BUZZ

HONEY BEES

by Raymond Huber

Contents

Six Impossible Things About Bees

"Sometimes I've believed as many as six impossible things before breakfast."
- Lewis Carroll, Through the Looking Glass, 1865

There are at least six impossible things about a honey bee: it's super-intelligent; it talks by dancing; it has a weapon it can only use once; it makes healing honey; it has magnetic crystals; and it feeds the world.

When I was eight, alone in our backyard, a small cloud swept over me, changing shape, and droning like a giant vacuum cleaner. It was a swarm of bees and I thought the world was ending. Now I live happily with 50 000 bees in my backyard and I've discovered how amazing they are.

A bee has a brain no bigger than a grass seed and a nasty sting, yet honey bees may have the key to life on Earth. Three-quarters of our important food crops need bee pollination. Without honey bees, it'd be goodbye apples, cherries, blueberries, watermelons, and strawberries. A world without bees would eventually mean the end of the world: most flowering plants would die out, followed by the animals that eat them.

This book is a doorway to the secret life of the honey bee – a story of stings and swarms and scientists – and the wider story of bees' partnership with humans.

Chapter 1– 20 000 Years with Bees

Sweetness and Light

When Ra weeps, the tears fall to earth and turn into bees.
- Ancient Egyptian Salt Papyrus

The story of honey bees story began long before we turned up on the planet. The oldest known bee is a 100 million year old fossil suspended in a piece of golden amber (a tree resin), found recently in Myanmar (Burma). In prehistoric times, honey bees spread around the world in partnership with flowering plants. Bees lived in the wild for millions of years, nesting in trees or on cliffs. It's only in the last few thousand years they've come to love the tidy beehives that humans build for them.

People discovered honey about 20,000 years ago. Back then humans ate wild animals and raw plants, so honey must've been a sweet treat. Finding this perfect food probably seemed like magic. It's hard for us to imagine because there's sugar in so many foods today. It'd be like finding chocolate berries growing on a bush in your garden.

Honey bees became a part of myths and religions in most countries. People believed they were little miracle workers because bees made both honey and wax. Back then, beeswax candles were one of the few sources of light in houses.

Bushmen of the Kalahari Desert in Africa told this creation story:

Bee was a kindly creature. One night, Mantis needed to cross a great, flooded river to reach his family, and asked Bee for help. Bee offered to carry Mantis on her back. She flew over the raging waters but was beaten down by a strong wind. Bee was dangerously close to the waves when she saw a magnificent flower floating on the water. Bee dropped Mantis onto the flower, fell beside her, and died of exhaustion. When the sun rose, curled up on the flower was the first human being – the fruit of bee's sacrifice.

In Ancient Egypt they believed honey bees were created by Ra, the mighty sun god. When Ra cried in heaven, the tears fell to the Earth and turned into honey bees. Many people thought that honey was the food of the gods, and the Romans called flower nectar 'droplets from heaven'. Bees became a symbol of the soul living on after death – tiny gold bees have been found in coffins from early times.

This myth from Brazil tells how bee's nests were created:

In the beginning, honey was found in huge pots on the ground, and people ate as much as they liked. The gods looked down and were greatly displeased. "Those humans are becoming fat and lazy," they said. The gods commanded the bees to build honey comb high in the tall jungle trees. Now people had to work hard to climb up and get the honey.

Sweet Words - *The bee's knees*

The bee's knees means simply the best. Bees don't have knees so this is just a catchy rhyme. It was popular in the 1920s to use this and other animal sayings – such as 'the cat's pyjamas' – to describe excellent things.

Honey Hunters...

Early honey hunting was an extremely dangerous job because bees lived in tall trees or on cliff faces. Cave paintings show daredevil hunters climbing wobbly ladders to raid nests. Imagine dangling from a vine rope, 150 metres up a cliff, while being stung by bees. People still go honey hunting today. In India, Malaysia and Indonesia hunters climb towering cliffs and trees to get honey comb.

Aboriginal Australians have always been skilled honey hunters. There are many myths about how they discovered the bees' secret:

Two Numerji brothers went on walkabout. They came across some bees collecting the sweet nectar from flowers. The brothers wondered how they could follow the bees back to their nest. The older brother had a bright idea. He attached a thread of sticky spider web to a bee. This made the bee easy to follow, and the younger brother ran after it. He tracked the bee to a hollow tree. There he found a delicious honeycomb – or sugarbag as Aboriginal Australians still call it today.

This really happened with wild bees in Australia. Honey hunters would use tree gum to glue a bit of Cockatoo fluff to the bee's back. In Africa, honey hunters are in partnership with a clever little bird. The

honey guide bird leads a person to a bees' nest, waits for him to dig out some honeycomb, then eats the scraps of wax left behind.

