NINE

Bee Stings and Other Defenses

Question 1: Do all bees sting?

Answer: Not all bees can sting. The bee's sting is a modification of the *ovipositor,* the female egg-laying organ, and so no males of any bee species sting. Most people are surprised to know that the stinger is kept inside the bee's body until it is used. Unless you see a bee trying to sting you, you will not see the stinger as a bee flies by or feeds from a flower. There is a group of social bees in the tropics that are not capable of stinging. They either lack stingers or have reduced sting structures without the necessary muscles to extend them as weapons. In this stingless bee family, females can defend themselves from harmful predators using other strategies (see chapter 9, question 7: How do stingless bees defend themselves?).

Female worker bees are generally quite peaceful, and they are only inclined to sting when an intruder threatens the colony or when they are alarmed by unfamiliar odors or high-contrast patterns that are easiest for them to see. The queen bee also has a stinger, but she uses it to lay eggs and only stings other queens in order to kill them and prevent them from emerging and threatening her dominance (see chapter 4, question 8: How is the queen bee chosen?).

Question 2: What does it feel like to be stung by a bee?

Answer: Though the amount of venom in a honey bee sting is small, it can cause a great deal of discomfort and occasional harm. One author describes a bee sting as similar to a car door slamming on your fingers. Others describe it as feeling like touching a hot match. To make matters worse, the stinging bee emits an alarm pheromone that calls for reinforcements, increasing the potential for more toxins to be injected by the bees that respond to her signal.

The face and ears are most vulnerable to bee stings, probably because these are the areas where bee predators have the thinnest hair. Bees may also cue on exhaled carbon dioxide to focus their attacks in vulnerable areas. Beekeepers almost always wear a hat and veil, even if they don't wear other protective clothing. Some beekeepers who have been stung many times build up a tolerance and become effectively immune to the venom.

Question 3: How does a bee sting?

Answer: The bee's sting is normally retracted inside her abdomen, which is the third or end section of the bee's body. When she is alarmed, the sting drops and locks into place like the landing gear on an airplane, and muscles in the abdomen thrust the stinger into its target. When the victim is another insect, the stinger can be used repeatedly, but if she stings a fleshy target, the barbed sting breaks away and is typically left embedded in the victim's flesh. When the sting breaks off, the venom sac protruding from the end of the sting is often still visibly pumping venom even though it has been torn from the bee's body. A bee that has lost its sting will die soon after.

Question 4: Why do bees sting?

Answer: It is impossible to know if bees feel anger, but their behavior can be quite aggressive if they sense signs of disturbance or imminent danger to the stability of the nest, and they

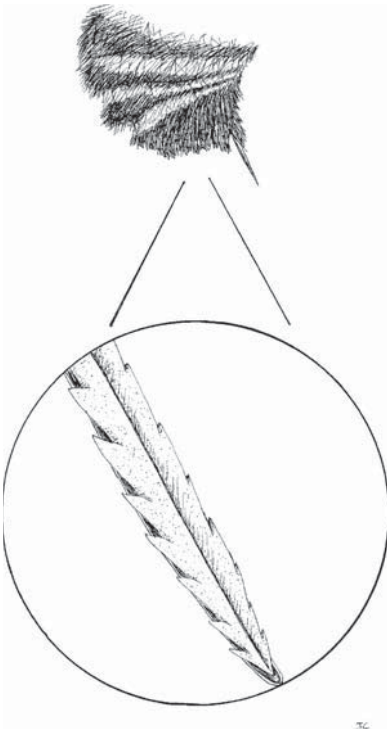

Fig. 29. Honey bee stingers are normally kept inside the abdomen; a close-up image reveals the serrated edges of these defensive weapons. *(Drawing by John F. Cullum.)*

seem to be able to moderate their responses depending on the nature of the risk they perceive. The risk is highest at the nest, rather than on flowers in fields, which is why most bee stings occur near the nest. Most bees will not sting without some trigger because the consequences can be costly. Depending on the target, stinging may cause the bee's stinger to break off, which results in the bee's death in short order.

Some scientists have described the triggers to many bee behaviors as being dependent on thresholds of response that can change depending upon the bee's age and experience. For example, perhaps only certain bees in the colony would sting a perceived intruder, depending on the bee's age and social role. For those that wouldn't sting, their hypothetical response threshold would be higher, and they would need to feel more threatened

before they would react by stinging. The condition of the colony, the local environment, and even the weather can play a role in whether or not a bee will sting. According to Samuel Beshers and Jennifer Fewell, the response threshold idea may also help explain how the honey bee colony is organized by division of labor, so that each bee, depending on the social environment and work to be done, receives signals that either hit or miss their individual threshold level of response for that behavior.

Question 5: Do killer bees really exist?

