

The beeline



100 MILLION YEARS AGO

Bees have been found in fossils (**pictured**) that date to around the same time as the first flowers. “And then there was a huge radiation of plants, accompanied by a radiation of bees,” says entomologist Walter S. Sheppard of Washington State University in Pullman. Today, there are 25,000 species of bees, which are found on every continent except Antarctica (see page S48). Honeybees are members of the genus *Apis*, but they represent only a tiny slice of bee diversity — about ten species. The genus arose around 35 million years ago, probably in southeast Asia. Scientists divide *Apis* into three types: dwarf honeybees; giant honeybees; and, of most interest to us, cavity nesters, which seek out spaces such as hollow tree trunks and fill them with multiple combs. “You can take down the tree they’re in and carry them home,” says Sheppard. And that is exactly what people have done, especially with *Apis mellifera*, which is also called the European, Western or common honeybee. Although its origins are not entirely certain, some scientists believe that *A. mellifera* arose in east Africa — where humans are also thought to have originated.

HUMAN PREHISTORY

Many primates, including gorillas and chimpanzees, are avid honey-eaters. This suggests that honey probably formed part of the diet of our ancestors. “There is a long evolutionary history to the human sweet tooth,” says Alyssa Crittenden, a nutritional anthropologist at the University of Nevada in Las Vegas. Modern hunter-gatherer groups — whose diets are thought to provide clues to the foods that early humans ate — raid wild-bee nests in search of honey. For example, the Hadza people of Tanzania obtain around 15% of their calorie intake from honey. These observations led Crittenden to the provocative hypothesis that this foodstuff may have played a vital part in human evolution, fuelling our energy-hungry, expanding brains. Honey is one of the most calorie-dense foods in nature. From around 2.6 million years ago, early hominins probably had an advantage over other primates in collecting honey — stone blades and axes would have helped them to hack into tree trunks to reach the honey-rich hives of the honeybee.

An Egyptian relief carved nearly 4,500 years ago depicts a bee-keeper working with horizontal hives — these are metre-long tubes made of sun-dried clay that were sealed at one end and stacked like firewood. The relief represents the earliest definitive evidence of bee-keeping, but by the time of the carving beekeeping was already well established in Egypt and possibly elsewhere in the near East, says Gene Kritsky, author of *The Quest for the Perfect Hive: A History of Innovation in Bee Culture* (Oxford Univ. Press, 2010). The hieroglyph for bee (**pictured**) had already been in use for about 500 years.

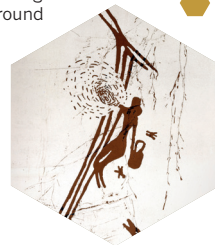


~2450 BCE

BEE ART

~6000 BCE

Evidence of prehistoric honey hunting: a cave painting (**pictured**) made around 8,000 years ago in present-day Spain depicts a person precariously perched on a cliff-face ready to raid a bees’ nest.



LONG-TIME FRIENDS

1000 BCE

Bee-keeping developed independently in several areas of the world. The Chinese have kept hives of *Apis cerana*, the Asiatic honeybee, for more than 3,000 years. In Central America, the Mayans kept native stingless bees (**pictured**) belonging to the genus *Melipona* — not closely related to *Apis* but also honey-makers — in hollow logs suspended from either the forest canopy or the eaves of houses.

TO BEE...

29 BCE

Roman poet Virgil devotes one book of *The Georgics*, an epic poem on agricultural themes, to bees. He draws parallels between the structure of honeybee colonies and human society.

...AND ALSO TO BEE

1599

In his history play *Henry V*, Shakespeare proves there really is nothing new under the sun by comparing a well-run kingdom to a beehive.

CLOCKWISE FROM TOP LEFT: REDMOND DURRELL/ALAMY; INTERFOTO/ALAMY; VISUALS UNLIMITED, INC./ERIC TOWNREY/GETTY IMAGES; PAUL PIEBINGA/GETTY IMAGES; NATURAL HISTORY MUSEUM, LONDON

Of all insects, bees — especially honeybees (*Apis mellifera*) — are the most lauded by humans. They have been praised by poets and writers, including Virgil and Shakespeare, and their colonies are seen as a metaphor for human societies. This affinity is no surprise: humans and bees have a long and interwoven history. By Sarah DeWeerd

GRAND VOYAGE

1622

Apis mellifera arrives in the New World. English colonists sent barrels of bees to Virginia on a ship that carried a cornucopia of seeds, fruit trees and other animals.