... Become Beekeepers

Honey hunters eventually turned to beekeeping. People realised it was much easier to get the honey if they gave the bees a home at ground level. The first human-made beehives were clay pots and straw baskets. The oldest hives ever found were dug up in a 3000 year old city in Israel (a country known as the 'land of milk and honey'). The Egyptians were keen beekeepers, having tens of thousands of hives lining the banks of the Nile river.

Drawing: Egyptians smoke bees, remove honeycomb, and store it in jars. This drawing is from a series in the pyramids – probably the first comic strip.

A special partnership grew between bees and humans. Honey bees preferred living in safe, ready-made beehives, rather than having to find nesting holes in the wild. Beehives gave them more space, so bees made more honey than ever before. (In this book, I describe life

inside a beehive, but the same things happen in wild nests.) Human settlers took honey bees all over the world and in return, the bees pollinated our food crops.

Stings

'*Let the bee be, and the bee will let you be*' - Beekeeper's saying

Honey bees aren't pets or farm animals, but wild creatures (they can survive without our help). But bees are not aggressive insects. They don't go around attacking people for no reason. Why? Because they will die shortly after stinging humans, or animals such as dogs. Bee stings have tiny barbs that get stuck in our thick skin. The sting rips out and the bee bleeds to death. Only queen bees can sting without dying.

Being around bees is a little like being around traffic in town. In fact, bees are a lot less dangerous than cars, but a few safety rules are needed. Firstly, don't disturb them. Bees usually sting when they are threatened or when defending their hive. They don't normally sting when on flowers. If you do get stung, remove the stinger by gently scraping it sideways, maybe with your finger nail. Never pinch the stinger to pull it out – that injects more poison.

You should also move away from the area – a sting releases a banana-like scent that attracts other bees – or cover up the bit that's been stung. Don't run or wave your arms because bees react to frenzied movements. **Important!** This advice is not comprehensive or intended as medical advice. Bee stings can be fatal, especially if people are allergic to them. No responsibility is taken for actions taken using this advice.

Question: What's more dangerous than being with a fool?
Answer: Fooling with a bee!

There's a Jesuit story that explains our fear of bees:

In times past, Bee would buzz around stinging people for fun. People told the Maker they were scared of Bee. So the Maker took Bee aside and said, "Don't sting people for no reason. Play it cool." So Bee kept quiet and didn't sting anyone. But people took advantage of this and were mean to her. So Bee went to the Maker and said "Why do they push me around?" The Maker said "I told you to stop stinging, not to stop singing." Since then, Bee has buzzed wherever she goes, and people keep their distance.

Chapter 2– Super Bees

If we lose our respect for these miraculous and mysterious insects, it is at our peril.
–Hattie Ellis

What is a Honey Bee?

Honey bees are one of the 25 000 species of bee on Earth. They are the most advanced of all the bees, because they are social and they store food. Being social means living in a cooperative family group. Honey bees build a permanent home and store honey – they can survive almost anywhere, from the Arctic to the Amazon.

Meet the Family

Every honey bee family has three kinds of bee: females, males, and one queen. Most of the roughly fifty thousand bees are females – called worker bees – with a sting and outstanding work habits. There are only a few hundred males – the drones – with stocky bodies, big eyes and no sting. The queen is the biggest bee, with a long, golden body.

Scientists call the honey bee family a superorganism. This means that the bees cooperate, sharing all the daily chores, and working like one giant insect. It's 'all for one and one for all'... well, almost all – the males are shocking slackers, as you'll see.

Multi-tasking females

A female bee lives for only 6 weeks in summer, but it's a full life because she is always changing jobs. A worker bee is a cleaner, babysitter, builder, honey-chef, queen-groomer, guard, farmer, and scout, and a few other things.

A bee grows through stages, a bit like a butterfly does. She begins as an egg the size of a hyphen (-). A worm-like larva hatches and she's fed by her older sisters. Then the larva spins a cocoon and over the next 24 days she transforms into a fully grown bee. Then the busyness begins.

Imagine... The diary of a bee girl

Week 1 Dear Diary, So unfair! The work started the moment I hatched. I had to clean out my birth cell (ew!), then spend the whole week tidying the rest of the hive. My older sisters call me a 'house bee' and say I'm not allowed outside 'til I'm 21. And I'm like, no way sister!

Week 2 Dear Diary, Yay! I'm a babysitter. The babies are sooo cute but totally exhausting. I have to check them 1300 times a day (okay, call me obsessive) to make sure they're OK. Meanwhile the comb cleaning goes on 4EVAH...

Week 3 Dear Diary, I've graduated to building honeycomb, and I have to admit my hexagons are pretty groovy. I make honey in my so-called spare time – when I'm not cleaning. Celebrated my 21st day with my first flight, collecting yummy nectar from flowers. My sisters always told me the job sucks, but I love it!

On warm summer evenings the female bees line up at the entrance to the hive, backsides in the air, wings going flat out. These are the air-conditioner bees, fanning their wings to push air around the hive. They also bring water droplets inside the hive and fan their wings over them to

blow cool air round. Honey bees have even been found living on a lava field (in Hawaii) where the ground temperature was 60°C.

