

A DUAL NARRATIVE ABOUT HONEY BEES,
VARROA MITES, AND HOW YOU CAN HELP

DESTRUCTOR

AUTUMN D. MITCHELL



DESTRUCTOR

AUTUMN D. MITCHELL



PennState

College of Agricultural Sciences

Destructor is sponsored by the Apes Valentes Student Award (via the Center for Pollinator Research, Department of Entomology, and the College of Agricultural Sciences at The Pennsylvania State University). The Apes Valentes Student Award supports student-led summer projects in pollinator biology and health with emphasis on the arts and humanities. The content and opinions of this publication reside solely with the author and not with The Pennsylvania State University. Special thanks to Dr. Christina Grozinger, Kate Anton, Jessica Good, and the award donor.

This publication is available on the Center for Pollinator Research website (RRID: SCR_026635):
www.pollinators.psu.edu/

Disclaimer:

This is a work of fiction inspired by scientific research. Some details in this short story have been fictionalized, altered, or reimagined for narrative purposes.

Cover Credits:

“*Varroa destructor* female (dorsal face)” ©Gilles San Martin, via iNaturalist, is licensed under CC BY 4.0/ “Orange and Beige Modern Minimalist We Are Open Coffee Shop Instagram Post” ©Goodware Std, via Canva com/ “Honeycomb Background Texture” ©Greenflash, via Canva. com

Table of Contents

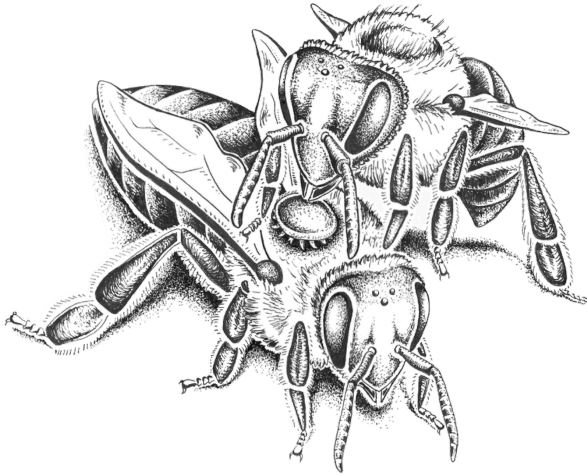
REFERENCE ILLUSTRATIONS	6
PART ONE	7
PART TWO	21
HOW TO HELP	31
“What Can I Do?”	32
Other Resources	34
WORKS CITED	35

Reference Illustrations

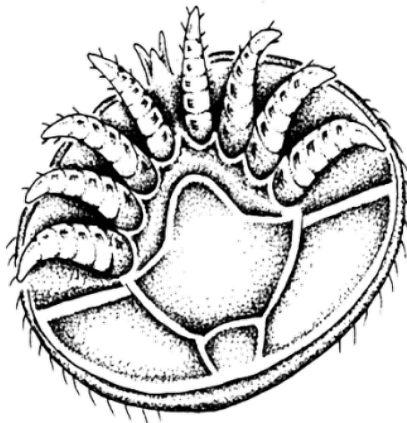
MICHAEL HILL

The Center for Pollinator Research

The western honey bee (*Apis mellifera*) and dorsal side view of the Varroa mite (*Varroa destructor*)



Ventral side view of the Varroa mite (*Varroa destructor*)



Part One

MELL

Day 1

The Queen deposited an egg inside a hexagonal cell. It slipped, white and elongated, from the tip of her seventh abdominal segment, and stuck to the wax. She moved on to lay another, then another, her devoted attendants following her path across the brood. The egg was just one of the two thousand she would lay that day.

Day 4

Mell, #620, broke through the soft casing and eased her way out. Warm wax cradled her, pulsing with life. Vibrations buzzed through the walls, a constant drone that lulled the young larva to sleep with the reassurance of her sisters' presence.

Dark! Warm!

Immediately, a pleasant cream pooled around Mell's body. Blind and limbless, she could only open her mouth to drink the royal jelly that the nurse bee had deposited in her cell. The tart, tangy custard contained all of the nutrients she needed to grow, and it momentarily satisfied her hunger. Floral undertones teased the suggestion of a world beyond her and her sisters and Mother. She could feel all of them in the vibrations surrounding her, in the scent of the air.

We are here, we are here, we are here...

Her family.

Her hive.

Day 5

Royal jelly flooded her cell at steady intervals, allowing Mell to drink and grow, drink and grow. Already she had grown three times as large as when she hatched.

