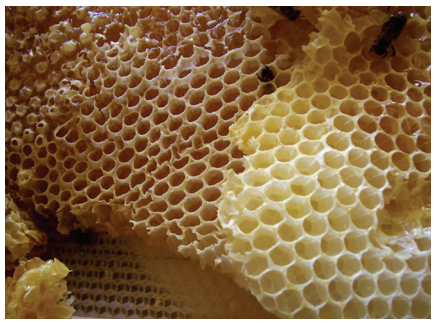
Leave honeybees on their own and before long they will get together to construct hexagonal wax architectures of exquisite perfection that they then proceed to fill with honey. No one knows quite how or why they do this, especially these days when all their hard work is plundered by humans intent on making crispy honey nut breakfast cereals. The Greeks believed the perfection of the honeycomb was a clue to the mathematical rules that governed nature. Darwin declared that anyone who could contemplate the subject without 'enthusiastic admiration' must be a dull man. D'Arcy Thompson was convinced it was the work of surface tension. But it was not until 1964 that the Hungarian Fejes Tóth, in a paper called *What the Bees Know and What They Do Not Know*, showed that the honeycomb structure wasn't quite as ideal as everyone first thought, and so relieved the collective guilt of cereal manufacturers, beekeepers, and others in the honey business.

For much of history, beeswax was revered and treated with a mystical reverence by paupers and kings alike. On a desert island, you could do a lot worse than learn the art of beekeeping. Honey is not only delicious but it is an analgesic, and so can be used to soothe a sore throat. It is also antibacterial and osmotic, so it is fantastically useful for healing wounds. To this day, despite our sophisticated medicines, you can still buy honey dressings in any chemist or drugstore.

Getting off the island by using wax to glue feathers to a wing structure is reputed not to work very well. Icarus famously fell to his death by flying too near the sun. But this tale seems unreliable, even if it is just an early example of technophobia, because the Greeks must have known that the temperature actually decreases the higher you fly, and so it could not have been the wax that melted.



Honeycomb: the wax architecture of bees.

The beeswax itself is nourishing, being a fat, but also turns out to make the perfect internal light source, the candle. In 1860, Michael Faraday delivered a series of six lectures on this single piece of technology that he revered above all others, commenting:

"I have taken this subject on former occasion, and, were it left to my own will, I should prefer to repeat it every year, so abundant is the interest that attaches itself to the subject, so wonderful are the varieties of outlet it offers into the various departments of philosophy. There is not a law under which any part of this universe is governed which does not come into play and is touched upon by these phenomena. There is no better, no more open door by which you can enter into the study of natural philosophy than by considering the physical phenomena of a candle."

How interesting can a candle be, you might say. But, like a classic black and white movie, these lectures (*The Chemical History of a Candle*) grip you right from the opening page. They star an old-fashioned material, solid, dependable, and yet infinitely adaptable to many roles: wax is the Philip Seymour Hoffman of materials science.

There are an enormous number of different waxes apart from beeswax; there is lanolin, paraffin, tallow, and many others. Each one has a different story, and so the film star analogy is not as fanciful as it might seem. For hundreds of years, wax has been used as a medium to depict the famous, especially in the form of a death mask. In 1835, a Frenchwoman called Madame Tussaud, opened a waxworks exhibition on Baker Street in London. It survives to this day and, although nominally a shrine to the concept of celebrity, featuring a full-scale model of David Beckham for instance, it is wax that is the true star of the museum, amazing visitors with its moldable ability to imitate the translucence and shine of human skin.

Modern waxes still play an important role in materials science, whether it be at the center of things in the lost-wax process of jewelry making, or at the edges in providing the mold-release agent for casting and injection molding. It has been honed and adapted for waterproofing and sliding, particularly in skiing, where it is now mixed with surfactants and fluorocarbons to control the level of wet and dry friction so exactly that, at the professional level, bespoke waxes are tailormade for each mountain.

This fine control of the melting point of wax is one of the keys to its success as a material. It can be melted even by rubbing and will then solidify in place to provide a perfect polished surface. Alternatively, it can be melted onto a surface and then ripped off as a solid, taking with it unwanted hairs. In both cases, whether it is used as a furniture polish or as a bikini wax, the aesthetic transformation invariably causes a loud gasp of astonishment. This is perhaps an involuntary echo of the eureka expressed when our ancestors first discovered that miraculous hexagonal honeycomb of the bees.