The female's most exhausting job is flying out to flowers to get nectar. A bee has two large wings and two small wings. They beat 300 times every second, making the air vibrate – that's the buzzing you hear. A bee flies about 1000 km in her life. If a bee was human sized, that'd be like going five times around the planet. All that flying wears out her wings. Then she dies.

Sweet Words- *Busy as a bee*

You watch bees flitting from flower to flower on sunny days. They always seem to be working, but in fact bees spend quite a bit of time resting too, especially at night.

Isaac Watts wrote a song about it in 1715:

How doth the little busy bee
Improve each shining hour
And gather honey all the day
From every opening flower.

HRH, The Queen

The Queen bee is treated as Her Royal Highness. She's constantly guarded, fed and groomed by her daughters. The queen is the source of their life. Her job is to lay eggs (up to 2000 eggs a day) in holes in the wax comb. She can live for up to seven years.

The queen is the boss. She uses special chemicals (called pheromones) to keep her huge family well behaved. The worker bees smell these chemicals and are controlled by them, especially when they're young. A queen is not born, she is 'made' – yes, it's another of the honey bee's surprising abilities. Any ordinary girl bee can become a queen. The workers prepare a royal baby by feeding a larva on a diet of royal jelly (a protein food made from pollen). This jelly triggers the genes (DNA) that transform the baby bee into a queen.

Lazy Drones

Male bees spend their time eating honey, sitting around, and sleeping. Drones are such slobs, they even do their droppings in the hive and the females clean up after them. (Female bees are scrupulously clean and *always* go to the toilet outside, at BP stations some children told me). The drones are a bit like those plump husbands in TV cartoons who laze around while their wives cook and clean – you know it's going to end badly.

Imagine...Family Bee

Mr B: Honey, I'm home!

Mrs B: You're always home, you big lump.

Mr B: Tiring day, petal?

Mrs B: The hive's humming, but you don't lift a wing to help.

Mr B: You can't argue with nature, sweetums.

Mrs B: But nature gave me the sting.

It's sad to witness the fate of the drones as autumn kicks in. They are herded together at the bottom of the hive and then pushed outside onto the grass. The females simply can't afford the honey to feed them all.

When winter arrives, the bee family hunkers down for the cold months. They huddle in a tight ball which traps the heat of their bodies. It's amazing that even when it's way below zero outside, bees can keep the cluster at a temperature of around 35°C. To adjust the temperature, the bees constantly change places within the huddle, and shiver their muscles. Cooperative little wonders! Because bees can control the temperature of the hive, they can survive in very cold climates.

Photo: drones sunbathing

Drones' Honeymoon

Why do the female bees put up with the males? The drones exist for one reason – to mate with a new queen. It hardly ever happens and it doesn't have a happy ending. When an old queen bee dies (or leaves in a swarm), a new queen hatches. She must be fertilized without delay or the hive will die out.

The drones' honeymoon is short and bittersweet. The new queen leaves the hive and zooms straight up into the sky, ensuring that only the fittest drones can keep up. Several drones will mate with the queen, then die shortly after.

Female bees have one mother but many fathers. Strangely, male bees have no father – they hatch from unfertilised eggs (wasps and ants can also do this trick).

Sweet Words

The birds and the bees:

This is a shy way of talking about sex. For a long time it was thought that queen bees had babies without mating. Ancient Greeks believed that bee babies came from inside flowers – a bit like the idea of human babies coming from the cabbage patch. Then in 1788 a blind Swiss naturalist, Francois Huber (no, I'm not joking!) proved that queens mated. Maybe the euphemism about birds and bees started after that.

Swarm

When the hive gets too crowded, the queen leaves taking half the bees with her. A swarm of 25 000 bees is an impressive sight - okay, a little terrifying - but it's safer than you might imagine. Swarming bees are much less likely to sting because they have no home to defend. They fly in a cloud to look for a new nest.

Observing a swarm is a good way to see bees acting as one body. It's a lot like a human democracy. In our elections, we listen to candidates promote themselves, then vote for the one we like. A swarm votes too. First, it rests on a branch and scout bees fly to find nesting cavities. Scouts measure out a likely hole (by pacing inside it), and return to promote their nesting sites by dancing on the surface of the swarm. The best sites will attract other scouts to visit them, and eventually the one with the most visits (votes) is chosen. The queen has no part in all this decision-making.

The scouts then make 'piping' noises which signal the swarm to warm-up, and take off. The hard-working scouts also guide the swarm to their new home in another remarkable way: 'streaker' bees zip through the middle of the swarm to nudge it in the right direction.

Scientists call a honey bee swarm 'a cognitive entity' – meaning it can think.