H u n g r y! she signaled to the nurses. *Feed me!*

Around her, her sisters signaled the same. A honey-like aroma wafted through the enclosed space and cried out, *Hungry! Hungry! Hungry!* Their bodies crushed against

the shared walls of their hexagons, and they wriggled impatiently in tandem.

From the darkness, the scent of a nurse reassured their calls, pleasant and calm. *I am h e r e!*

An olfactory cue rose over the brood, all of the nurses communicating as one, *We are here! We are always h e r e!*

Although she could not yet see her, Mell felt a nurse's antennae *bap bap bap* into her cell before the delicious rush surrounded her. The softness of her touch soothed and reassured her.

Eat, the nurse urged, before she moved on to the next mewling larva with the crowd of other nurses. When Mell had drank her fill, another nurse came along to refill her cell. Mell reared herself forward, embracing the savory flow.

As she suckled, Mother's presence blossomed through the hive, floral and light, and Mell fell asleep, warm with her love.

Eat and sleep, e a t a n d s l e e p...

Day 6

C o l d! Mell squirmed into herself. *So cold!*

The hive had chilled suddenly, and above her, nurse bees communicated their panic through flashes of potassic olfactory cues.

Cold! Cold!?! Why?

Winter—over! Spring... n o w?

Why cold!?! So cold...

Messages shimmered through the air.

Frost! Warm the brood!

Warm the brood! Warm!—Warm!—Warm!

Nurses bustled above Mell and her sisters, each snuggling against the cooling wax for each other's heat. Then came a rush of wings and crushing bodies. Mell's cell warmed and she delighted in it, writhing upwards and rolling into herself. She knew not of "winter" and "spring" and "frost," but with each feeding, she gained a new understanding of herself and her sisters. Eat and grow. Eat and grow for the *H I V E!* Their

shared, ultimate purpose.

The thought made her mouth and its new appendages grasp for purchase on something more solid. A nurse responded promptly, and instead of the smooth cream she had been feeding on, a chunkier substance dripped into the cell. Grains of pollen swirled in the jelly, transforming it into worker jelly. The grains pieced apart in her mouth, fermented and yeasty. She gnawed on the crumbs of the outer world and drank its sweetness, the floral aroma filling her cozy cell with the hot air.

Despite the warmth, the complex scent structure of anxiety persisted above her. Mell finished her meal quickly and she ached for more. *More!* She signaled again, but already, the frantic nurse had retreated, pheromones of others calling her away, into the unknown.

Worry! Tired.

Tired...

Honey? Enough h o n e y?

Messages darted across the hexagonal cradles, but within them the brood slept soundly.

Day 7

The cold persisted the next day. Nurses and other workers swapped shifts to relieve the tired and the dead from their duties, snuggling and vibrating close together to protect the larvae.

Meanwhile, Mell focused less on the pungent anxieties and gossip above, and more on the changes happening within her own body. She was now five times the size she once was and the wax of her cradle had grown restrictive. Her crescent-shaped body filled the bottom, and she had to curl into herself to fit. New segments and muscles stretched and braced against one another as she shifted. Something was changing within her. Mell knew that, very soon, she would assume the role of a nurse, tending to her young sisters as the previous generation had tended to her. She was filled with determination and ate,

ate, ate to accommodate her ambitions. Instinct urged her into the future, one full of delightful smells, tastes, and sights. What awaited her beyond the hive, she knew not, but the rippling conversation above her informed her dreams.

Far away! Flowers grow farther and farther... Worry! Worry!

Tired... tired... tired...

Wildflowers... one half mile away... 60° from hive...

Mites? Where! Where?

Tired...

More foragers! We need more foragers!

No! Stay! Cold!

Serviceberries!... one and one half miles away... 23° from hive... far!

Danger!...

The outside world came to Mell's imagination in olfactory sensations that hinted at the idea of soil, of plant life, of floral feasts to sustain the hive. Her biology stirred at its purpose drawing nearer each moment. But growing is tiring, and she sank into sleep to the passing odor of Mother perfuming her dreams once again.

Day 9

Mell stretched herself forward, orienting her head toward the mouth of her cell. Inside her, her organs grew with her, changing and developing. She could no longer curl at the bottom like she had when she first hatched. Her skin prickled with excitement, on the edge of a transformation that she had been waiting for her entire life. She signaled for food, more bee bread to satiate her hunger. The feedings had grown sparser to her disappointment, and she longed to sink her mandibles into the crumbly supplement. They needed to get stronger. They needed to grow!

G R O W! Hungry!