QUEEN BEE

1942

In the United Kingdom, newlyweds James and Eva Crane receive a bee-hive as a wedding present; the honey was intended to provide a supplement to their Second World War sugar ration. Nuclear physicist Eva Crane (**pictured**) became fascinated with bees and went on to visit more than 60 countries to study the insects, becoming the twentieth century's foremost bee researcher.



HIVE GEOMETRY

1976

Creation of the top-bar hive (**pictured**). This structure was inspired by an ancient Greek design that encourages bees to build trapezoidal combs not attached to the side or bottom of a hive. Practical and inexpensive, the top-bar hive technology has contributed to economic development schemes across the world.



GENOME BUZZ

2006

The first draft of the *Apis mellifera* genome, only the third insect species to have its genome sequenced (Honeybee Genome Sequencing Consortium, *Nature* **443**, 931–949; 2006), provides intriguing hints that, for example, insects tend to have an enormous diversity of smell-receptor genes.

1852

Reverend Lorenzo Lorraine Langstroth, a clergyman from Philadelphia, Pennsylvania, patents the modern box hive, a construction with multiple removable combs that is still in wide use today. The design's interchangeable parts increase the efficiency of managing hives and honey extraction, but may also hasten the spread of disease if contaminated frames are swapped into new hives.

1945 – PRESENT

In the United States at the end of the Second World War, the number of honeybee hives (**pictured**) reaches about five million because honey is used instead of sugar and beeswax is needed for bomb production. Since then, the number of hives has halved, even though the country's agriculture has become more dependent on managed honeybees. Modernized farms needed access to millions of bees to pollinate vast monocultures, but only for short periods of time. These concerns drove the development of migratory bee-keeping. Dennis vanEngelsdorp, an apiarist at the University of Maryland in Beltsville, describes the bees as “a mobile pollination force”. A bee-keeper might transport hundreds of hives thousands of kilometres from Florida citrus groves to New Jersey watermelon fields to Maine's blueberries.



1987

The *Varroa destructor* mite was originally a parasite of *Apis cerana*. It has jumped species and spread to managed *Apis mellifera* colonies around the world. The pest reached mainland United States in 1987, the United Kingdom in 1992 and New Zealand in 2000. “It's like a baby vampire,” Dennis vanEngelsdorp says. The mite transmits viruses and weakens bees' immune systems. The only country to remain free from the *Varroa* mite is Australia.

2006

Bee-keepers notice large numbers of adult worker bees disappearing, emptying healthy hives in a few days. They dub the phenomenon colony collapse disorder (CCD) (see page S52). “We don't have a culprit,” says Dennis vanEngelsdorp, then state apiarist of Pennsylvania who investigated some of the first cases of CCD. Pesticides, stress from moving hives, lack of forage, parasites and disease remain big problems. Although vanEngelsdorp says that he has not seen any confirmed cases of CCD in the past few years, US bee-keepers routinely lose half of their colonies every year.

2015

More revelations from the honeybee genome, first sequenced in 2006, hint at the roots of instinctive behaviours. Innate behaviour, including the honeybee's dance language, is “anything but simple”, says Gene Robinson, a genome scientist at the University of Illinois in Urbana-Champaign. Other work explores the genetics of social behaviour: in May 2015, analysis (K. M. Kapheim *et al*, *Science*, in the press) of the genome sequences of ten species of bees shows that “there are different ways to make a social bee”, Robinson says. Although the genes involved may differ each time sociality evolves, it tends to involve complex gene networks — a pattern also seen in primates.

CLOCKWISE FROM BOTTOM LEFT: BEES FOR DEVELOPMENT; RICHARD JONES/EVA CRANE TRUST; KEN GILLESPIE PHOTOGRAPHY/ALAMY; DESIGN BY MOHAMED ASHOUR/NATURE