Chapter 3– Miracle Honey

Where the bee sucks

There suck I

- Shakespeare (1609)

To make honey, bees must first go and fetch the ingredients. A visit to the flowers is a bit like a trip to the supermarket. A bee doesn't eat from a flower – she's there to collect nectar. When she finds a flower with tasty nectar, she sucks it out with her tube-like tongue. The nectar goes into her honey sac, an extra stomach designed for storage. She' good at clambering around flowers. Her six feet have sticky hooks that cling to petals, like velcro. The bee takes the nectar back to the hive where it's made into honey and stored for hard times.

Comb Sweet Comb

Honeycomb is one of the lightest, strongest, least wasteful structures known. It's the bee's home: providing a kitchen, nursery, pantry, dance floor, and bedroom. The six-sided holes in the comb (called 'cells') hold honey, baby bees, and pollen. Bees build these beautiful wax hexagons using their mouth and feet. Flakes of wax are made in glands under the bee's body. Each cell is designed so it tilts backwards at an angle of exactly 13°, so the honey doesn't flow out.

This folktale from Thailand explains why bees build comb in cosy places:

Long, long ago, elephants did not have trunks. One day a terrible forest fire swept over the land. To escape the smoke, the honey bees hid inside the elephants' mouths. The elephants trumpeted angrily, but the bees would not come out. The elephants blew so hard, their mouths stretched out into trunks. In desperation, the elephants breathed in the stinging smoke and the bees finally buzzed off. Since then, bees have always built honeycomb in hollow trees, because it reminds them of elephant trunks.

Scientists have recently found out elephants make a special rumbling sound when bees are around. Beehives are used to keep elephants away from crops.

The comb of the hive bee is absolutely perfect.
–Charles Darwin, 1859

Electric Bees

A bee also collects pollen. She scrapes it off flowers and packs it into her pollen baskets (curved hairs on her back legs). Pollen grains can leap onto her furry body because her hairs create an electric charge. It's like the static electricity you get from rubbing a balloon on wool then making someone's hair stand on end.

How To Make Honey

A bee returns home, heavy with nectar, and looks for a 'house' bee to help unload it. She passes the watery nectar (mouth to mouth) to the house bee who begins to transform it. First she regurgitates the nectar a few times into the cells, which mixes in enzymes and kills any germs.

Now the bees thicken the nectar as a chef thickens a sauce. They fan it with their wings – about 26,000 wing beats – to evaporate the water. Nectar is 70% water and it must be reduced or the honey will go off. They fan through the night, working in teams. Meanwhile, air conditioner bees keep the air flowing through the hive to remove the moisture. The reward for this labour is thick honey, with less than 20% water. Lastly, it's sealed with a lid of wax. And that's how every drop of honey you eat is made.

Honey is high in sugar and from it bees get most of their energy. But you can't make a living from sugar alone (unless you're a dentist), so bees also need to eat pollen. It's rich in protein, fat, vitamins, and minerals. Pollen is a bit like milk for baby bees, it helps them grow strong. A beehive needs about 20 kgs of pollen to eat each year.

Sweet Words – *A bee in your bonnet*

In great-grandmother's day, women wore bonnets (hats) with fake flowers in which bees got caught. To have a bee in your bonnet means you get stuck on a problem or idea. It buzzes around inside your head and annoys you. It irritates others too if you go on and on about it.

Miraculous Food

We're so used to honey, it's easy to forget how remarkable it is – a delicious treat eaten straight from nature, needing no preparation, cooking or preserving. Honey is the only food made for us by insects. Is it animal, vegetable or mineral? Maybe a bit of each, because it comes from plants but is processed by insects.

Honey bees visit about three million flowers to produce a 500 ml jar of honey, and they must fly a distance equal to a trip around the planet. Each kind of flower lends its own distinct flavour to the honey. Darker honeys are stronger: my favourite is chestnut tree honey.

Honey-dew is made from insect droppings. Tiny insects called 'scale' suck the sap from beech trees. They excrete a sweet liquid which bees collect and then make into honey. We call it honey-dew. Through a tree, a bug and bee – that's recycling!

Ancient people didn't know how bees made honey but they did know it tasted good and was good for you. Honey had the status of a magic potion. The Greeks, Hindus, Egyptians, Muslims, Chinese and

Romans all used honey as food, drink and as a medicine. Honey was a popular treatment on wounds, for stomach problems, and mouth infections. Honey lasts for a long time in airtight conditions, and edible honey was found with mummies in the pyramids. It's said the body of Alexander the Great was preserved in a golden coffin filled with white honey.

Scientists have now proved that honey kills bacteria and fungi. Most honeys heal wounds by producing hydrogen peroxide. New Zealand manuka honey and Australian jelly bush honey have the strongest anti-bacterial power of all. Doctors use manuka honey to dress wounds and fight a range of infections – it even works where antibiotics have failed. Honey also helps to heal skin that's been burned.