Beyond the wax was open air, so she stretched further and followed the vibrations of her sisters. The cold had retreated,

and the hive was once again warm and temperate. Their pheromones tickled and delighted her, affection wafting over her in lovely bouquets. They smelled like home. They smelled like love.

She signaled again, muscles reaching and stretching, although she did not yet have limbs.

Hungry!

A sour smell interrupted the flow of information, and Mell cringed backwards. A nurse struggled up the comb, gripping the wax with her claws. Her weary vibrations made the walls and Mell quiver. She smelled different than the others. Something was wrong, yet Mell could not understand why distress and exhaustion radiated off of her.

A small, chunky portion of worker jelly settled in front of her, and she was content to eat while the nurse slowly, but gradually, constructed a cap for the front of the hive. A cap! The eve of her transformation was upon her! A tickle rippled down her body at the thought. Eventually, the nurse finished securing the wax and wandered away to cap another larva, struggling to hoist herself to the next hexagon. Mell settled herself and prepared for the biological changes that would transform her into a young honey bee worker.

But as the total darkness surrounded her, she noticed another presence in the cell. She wriggled against the walls, but instead of the soft reluctance of the wax that reassured her of her place among her thousands of sisters, she brushed against something hard. Bristling hairs scraped against her skin, and she recoiled. Its smell told her it was not another honey bee. It was something unknown and foreign to the hive. The creature skittered away from her, and she lost contact with it in the darkness. She could barely make out its movements around her, and its scent was impossible to identify. After some time, it did not brush against Mell again, and she relaxed, allowing her body to continue with its natural processes. Her silk glands activated, and she began to spin herself a cocoon within her

chamber. She swaddled herself in the thin fibers and delighted at its softness. Her developing mandibles already ached to bite through her cocoon, then the waxen cap on her cell, and emerge into adulthood a new bee.

But the moment Mell had settled and forgotten about the presence in her cell, something poked at her from the outside of her cocoon. She thrashed, fear spiking through her nervous system. It poked at her again, testing different areas of the formation, until a sharp pinch broke through. Something bit into Mell's skin, piercing her insides. She thrashed again, but the thing held fast, gripping onto her with its eight legs. She attempted to signal for help but her attempts were futile now that she had been capped. She was trapped. The site of the injury burned as the thing sucked and lapped at her. Something dribbled down her body, and Mell realized with a shudder that it was her own insides. It weakened her and made her feel hollow, the opposite of the intense growth she'd experienced these past few days. The air within the cell grew stifling, and she panicked at the unexpected danger that she had found herself in.

Mell tried to signal for her sisters, but none came to her aid.

Day 10

Mell's body changed entirely, but not in the way that she had anticipated.

Her body continued to develop, stretching the already thin cocoon thinner as her head and legs began to grow. Nubs sprouted from her chubby thorax, straining against her confinements. She wriggled and stretched to ease the growing pains, rearing her swelling head around the top of her cell. Rather than total darkness, her developing eyes took in a new near-darkness, and although she still could not see well, she could make out the faint light radiating through the thick wax cap. Her gossamer cocoon obscured most of her vision, and she could not tell whether she should be disappointed or relieved.

The creature, a Varroa mite, continued to skitter and climb around the cell, puncturing her repeatedly at the same point of entry to steal her hemolymph and drain her life force. Before the wound could scab over, it sliced into her with its mandibles and leeches off the well-fed larva. Small shadows occasionally crossed her restricted line of sight and induced a cold dread inside of her. Were there more of them? Did she even want to know?

Her body was growing still, but at the same time, it was beginning to fail her. Her consciousness came and went with the bursts of pain, and when she attempted to maintain her focus to signal for help, sickness overwhelmed her senses. Without hemolymph, her immune system was compromised. She could practically feel the viruses crossing from the mite into her body, the parts of her that would have developed into wings shriveling within her before they'd even grown. She needed her sisters to save her, to remove these mites from her cell, to nurse her back to health so she could fulfill her purpose in the *H I V E*!

Her eyesight continued to develop and pigment flooded into the compound eyes that ballooned from the sides of her head. As her senses refined themselves, she was able to finally see the red mites crawling through her chamber. They jeered at her, their faint yet foul scent permeating through the stifling cell. Or was that her? The smell of her own body decomposing? What scared her most was that she could not tell. But the air was hot and suffocating, and the pungent odor only weakened her more. Her once hardening cuticle softened under their barrage of punctures. The hoard feasted on her body. Her skin sloughed off, exposing her gooey insides to the heat. Something pooled beneath her, and she desperately wished for her sisters to save her before it was too late.