Answer: Africanized honey bees are known popularly as "killer bees," although their venom is no more toxic than that of the common European honey bee. They are dangerous because they can be very aggressive when their colony is disturbed and sometimes thousands at a time will sting one victim, flooding the person or animal with multiple doses of venom that can reach highly toxic levels. Although many people can survive an attack like this, it can be lethal to children or physically vulnerable adults.

Killer bees are all hybrids, descendants of twenty-six Tanzanian queen bees, *Apis mellifera scutellata,* and various strains of European bees with which they have mated. The Tanzanian bees were accidentally released in 1957 from a breeding program in Brazil which was attempting to artificially select for bee traits that would produce more honey and better pollinators in tropical conditions. Prior to the European colonization of North and South America, no honey bees lived in these areas, so we know that any honey bees in Brazil prior to 1957 were of European origin. Since that time, the hybrid bees have moved north through South and Central America and, more recently, into North America.

Mark Winston of Simon Fraser University describes how beekeeping has been affected by these bees and their unique traits: "Indeed, the politics of the Africanized honey bee, and the media attention to it, have caused us to lose sight of the

unprecedented success story of an introduced species that is elegantly preadapted to its new environment. The bee is so well suited to tropical life that we have not been able to devise a way to stop or even slow its spread. We marvel at its success in the wild, even as we struggle to blunt its impact on beekeeping and the public." Africanized bees have established themselves in an increasingly wide area of the United States, and at their peak rate of expansion they spread north at a rate of almost a mile or about two kilometers a day.

By 2002, these aggressive bees had been seen to the south in Argentina and to the north as far as Trinidad in the West Indies, Mexico, Texas, Arizona, New Mexico, Florida, and southern California. In June 2005, they were found in southwest Arkansas, and in 2007 they were reported in the New Orleans area. They are said to have caused eleven deaths in Texas in the fifteen years that they have been in the area. They occasionally are seen in northern ports, probably after being transported by ships that move through the Panama Canal. So far, no way has been found to stop their expansion, but regular population monitoring and swarm trapping is conducted by both local and federal government agencies. Africanized bees are not adapted to cold temperatures, so their continued overwintering survival and expansion into northern regions of the United States may be limited.

Question 6: Does a bee die after it has stung somebody?

Answer: If a honey bee stings a person, its stinger usually breaks off in the person's body and the bee usually dies within a few minutes. The ancestors of bees were parasitic wasps, and they needed an ovipositor (their egg-laying organ) that could pierce the hard outer exoskeleton of an insect in order to lay their eggs inside its body, using it as a host for the developing eggs. Stingers and their associated poison glands evolved to protect the colony against invading insects, especially bees from different hives. Interestingly, most wasp and bee stingers are straight, like a sewing needle, but the stinger of a honey bee

is barbed. The barbed stinger can penetrate another insect's *exoskeleton* and retract safely, leaving the bee intact and able to sting again; but it breaks off in soft flesh, so a honey bee worker can only sting a person once, whereas other types of bees and wasps can sting people multiple times. Queen honey bees can sting, but they very rarely use their stinger for defense, probably because it could risk damaging their ovipositor, which is central to their role in the colony.

Question 7: How do stingless bees defend themselves?

Answer: Meliponid or stingless bees have vestigial or atrophied stingers and are not capable of stinging (see chapter 1, question 3: How many species of bees exist?). Although most species of stingless bees are generally mild-mannered, a few species will defend themselves by biting fiercely when they are threatened, and Dylan Voeller and James Nieh have filmed *Trigona spinipes* and *Melipona rufiventris* fighting viciously over food. David Roubik, Brian Smith, and R. G. Carlson described at least two species within the *Oxytrigona* genus that secrete caustic salivary substances made up of formic acids and other defensive chemicals, making their bite extremely uncomfortable. The stingless bee *Trigona fulviventris* marks potential predators with a chemical secretion that elicits additional bees to react defensively by buzzing, biting, and hair pulling.

Another species enters the eyes, ears, and nose of the threatening animal or person and then buzzes its wings loudly; this strategy is an effective way to make a predator run away from the bee nest. Other species will attack a potential nest intruder with sticky nest substances, like resins or honey. Being covered in gooey materials discourages further nest intrusions.

Alexandros Papachristoforou studied Cyprian honey bees *Apis mellifera cypria* that have an interesting way of defending themselves against the local Oriental hornets *Vespa orientalis*. Hornets, like all insects, breathe through *spiracles,* which are holes in their exoskeleton. They contract their abdominal muscles to exhale and relax the muscles to inhale, and these muscle

Stingless Bees

While beekeeping for honey and wax production mainly relies on the behavior of the European or Western honey bee *Apis mellifera,* other social bees are also raised and kept in managed colonies for the production of honey, wax, and pollen. Stingless bees in the family Meliponidae have long played a part in providing people in Central America with renewable hive products as well as being a regular source of local pollinators.