Molan's Mighty Manuka

Dr Peter Molan helped to put honey on the map of mainstream medicine. He found that manuka honey is good at healing wounds because it contains antibacterial substances from the manuka tree. 'There's no antibiotic like the (non-peroxide) activity of this honey', says Dr Molan. His recommended wound treatment is manuka honey on a dressing and regular changes of the dressing. Since reading Dr Molan's research, I always put manuka honey on cuts and infections.

Food For Life

For a long life, breakfast daily on honey.

- Pythagoras (600 BC)

Pythagoras was right about honey (and triangles). Honey contains vitamins, minerals, natural sugars, and many anti-oxidants. It is easily digested and a quick energy source. Honey is best eaten raw – overheating destroys some of its nutritional effects and healing ability. Supermarket honey is sometimes heat-treated to keep it runny (honey will naturally harden over time). Buy it untreated from local markets if you can and use low temperatures if cooking with honey.

Honey is twice as sweet as cane sugar, so you don't have to use as much in cooking. Honey contains 'good' sugars that are low glycemic. Cakes made with honey will stay fresher because honey attracts moisture.

Sweet Words

Honeymoon: Honey has long been a part of marriage traditions in Europe. It was a Celtic custom for newlyweds to spend the Honey Month (May, when honey was harvested) alone together after their wedding, eating and drinking honey. Honey wine is called mead.

Jaws and Vampires

Biologically speaking, if something bites you, it is more likely to be female.
– Desmond Morris

Wasps are in the same insect family as honey bees, but they are like the black sheep of the family. Wasps are meat eaters with strong jaws, while bees are vegetarians with long tongues. Wasps attack hives and eat honey and baby bees. I'm very nervous around wasps because they attack more readily than bees, and they can sting over and over without dying. One beekeeper told me that he has glued threads of cotton to wasps that attack his hives, and tracked them back to their nest –just like in the Aboriginal myths!

Asia has a more violent 'Jaws' – the giant hornet is five centimetres long and 20 times the weight of a honey bee. It decapitates bees and feeds the bodies to its larvae. But Japanese honey bees have worked out a remarkable defence. They surround a hornet in a ball of bees and heat it up. Hornets die at 45 °C, but bees can stand up to 47° C. The hornet is

suffocated and cooked at exactly 46°C.

Sometimes ants try to get into a hive entrance. The guard bees fan their wings as hard as they can and blow the ants off their feet. If a large bug or mouse does succeed in getting inside, it's killed and often mummified in a sticky gum (called propolis). The worst enemy of honey bees is the Siberian vampire bug, commonly called varroa mite. Varroa mites suck their blood leaving the bees badly weakened. Humans have spread the mites to every country, except Australia.

Sweet Words: Candy

The Mediterranean island Crete produced a lot of honey and became famous for it. It's capital city was named Candia and the word candy soon came to be used for any sweet treats.

Chapter 4– The Outer Limits

You are about to experience the awe and mystery which reaches from the inner mind to the outer limits.
– The Outer Limits, TV series (1963)

There are three things make honey bees exceptional insects: their language, navigation, and their learning ability.

Dances With Bees

'The second most complex language on the planet.'
– Professor James Gould

We read and write using symbols called the alphabet. Bees are the only other creatures we know of that use a symbolic language.

If I asked you to tell me the way to your school you might say, "go for 1 km along Trudge Rd, turn left, then go down Plod St for about a minute..." You use words to describe something that is distant in time and place. This is what bees do with dance moves, to tell each other where to find flowers.

When you see the letters 'c-h-i-p' you know it means a chip. In the same way, each dance move makes meaning for a bee. When a bee finds a fantastic patch of flowers she tanks up on nectar and heads home. Back in the hive she dances on the comb for her sisters. She dances in circular patterns, and does some body-shaking, called 'waggling'.

The dance shows the other bees both the **direction** to fly, and the **distance** to the flowers. The direction is told by the angle of the dance on the comb. They use a kind of sun diagram to work it out. Imagine a clock face on the honeycomb, with the sun at 12 o'clock.
If the bee dances straight up towards the 12 it means 'fly straight towards the sun to find the flowers. If it dances towards 2 o'clock it means 'fly on that angle, to the right of the sun'. The bees memorize the angle, then go outside and figure where to fly using the real sun as a guide.

The distance to the flowers is told by waggling. The more waggles, the further away the flowers. One waggle might mean 50 metres away (so ten waggles would mean 500 metres to fly). The bees must count the waggles and note the speed of the waggle too. Faster waggling means the flowers have plenty of nectar.

Don't forget that bees are dancing inside the hive in the dark! Impossible as it seems, the hive audience receives instructions through sound, smell, taste, and by feeling the vibrations of the dance.
Bee dance language changes in different parts of the world, just as human language does. If you travelled to the USA and asked for 'chips', they might give you wood chips. But if you asked for 'fries' they'd understand you wanted potatoes. Honeybees around the world have slightly different meanings for their dances. For bees in Europe, each waggle might mean 20 metres to fly to the flowers – but for bees in Egypt, a waggle might mean only 10 metres.