Day 11

Disease!

Infection!

Mites!

An alarm came from far away but rippled through the crowds of sisters that covered the comb.

Mell dully registered the olfactory signals; her body overwhelmed by pain and fear. But relief cut through the pain as easily as the mites continued to cut through her mushy body. The seeping puncture wound had grown with the constant aggravation. Delirious, Mell could only attempt to wriggle as the golden-brown cap on her cell was ripped away by her sisters. They had finally sensed her distress!

We are here! We are here! they signaled through large bites of wax.

For the first time, Mell *saw* her sisters. Their fuzzy outlines and dull coloration told her that her eyes were still underdeveloped, but she rejoiced that in time, she would be able to see them each as fully as they could see her now. They just had to get the mites off of her, just had to clean her, and she would be able to continue pupating, late, yes, but alive. A fuzzy golden face pushed through the entryway of her cell, and a pair of antennae prodded at Mell. The nurse bee's compound eyes glittered in the hexagonal entrance, and she cringed away from the putrid odor. Was that really her? Or the foul creatures that would soon be removed, one by one? Mell suddenly felt very, very weak.

One of the red creatures attempted to skitter out and latch onto the nurse, but she saw it and dodged its attack. It skittered down the edge of the comb, sending up the sharp scent of alarm as it went.

Mites! Varroa in the brood!

Soft antennae *bap, bap, bapped* over her face just as they used to do during feeding time, but the comfort left as quickly as it had arrived.

Diseased!

She raised the alarm, and with it, Mell was pulled from her

cell with a wet *shhhhlup* by another bee, an undertaker. Her white skin had decayed to a pallid taupe, and her underdeveloped eyes glazed over with ooze. Where were they taking her? To remove the mites and put her back in the warm, dark cell that she loved so much? Maybe a new cell that smelled like Mother and her sisters instead of the putrid creatures that had harmed her?

Instead, the undertaker descended through the comb with her dripping, oozy body, clutched in her gentle mandibles and forelegs. She climbed down the wall of comb and Mell vaguely perceived other cells dripping with foul odors and liquids. Bees all around her avoided the undertaker.

Disease! Disease! Disease!

She shifted, and the world tilted horizontally onto a new kind of floor. Harder than wax with a different smell but covered in waste, propolis, and...

The darkness receded, and fuzzy shapes grew somewhat clearer to Mell's eyes. Dead and dying sisters lay across the floor. Some furiously buzzed their wings, but instead of a shimmering film, their wings were no more than gnarled growths. Other undertakers and workers hurried to dispose of them, dragging their bodies toward a rectangular brightness that Mell instinctively knew must be the entrance to the hive. A fresh breeze blew through and Mell's developing trachea filled with a clarity that overwhelmed her senses. All pain ceased and her mind was occupied by visions of flowers, trees, and the sky. Other undertakers rushed past them carrying goopy clumps of what Mell first thought to be wax or waste clumps, but then their foul odors blew back at her, souring the breeze. Her younger sisters helplessly writhed in their sisters' grasps, their skin falling off of their bodies in slimy sheets that stuck to the floor behind them with brown ooze. Large red mites clung to them, and to Mell's horror, she realized there was one still latched on to her as well, suckling from the same infected wound that the first had created. Its mandibles mashed her flesh

into a runny paste and pain radiated from the site. Maybe the undertaker would remove them outside, and then she would be readmitted? Her sisters would heal her and she would return to her cradle. But as the bees approached the exit, and she could see the workers instead tossing her younger sisters over the edge, Mell was overcome with fear.

No! She couldn't! She wasn't ready yet. It wasn't fair!

She tried to resist, but her body was more goop than cuticle. The undertaker's wings droned into a furious buzz and she took off from the landing board, whipping her legs to toss Mell from her grasp.

Mell fell into a world of dazzling colors. The light blinded her, so used to the darkness of the hive, and shapes blurred past her on her descent. Her body hit something flexible and green, and her trajectory changed, springing into another pole of grass before finally crashing into the cool soil. Above her, the sky blazed blue and white between the leaves.

The world spun around her, eventually easing back into place as Mell's spotty vision adjusted. Some dirt had stuck to the goop in her eyes and her limbs were not yet able to fully move. Instead, she writhed in pain and confusion. Scattered corpses of other bees littered the area around her, dotted with the bodies of large mites. Some possessed crumpled wings, sticking out of their backs like shriveled, brown twigs. Some were like her, goopy mounds of pupae, already giving away into the earth.