Like honey bees, stingless bees are highly social bees that nest in cavities, but they do not sting. They also exhibit age-polytheism, which is the predictable change of tasks that occurs with aging in some social insects; and they use a symbolic form of communication to recruit nest mates to profitable food sources, albeit one that differs from the waggle dance of the honey bee.

Another way that stingless bees differ from honey bees is the way they feed their brood. Honey bees continually bring food to their young, but stingless bees "mass provision" their young, collecting pollen and placing it in brood cells along with glandular secretions and nectar or honey. The queen lays an egg on this mixture of food, and then workers enclose the newly laid egg within the cell. They will not meet their new sibling again until it emerges into the colony as an adult. One advantage of this style of feeding offspring is that there is a reduction of disease transmission within the colony because there is less communication between the generations.

Another important difference between honey bees and stingless bees is in the structure of their nests. Stingless bee nests have a physical separation between the brood area and the food storage area. The brood cells look more like little jelly beans arranged in sheets, layers, or clusters, while the food cells resemble small pots that can be as large as a kidney bean. Many species of stingless bees have nests with food areas that can be removed from the colony without disrupting the brood, but the food cells cannot be replaced, as is the case with honey bees. Stingless bee nests can supply people with

wax and honey, provided attention is given to the timing of nest disruption and the prevention of attack from ants or nest parasites. With some species, pots of pollen are removed along with the pots of honey, which adds to the flavor of the honey.

Honey from stingless bees is a valuable commodity in many local communities in Latin America, where it is believed to be a healthy elixir. Stingless bee honey is lower in sugar content and is usually less viscous than the honey from *Apis mellifera,* but many people prefer its taste. In Panama, some small stingless bees, *Trigona angustula,* are known as *angelitas* because they are thought to be guardian angels of the home. These bees are kept both by individuals and, in some communities, by specialist beekeepers. The colonies are typically suspended under the eves of buildings. One species of particular interest is *Melipona beechii;* in Honduras these bees are known as *estrella blanca,* or "white star," bees because of the distinctive, star-like nest entrance these bees construct. Because they close their colonies with new wax every evening, the entrance becomes a "white star" each day (see color plate F).

Unfortunately, stingless bee culture is on the decline across many areas of Central America. David Roubik, a scientist working at the Smithsonian Tropical Research Institute in Panama who is known around the world as the "Bee Man," reported that the loss of these cultured bees in areas of the Yucatan Peninsula could have a dramatic impact on the pollination ecology of the local flora, as these native bees often work as pollinators for plants not visited by honey bees.

Melipoculture (raising stingless bees) is ripe for local development in many places since keeping these bees is less expensive than keeping honey bees and does not typically require the protective beekeeping equipment needed for apiculture. Ester Slaa, a tropical bee researcher from the University of Leeds, and her coauthors from Brazil, Costa Rica, and the Netherlands, describe stingless bees as strong candidates for

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Stingless Bees, *continued*

use as commercial pollinators and report that at least eleven species of stingless bees forage effectively on crops grown in greenhouses. Tim Heard, in a review of these bees as pollinators, reports that stingless bees pollinate coffee plants, tomatoes, peppers, cucumbers, mangos, avocados, sweet peppers, and others. Slaa and her colleagues advocate for more integration between agricultural crops, habitat conservation, and the promotion of melipoculture.

movements open and close plates in the exoskeleton that protect the holes. The researchers found that bees cluster around the hornet to defend against it, and they actually suffocate the hornet by making it impossible for it to open its spiracles to take in air. This form of asphyxiation has not been documented as a defense against other invaders, but it is a strategy that could work against many other insects.

Japanese honey bees, *Apis cerana japonica,* guard against their local, predatory hornets, *Vespa simillima xanthoptera,* in a different way. Both the bees and the hornets are accustomed to a relatively cool climate, and Masato Ono and colleagues found that when bees are threatened by a hornet, a huge group of bees *thermoballs* it, surrounding the predatory hornet in a cluster and vibrating their muscles until they heat the hornet to a temperature that kills it (113 degrees Fahrenheit, 45 degrees Celsius). This form of thermal strategy seems to be a rare type of colony defense, and it is not commonly seen against other intruders.

Question 8: Is being stung by a bee dangerous?

Answer: Although bee stings can be painful, they only rarely cause serious complications. The discomfort and localized swelling caused by a normal reaction to a bee sting can last for several days but is not a cause for alarm. Taking antihistamines

can ease the discomfort of a sting as can the application of an ice pack to the sting site. A beekeeper who has been stung many times can build up a tolerance and will not swell in response to a sting: people may become effectively immune to the venom, but there is a range of possible reactions.