Sweet Words

Make a beeline means to go directly and quickly to a place. This saying comes from beekeepers who noticed that bees fly in a straight line to the flowers, following directions from their dancing instructor.

Bee GPS

It's helpful to have map directions to find flowers, but the real world is a big place for a speck of a bee. A lost bee is a dead bee so she must have some outdoor guides. We think new cars are pretty high-tech with GPS (Global Positioning System) computers to guide us by satellite. Bees have similar navigating systems built into their tiny brains.

Bees are mainly guided by remembering the position of the sun. It's not easy, because the sun is always moving. Young bees take short play flights to study how the sun moves before they go on longer journeys. But what happens when the sun is hidden behind a cloud? The bees have back-up systems.

Look at a clear sky and you see blue light. A bee sees something extra – 'polarized' light, which is light bouncing off air molecules. She sees it as a pattern of circles around the sun, guiding her when the sun is hidden.

When there's no blue sky, bees can navigate using landmarks. They remember the position of objects such as large trees, lakes, or buildings. Shut your eyes and imagine you are at your front door. Now picture the route to the street, and to a neighbour's house – you've just created a

mental map. Bees do a similar thing using landmarks near the hive. The smell of the hive also guides them home.

Scientists also think that honey bees use magnetic guidance. The Earth is like a giant magnet, and they can sense its magnetic fields. Bees have millions of magnetic crystals in their body. Some fish, birds and butterflies also sense magnetic fields.

Learning Bees

'The life of the bee is like a magic well: the more we draw from it, the more there is to draw.'

– Karl von Frisch

Honey bees are one of the most studied insects on Earth. They can learn, count, tell time, measure, memorize, and make decisions. Impressive for a critter one centimetre long. Bee brains may be tiny but the density of their neurons is about 10 times greater than in our brains.

Scientists have been able to test honey bee intelligence because bees are easily trained using sugar as a reward. They've found that bees can learn things, such as recognising shapes that are similar or different. One test was to see if bees could recognise the letter B. Some bees could identify B among other letters, but only one bee was able to spot B among confusing shapes. It was reading this research that inspired me to create Ziggy, a super intelligent bee character in my novels.

Bees can also make predictions. In one test, scientists gave bees food outside their hive. They kept moving the food a bit further away, but by a regular distance each time. The bees soon worked out the distance involved, and the scientists were amazed to find the bees waiting for them to arrive at the next projected feeding spot.

Honey bees have a body clock to keep track of time – it's important because flowers produce nectar at different hours of the day (eg. dandelions at 9am). We have a similar inner clock but most of us rely on outer clocks. If I removed all your clocks and asked you to be somewhere at exactly 10.30am tomorrow, could you do it? Scientists trained some bees to feed at 10.30am, and the bees turned up at that time every day there after.

There are still many exciting questions for scientists to answer about bees. Are honey bees conscious? There's no way of knowing yet. It's hard for humans to imagine an insect thinking deeply. Does a bee enjoy the smell of a flower and the warmth of the sun? I like to think it does.

Imagine…You are a Bee

You have no nose, five eyes, antennae instead of ears, and your body is very furry. Your big eyes have 7,500 lenses each (human eyes have one lens), and there are three small eyes on top of your head. You can see all colours (except red) and also ultra-violet light – blue is a favourite colour.

You can keep track of fast action, about 100 movements a second, while humans can only see up to 20 separate movements a second (which is why a movie seems to 'move' because it has 24 pictures a second.) To tell the truth your vision isn't as sharp as humans', but your sense of smell is much better.

It's dark inside a beehive, so your other senses have to be pretty sharp. Your antennae are better than a Swiss army knife: they are used to taste, feel, hear, and smell. Each antenna smells in a different direction – you can smell in stereo!

You can also taste with your feet. Simply hover over a flower and touch it with your foot to decide if the nectar is tasty. Your body is fluffy, even having hairy eyeballs. These tiny hairs help you to feel changes in wind speed and direction while flying.

Finally, you have a mysterious sixth sense that humans don't have – you can detect magnetic fields. There are millions of magnetic crystals inside your chest.

Chapter 5– The Bee Connection

Life is all one – as big as the world and as small as a honey bee.

-Hattie Ellis

Honey bees are the planet's best pollinators. They've been the key players in two global take-overs. First, bees and flowers helped each other spread over the earth many millions of years ago. Second, bees and humans helped each other to expand into new lands, through crop pollination.

Pollination

As bees flit from flower to flower they are spreading pollen around. It's called pollination, which is yet another word for sex. In humans, sperm and egg must get together for a baby to begin – in flowers, it's pollen and egg. Pollen is on the male part of the flower and must travel to a female egg in another flower. Most flowers need bees to move the pollen (wind helps too). That's why flowers are such gorgeous creations – colourful, perfumed, and sweet tasting – to attract bees. Pollinated flowers are able to have 'babies': seeds, nuts, fruits or vegetables.