The soil was cold compared to the warm embrace of the brood, yet the air was still terribly hot. It both chilled and suffocated the remains of Mell's body, and it was then that she understood that what had happened to her could not be fixed or rectified, that the changes she had been intended to go through would not happen, and that for the first time in her short life, she was truly alone. Her vision became clearer then foggy at intervals, failing and fading with her health. She was going to die.

A rustle from the shadows gave her pause and she struggled

to find the source of the noise. She quieted herself and listened. Another whisper. Then a step. Then another and another and another followed suit. The blades of grass swayed with the breeze, but there was something wavering between them as well. Another step. Mell fixed her eyes ahead and tried to see what approached

A tall, spindly figure emerged from the blades, cloaked in shadow. Its long legs crept over the greenery, thin and delicate. Mell watched it approach one of the corpses. It paused and then, with a crunching, wet reluctance, it began to eat. She wriggled, more so a repulsed instinct than an attempt to escape. Surely it would eat her too. The creature, a harvestman, stopped. It slunk closer, reaching curiously with its thin pedipalps, then drew away, as if surprised that Mell wasn't already dead.

It settled back onto its many legs, furling and unfurling to steady its bobbing body. The ooze obscured its face, but when it came closer again, Mell made out a pair of dark, globular eyes set high in its crooked face. Less of a face and more of a mask. A mask of death.

Hello little one. Her intentions resonated within Mell's mind in a deep timbre.

She tried to communicate back, attempting a chemical response, *Help! Please, help! H e l p!*

The harvestman studied her patiently. A long, spindly limb reached out and probed her body.

I cannot help you, she replied. *You are dying. Out here, your kind all pass within the night once they fall from the sky.*

No! No! Not f a i r! Mell signaled, frustrated. She never got to serve her purpose. Never got to serve her hive. And now she was going to die alone, without her sisters, without Mother...

The harvestman bobbed, considering her for a time. She delicately settled her speckled, brown body beside Mell. Up close she could vaguely see the patterns that raced over the top of

the arachnid's body segment. She examined her, a pedipalp gracing over the slime.

Fair? Fair is not a word in nature's vocabulary, little one. She looked around at the flowerless vegetation that surrounded them. *Have you ever stopped to think that maybe, we're all a part of something more than your hive?* the harvestman asked patiently. Mell detected a brief flicker of anxiety that permeated through her soothing signals, then disappeared.

No, she had not considered it. She had only been alive for mere days, learning only some from the bees who cared for her and the generational instincts that had just barely emerged from within her.

The harvestman continued, *There is purpose in life, yes, but out here, there is also purpose in death. The plants eat the light, the animals eat the plants, and then some animals eat other animals. Eventually all the animals return to the earth for the plants. It's the circle of life. You are serving your purpose as did they, and as will I one day.*

She gestured to the bodies of the other workers.

Abandoned! A l o n e! Mell signaled, desperate, but the creature *tap, tap* tapped her legs around her.

No little one, you are never alone in this world. This... changing world. You will rejoin your kind, just in a different way...

Despite her inexperience, Mell could tell that something else hovered behind the harvestman's all-too comforting words.

... *But?* she questioned.

The arachnid perked up and chewed at her palps, threading them through her mouth.

... *But, these cycles are not normal. The cold. The death. The Varroa swarming your ill-prepared hive in numbers unseen until the warm winters began. Had you had the time to grow, maybe you would have had the opportunity to adapt to the changing world. But you were not so lucky... All I can offer you in your last moments is comfort. I am so very sorry, little one.*

Mell wanted her to say more, to explain, but pain radiated through her melting body and she could not summon the energy to ask. Deep inside herself, Mell could feel something detach, as if her body was preparing her for what was to come. The creature shook herself and patted her while her vision wavered and her body twitched.

I am so very sorry, she whispered, watching over her.

Cradled between her sisters and the creature, the sweet, putrid scent of decay engulfed Mell. She curled into herself, and her pseudo-sight began to honey with mucus, turning the bright world dark shades of amber. Even though her underdeveloped heartbeat faded quickly, slowing and slowing with every burst of energy it took to pump hemolymph through her system, she looked toward the sky with a desperate hope that she was returning to something bigger than herself, that her hive would survive through the precarious spring and into the summer.

It was all she could do.

Part Two

FERA

The cold returned.