There are fifty to one hundred deaths in the United States each year from insect stings, about half of which come from honey bees. In highly allergic individuals, bee stings can result in anaphylaxis, which causes the throat to swell shut and the blood pressure to drop, which can be followed by shock, unconsciousness, and even death if left untreated. This type of anaphylactic response to a bee sting is rare, however, and can be treated via professional medical intervention. People who think they are having an extreme allergic reaction should seek immediate medical help and discuss desensitization procedures with an allergist.

Africanized bees (also called killer bees) are very aggressive and attack in large groups when they are threatened, which can result in a victim being stung repeatedly, in some cases thousands of times (see this chapter, question 5: Do killer bees really exist?). The amount of venom injected in such an attack can be so large that it can be lethal. The amount of venom in a single honey bee sting, by comparison, is tiny.

Question 9: What is bee venom?

Answer: Venom is a complex mixture of chemicals, including a toxic protein called *melittin,* which bursts blood vessels and damages tissues. Emollient enzymes act like water on a dry sponge, maximizing the toxins' spread into the tissues. Neurotransmitters are stimulated in the brain that accentuate the fear and excitement felt by the victim, and the venom stimulates the victim's body to release histamines that produce itching, redness, and swelling as a side effect of defending itself against the toxin. Bee venom is available in various forms and with different degrees of purity (it can contain traces of pollen, honey, dust, feces, or nectar), and it can be processed and freeze dried.

There are unproven uses for bee venom, such as to treat cancer, multiple sclerosis, chronic pain, joint diseases, and skin diseases. In many countries, bee venom is a component of prescription and non-prescription creams, liniments, ointments and salves, and injectable compounds. Some beekeepers claim that a bee sting on a painful spot provides excellent pain relief, and some people use bee venom to treat arthritis. Some veterinarians use bee venom injections to treat horses and dogs with arthritis.

Question 10: Does collecting venom kill the bees?

Answer: During the 1950s and '60s, bee venom was collected using a wooden or plastic collection frame with an electrified wire grid placed at the entrance of a hive. Under the wires was a glass sheet that was covered with plastic or rubber, and the bees came in contact with the wire and received an electric shock that would cause the bees to sting the rubber sheet, paralyzing their muscles and usually electrocuting them. If that didn't kill them, when they stung the surface of the collector sheet their stinger would generally break off, resulting in death. Their venom was deposited between the glass and the rubber or plastic, where it was allowed to dry, and then it was scraped off and collected.

Newer collection methods claim to be safe and relatively harmless. In 2005 the first microprocessor-controlled bee-venom collector device went on the market, capable of collecting venom from up to one hundred hives at a time. The newer devices use the same principle as the older frames, but their circuitry allows them to administer very low levels of voltage, just at the threshold that stimulates the bees to sting but is not enough to kill them. Also, the newer devices have replaced the rubber collection sheet with a high-tech diaphragm that does not kill the bees by causing the stinger to break off. The manufacturer reports that during thirty to sixty minutes of collecting using the latest device, fewer than five bees will be killed, not a significant loss to a thriving colony.

Question 11: How can you avoid being stung by a bee?

Answer: The best way not to be stung by a bee is to stay away from bee colonies, because bees are very reluctant to sting unless their nest is threatened or disturbed. For the most part, it is easy to avoid honey bee nests because they tend to live in managed colonies, which are typically large, white boxes. Occasionally, people will be surprised to find themselves near a bumblebee nest in the ground.

If a bee is nearby, the best strategy to avoid being stung is to ignore it—most bees will simply fly by, as people do not usually have anything of interest to them and bees are not usually in an aggressive state when foraging away from the hive. Waving your arms around can touch or threaten the bees, and accidental stings can result. Another anti-sting strategy is not to wear strong perfume or cologne and to wear light-colored clothing. Bees will sometimes investigate high-contrast patterns, especially if they are accompanied by distinctive or sweet smells.

Picnic tables are often the sites where people encounter what they think are bees, but in reality, the stinging insects that visit picnics are usually wasps known as yellow jackets. Bees, as strict vegetarians, do not find much to eat at picnic tables, and they do not like cans of soda pop as much as wasps do!

Question 12: Are there any natural remedies for bee stings?

Answer: Most so-called natural remedies have not been scientifically assessed for their effectiveness against bee stings. That said, anything that reduces swelling, like the application of an ice pack, can ease the discomfort of a bee sting. A poultice of water and baking soda or even meat tenderizer may also alleviate the itch of a bee sting. Other remedies that are sometimes mentioned include putting a slice of onion or potato on the site of the sting or washing the area with cider vinegar.