Bees feed the world. Pollination is vital for the growth of many of our health-giving foods. If bees died out, most of the colour, vitamins, and antioxidants would disappear from our diet – leaving mainly wheat for bread. Meat and dairy foods would also become scarce (make that

bread without butter) because most cattle feed is bee pollinated. Tea, coffee, and cotton are mostly bee pollinated crops.

Honey bees give us……

Fruit: apple, orange, peach, pear, kiwifruit, cherry, strawberry, blueberry, raspberry, blackberry, watermelon, plum, passionfruit, mango…
Vegetables: tomato, broccoli, asparagus, eggplant, pumpkin, courgette…
Nuts: almonds, cashews, macadamia, sunflower,…

There are other important bees that pollinate our plants: bumble bees and native (solitary) bees. Native bees are quite small, usually live alone and rarely sting. Native bee in the following photo is 5mm long in real life (photo by Dr John Early).

Bumble bees are also peaceful – they don't sting much – but they live in family groups, like honey bees. They are endangered in many countries,

so we need to treat them well. In the past bumbles were named humble bees.

To Bee or not to Bee?

This earth is the honey of all beings, and all beings are the honey of this earth.
– Upanishads (800 BC)

The bad news is, bees have been vanishing in large numbers in recent years. Over 30% of U.S. and British hives have been dying out each year; and up to 50% of Japanese and French hives. The bees simply fail to return to the hive and dead bodies aren't usually found. It's been called CCD (colony collapse disorder) and the exact cause is a mystery. There is a suspect though.

CCD seems to be due to things that are all a result of human activity: chemical poisoning, destruction of wild places, large crop farming (a poor diet for bees), and the spread of bee viruses and pests. These things probably work together to stress the bees.

Honey bees have a finely tuned life, and it's not surprising they are upset by the way humans blunder about in the world. They're like the canary in the coalmine – very sensitive to changes in nature – so it'd be wise to take notice of all the empty beehives. The biologist E.O. Wilson – famous for his work on ants, a superorganism like bees – warns that the environment would collapse without pollinating insects. Wilson singles out the threat of chemicals: *'The bottom line is this: be careful with pesticides.'*

Chemicals on seeds and plants (especially flowers) will poison bees, and can disrupt bee navigation.

'Most insects in our environment are beneficial – they do important ecological jobs. Yet you can go into a supermarket and buy a spray can of broad-range poison that will kill all of them.'

– Dr Peter Dearden (Genetics Scientist).

Bee Guardians

The good news is, we can change the world, starting at home. Like humans, bees need a clean place to live and good food. You can support bees by creating a bee-friendly garden; and not using chemicals. Bring the wild to your back door!

* Plant natives, flowering trees, bushes, herbs and wild flowers. Plant in big clumps; and use flowers that bloom at different times of the year.

* Instead of mowing madly, leave a part of your lawn to grow wild. This provides shelter for bees, attracts helpful insects, and saves petrol.

* Avoid using chemical sprays on gardens and lawns (or use organic sprays).

* **Never** spray chemicals on plants in flower.

* Don't tip chemicals where they will be washed into waterways – bees drink out of puddles.

* Become a backyard beekeeper.

6 of the Best Plants

These plants grow easily and provide good food for bees:

1. Californian lilac
2. Heather (Erica)
3. Hebe
4. Lavender
5. Thyme
6. Borage

Beekeeping

Most beekeepers in the world are hobbyists. They don't do it for money, but because they enjoy having bees (and honey!) around. Some don't even take honey off the bees; they just provide them with boxes to live in. Commercial beekeepers sell honey or hire beehives to farmers as crops pollinators.

Beekeeping was revolutionized by an American inventor, Lorenzo Langstroth. The challenge for beekeepers over the centuries was how to take the honey without destroying the comb. For a long time, they'd melt the wax comb, forcing the bees to rebuild it. The problem was solved in 1851 when Langstroth designed a beehive like a filing cabinet. The honeycomb could be used over and over again. His bee boxes are now used world-wide.

One of the most famous beekeepers was Brother Adam, born in 1898. When he was only 12, his mother sent him to live with monks in Buckfast Abbey, England. Adam was fascinated by nature and was put in

charge of the bees. He later travelled the world looking for special queen bees and used them to breed one of the world's gentlest honey bee. He died in 1996.

The conqueror of Mt Everest, Sir Edmund Hilary, was a beekeeper. He believed much of his strength came from the bee work which he and his brother did together. Hilary said, "*The summer was a time of great excitement. We competed with each other, running side by side with heavy loads of honey*." That brilliant detective, Sherlock Holmes, became a beekeeper. In his final story he's absorbed with studying bees instead of baddies. Holmes says "*I watched the little working gangs as once I watched the criminal world of London*."