Fera, #2006, dug her claws into the landing board to stabilize herself against the biting wind. Above her, the steely sky darkened, and she hesitated to take flight. Instead, she shifted her focus from the racing clouds to her sisters below. Heaps of their bodies piled just beyond where the hive's wooden frame met earth. Some, still alive, seized and thrashed with some unknown pestilence. Their thin legs rubbed against their abdomens as if they were grooming themselves, reaching up and combing through their setae in sporadic bursts of movement. Those with deformed wings buzzed and spun in spirals, still attempting to fly. Fera watched one of her sister's futile attempts before she collapsed among the dead.

Distress gripped Fera's senses, and she retreated from the edge of the landing board. Her already anxious mind bounced between visions of her own death and the death of her sisters. Would it be better to remain in the hive and starve? Or to die attempting to forage? Although she longed to rest her weary body, she could not settle herself and paced, directionless. A few older foragers returned and made for the hive entrance. Food storers scurried out to relieve them of their nectar crop but they turned them away. They had nothing. Dejected, the workers retreated back into the hive.

Almost a week had passed since the last cold front froze the budding spring flowers off their stems, and the sudden heat wave that followed, however intense, had given the hive hope that the weather would resume its normal cycles. Foolish hope considering the warm, unpredictable winter weather that heralded the Varroa infestation, but still they hoped. What else could they do? A gust of cold wind nearly uprooted Fera from her spot and bullied the foragers in flight as if to emphasize their naïveté.

Fera considered the directions that another sister had danced for them this morning—*three miles from the hive... 78° by the sun... the human gardens*—and debated whether or not

she had the energy to fly so far from the hive in these weather conditions. In *her* condition... She shook herself and rubbed her face. No, she wasn't sick. She couldn't be sick! Just in case, she groomed her abdomen for any mites nestled in her setae.

Fera looked back at the hive and ached to return to the comforting vibrations and scents of home. To return to her first job as a nurse, feeding and tending to her baby sisters. But she was a forager now, and she avoided the center of the frames to spare herself the sight of the poor pupae and the possibility of infection. Shame crept through her at the relief she felt being a precocious forager, even if she was only a day into her new role. Not too long before this, she had only just gotten used to the routine of storing nectar and building combs, before the number of foragers continued to decrease and more food was needed to sustain the hive. She'd been promoted in a matter of days. But watching the undertakers excavate the oozing, putrified pupae from their cells while they cried out for their sisters to help them... She shook herself again to calm the tension roping through her muscles and the panic gripping her mind and groomed her antennae.

Those parasites. She hated them. They were responsible for the collapse of their hive.

Frantic buzzing forced her attention upwards, and she scuttled out of the way just as another forager crashed onto the landing board. She immediately started thrashing, seizures wracking her small body until the few specks of pollen that coated her flew off and into the wind.

... h o n e y – pain, pain, pain... 40° from the s u n!—fields—panic!... pain, pain, pain...

Her confused signals stuttered and clipped in time with her spasms. Guards rushed to her side, but even from where she perched Fera could smell the sharp tang of chemicals on her body. *Pesticides*. She moved back with her sisters. The guards held her fast, but there was nothing they could do. She died,

and the guards shoved her body over the edge with the others. Before the crowd could recoalesce, an undertaker exited the hive with a gooey mass covered in red mites. A pupae, barely formed, writhed beneath the onslaught of parasites, disoriented scent cues wafting off of her. She too went over the edge and the crowd of workers reformed.

Something stirred within Fera, but she steadied herself, faced the sky, and revved her thoracic engines. She could no longer sit idle and watch her sisters suffer. Everyone had to do their part to replenish their depleted food stores or else they would starve. Fera recalled the directions that had been communicated to her this morning, and took off in the direction the waggle dance had suggested. Before her wings carried her too high, she turned and memorized the location of her hive. With an aching heart, she forced herself away from the comforting sight of home, and set off to forage.

The wind battered Fera's body as she flew against the stinging currents. Fields of corn passed below her. Small green shoots sprouted in neat rows, dividing the brown soil into grids. She knew they would yield nothing but disappointment and pesticides, so she flew onwards over the rolling green and tan hills. Occasionally, she hovered between the patchwork to check if the frost had spared any of the wildflowers. But those that had survived refused to give up anything more than what Fera needed to sustain herself on her journey. She took off again, yearning for an early clover or coneflower to fill her crop and pollen basket with.

Along the way, she found a few dandelions scattered along the roads, and but what she collected stank of oils and gases. Cars roared past her, bending the weeds with their speed and drawing the wind after them. Fera braced herself against the spiky leaves and struggled to remember exactly which direction to continue flying in. Fumes confused her, but when she ascended to put some distance between her and the road, she recalled the directions clearer than before: *three miles from the hive... 78° by*

the sun... the human gardens...