Bizarre

Humans and bees are strangely alike. We both live in close-knit communities, often in similar high-rise buildings. We both have highly organised work habits, where the young help around home (parents wish), then venture into the world at about 21 (days or years). Neither humans or bees can survive well without company – and we're both at our best when we cooperate. Some countries have a single ruler, like a queen bee; and the NZ government works in the Beehive building shaped like an old straw hive (called a skep).

Because of their seemingly magical behaviours, bees have attracted superstitions. One of the most ancient is the belief that if a bee hovered over a babies' mouth, the child would grow up to be a great poet or speech-maker. 'Telling the bees' was a common beekeeper's custom in

the 19th century. Bees were told of important events because they were considered part of the family. When a beekeeper died, the bees must be informed or they'd fly away. An English newspaper reported a story which supported this. An old beekeeper was dying, and her bees flew into the bedroom. They settled on curtains around the bed where she lay, and stayed until the woman died. Then the bees flew out and disappeared. Beekeepers in Europe would give their bees written contracts, agreeing to look after them in exchange for honey.

Sweet Words

To eke things out means to make supplies go further, especially food. Early beehives were a straw design – you can see a picture of a skep on matchboxes. The hives were made bigger by adding extra layers called 'ekes'.

The connection between bees and humans can get weirdly close. Bees living in human cities sometimes use our road bridges to get around. They don't like flying over water and have learned to use bridges to cross rivers. It's strange, but bees seem happy living in our cities: they make more honey and have a lower death rate.

But bees aren't always welcome in cities: City Council rules often say that bees are 'inappropriate in a residential area'. This is based on an irrational fear of bees. People in cities are many, many times more likely to be badly injured by a car than by a bee. With decreasing bee numbers, we urgently need beehives in cities to pollinate our home gardens. In some countries hives are placed in city parks, and mini 'hotels' are

provided for native bees in cities. Villages have declared themselves 'bee-friendly' and planted heaps of flowers.

Sweet Words

Mind your own beeswax means to mind your own business. It's a way of telling someone to stop poking their nose in, without sounding too rude. It probably began in the 1930s, but may dates back to the 1700s when rich women used beeswax as face make-up.

Beyond Honey

We fill our lives with honey and wax – giving humans the two noblest things, -which are sweetness and light.

-Jonathan Swift, 1773

Honey bees make many useful products: wax, propolis, pollen, and venom.

Beeswax has oodles of uses, including in polishes, cosmetics, jelly beans, art, dental floss and even for cleaning up oil spills. It's always been a favourite for candles because beeswax gives off a sweet scent and a lustrous, smokefree light.

Propolis is the bee's cleaning product – a sticky, germ-killing gum which they collect from plants. It's used to plug cracks and keep the nest walls smooth and clean. Propolis will also fight infection in humans, especially in the mouth.

Pollen is rich in protein and vitamins. The powerful boxer, Muhammad Ali, ate pollen, which may explain his slogan '*Float like a butterfly, sting like a bee*'. Some people also eat royal jelly believing it's the secret of long life – because it makes queen bees live 50 times longer than workers. There's no proof of this, and I can't help thinking of the human baby which turns into a larva in Roald Dahl's story *Royal Jelly*.

Bee venom – collected without killing the bees – is used to treat painful diseases such as arthritis.

Bees in New Zealand

Mary Bumby introduced honey bees to New Zealand. She was 27 years old when she settled here in 1839. Mary brought her bees with her all the way from England in two straw hives. She and her brother were likely the first beekeepers. There were no native bees and Maori were curious about an insect which made food. Maori people 'had never heard of the busy little bee', Mary wrote. She also attracted attention: Mary is described as 'a vision of delight...with a smile that lighted up her gentle hazel eyes, out of which beamed only loving thoughts.'

Settlers realised that New Zealand had many plants that bees would love. One wrote home, 'The flowers of the plants abound with honey [nectar] which the natives frequently suck.' In 1840 many more bees were shipped from Sydney.

William Cotton helped start beekeeping in New Zealand. He shipped hives in and taught the Maori how to care for bees. Cotton invented clever ways to keep bees sleepy during the 6 month voyage

from England, using barrels on springs, packed with ice. But many hives were thrown overboard by superstitious sailors who blamed the bees for the stormy seas.

Honey bees have now become vital to New Zealand horticultural and agriculture. They are worth about $12 billion dollars a year to the economy, mainly because they pollinate crops. The varroa mite has wiped out many honey bees in the North Island.

Bees For Development Trust is a charity which works to combat poverty through beekeeping. They promote beekeeping methods and livelihoods amongst some of the poorest communities in the world. See www.beesfordevelopment.org

Bee Books

Sweetness and Light by Hattie Ellis
A World Without Bees by Alison Benjamin
The Beekeeper's Pupil by Sara George (a novel about Francois Huber)
Letters From the Hive by Stephen Buchmann
The World History of Beekeeping and Honey Hunting by Eva Crane