Past the farms and the woods, the colorful gardens of the suburbs greeted Fera with open petals. Relief flooded her senses despite the exhaustion that tugged at her muscles. She chose a well-manicured garden, but as she descended, the chemical stench of pesticides rose to meet her. Desperate, she attempted to ignore the stinging olfactory cues to follow the ultraviolet nectar guides of a lungwort plant; but it was too much for her to handle. Disoriented, she abandoned the first garden and drifted to the next, then the next. Fera flitted from flower to flower, barely tolerating the noxious fumes that seemed to rise from every trimmed lawn in the area. Even then, not all of the dazzling flower yielded to her touch. The petunias' long bell shapes prevented her from lapping up the nectar at their core and forced her to accept meager amounts of pollen for her troubles. A small pot of marigolds resisted her prying and kept their nectar tucked beneath their layers and layers of petals just like the tight roses. She had some luck with a pot of lavender left outside on someone's porch, but as the sky got darker, Fera was forced to land and take stock. She was growing weak and knew that she would have to leave soon if she wanted to make it back to the hive with what little she had gathered. The cold gripped her muscles and forced her hemolymph through her body like sludge.

Fera hesitated on the lip of the pot and stress drained her of her precious energy. She struggled to remember the exact location of her hive despite her attempt to memorize it. But with some effort, she calculated its approximate angle from the dwindling sun and took off. This time the wind was at her back, and she hoped that it would propel her back to home, back to safety, back to her hive. But even though the wind propelled her out of the suburbs and over the woods, she felt the weakness in her body grow worse and worse. Something pinched within her body and her sight wavered. She hovered, attempting to

groom her face and focus on retracing her flight path back home, but the wind spun her through the air in dizzying spirals. She caught herself, but the large swaths of green and tan fields only confused her more. They stretched for miles in either direction. Was the hive two miles from here or one and one-half? Had the sun directed her 80° north or south by 55° ? A mental fog obscured the directions, and although she had not yet oriented herself, Fera took off as panic settled over her. She had to get home. She had to get home. Her antennae searched for the familiar bouquet of scents that her sisters shared, but she only detected a change in her own smell.

Before she could register if she was covered in pesticides or if an unknown disease had worked its way through her system, Fera's vision began to waver, and her sense of direction failed again. She flew in circles, flew too high, then, fearing for her life, she flew back down through the foliage. Leaves and branches whipped past her, knocking her from her path, and sent her crashing into the soil below. Aching and exhausted, Fera struggled to right herself and, defeated, resigned herself to the forest floor. Her body was failing her. She was going to die. Her hive was going to die. Although she carried just a small amount of pollen in her pollen baskets, she fretted over the amount that she had with her. It could have fed another sister, and here she was dying with it. Frustration made her wings buzz against the ground, and she spun in furious circles until she no longer had the energy to move. She could feel something pinch again in her body, and she shuddered, stroking her own legs and abdomen to soothe herself. Once the tremors passed, she beat at the ground with her forelegs. She shouldn't even be out here! She was supposed to work within the hive, not outside of it! She was still too young and now she was going to die all because... because...

Another tremor came and went, leaving her too exhausted to feel anything at all. The cold wind passed above her, and a chill settled over her body.

Oh, another one...

The signal, accompanied by a pungent, musty smell, made Fera surge to her feet, whirling toward the source despite her weakness. Within her abdomen, her stinger throbbed. At first, she couldn't tell where the signal came from among the grasses and dead leaves, but then, what she thought was a twig moved. Another followed, then another, and another, until a harvestman crept from the shadows.

Ah, still alive! I'm surprised after such a landing... she communicated, bobbing up and down with the uneven stride of her seven legs. Fera tensed. Harvestmen only ate the dead, but seeing the creature gave her no more hope for herself than she had before.

Your kind seem to be raining from the sky every day now, the arachnid continued. She was so close now that Fera could see the dark patterns flowing down her cream body segment. Her beady eyes glittered, and her orange chelicerae twitched.

Fera lashed out with her abdomen. If she was going to die here, she wasn't in the mood for conversation. She buzzed, wings revving angrily against her back, but they sputtered and the exertion made her vision dance.

Begone! She signaled, her alarm pheromone stinging the air, *Monster! Eater of the dead! L e a v e!*

The harvestman did not retreat, rather, she waited patiently until Fera's wings were gripped with the paralyzing seizures again and she fell to the soil.

Are you sure I am the one to blame in this situation? she asked calmly. Her long legs reached for Fera and before she could lash out with her dagger, the tip of the arachnid's pedipalp touched something on Fera's back. A burning shock of pain seared through her body and she spasmed. Although she could not see what she had touched, she instinctively knew it was a Varroa mite. The filthy creature scuttled across her thorax, foul legs gripping her body. It had been there all along and she had

not known. She tried to groom it off of her, now panicked, but the mite held fast despite her best efforts. Pain settled inside her organs at the puncture site, and something felt loose within her body. Fera's consciousness seemed to unmoor from her physical body. She stroked at her own legs again, slower this time, searching for other mites. Had she infected others? Who had infected her? When had the creature assumed command over her body?

Why... us? Why? Why me? Her mind fell into disorder, failure and loss and fear twisting until she could only think of the warmth of the brood before the chaos began, the smell of Mother and her sisters, and the feeling of safety that she thought she'd never lose. She regressed, searching for the comfort of her youth, *I... am young! Shouldn't even be... forager-foraging... But m i t e s...*

It's not just the mites. You must know this forager, the harvestman replied, but Fera interrupted her.

Still y o u n g! Should not be... forager yet! Not y e t!

Her emotions lashed out, unsure of who or what to blame.

The harvestman bobbed closer, and Fera could now see the closed wound where her one leg had once sprouted. Her beady eyes were cloudy and her exoskeleton was pocked with injuries. The scent of death surrounded both of them.

She said bluntly, *You're not a child anymore. The world decided it, now you need to face it instead of blaming others. That is the temptation of crisis: to blame one another for what they cannot control in a changing world. It's not just your hive under siege. I have encountered so many like yours. Parasites. Pestilence. Pollution. The world is out of balance. We are all feeling it.*

At this, Fera noted a tremor and sluggishness that seemed to weigh on the harvestman. Was she too sick? Sick from feasting on the contaminated dead?

But why? Fera asked, hurt by the reprimand no matter how

true it might be. *W h y?*

The harvestman considered her for a moment before settling beside her. Above them the weather raged on, the clouds obscuring the fading daylight.

Humans pollute the Earth with chemicals to bend it to their will. Their machines billow death into the air as they replace our natural ecosystems with desolate fields, sprayed down with more chemicals that run into our waters. The chemicals... they're in the air, the water, the soil, and now, they're inside of us. All of us.

The harvestman glanced at Fera.

We are too small for their consideration, my friend. Now we will all suffer because of them. Despite the influx of supposed nourishment... I fear that I too am unwell. But her gaze softened. *I'm sorry about your hive. I'm sorry about you.*

Fera took all of this in and considered it, thoroughly humbled. She had never questioned the nature of her hive, of how they fit in the larger schema of the planet, or what role the humans played in shaping their fate and the landscape. Could they have helped protect them from the mites? From the pestilence they carried? What else had the humans' ignorance destroyed? She tensed to buzz, distressed and angry, but she could no longer move. She thought of the infestation, how it would spread with the next surge of warmer weather, how it would fester during the frosts. Foragers would continue to die in the field, and pupae would turn to soup in their cradles. The hive would collapse and the world she once knew would cease to exist. Fera longed to be with her sisters and Mother once more.

I am... sorry, she communicated, *For you... t o o...*

Thank you, my friend, the harvestman replied.

A silence stretched between them, broken intermittently by Fera's seizures or the howling of the wind. Around them, the world grew darker, and Fera could no longer tell if it was because the sun was setting or if she was finally preparing to die.

Will you... stay? she asked the harvestman.

The harvestman considered her and settled beside her. Her eyes glossed over as she gazed into the forest, as if in remembrance.

Of course. I am so very sorry...

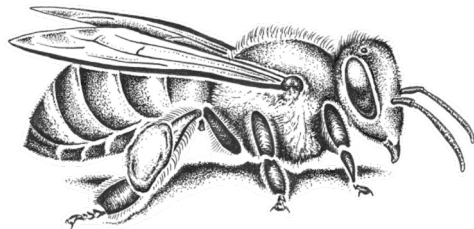
As Fera took her last breaths, she found comfort in the memories within the hive, and died imagining the possibilities of its future. It didn't have to be like this, but this was her reality, and no imagining could douse the pain that came with her passing. The harvestman stayed by her side, unmoving, even as dusk deepened into night.

How to Help!

Managed honey bees, wild bees, and other pollinators face serious threats in Pennsylvania and across the world. In the United States, 30 – 50% of honey bee colonies die each winter, and over 20% of pollinators in North America are threatened by extinction. For example: the number of butterflies in the United States has decreased by more than 20% over the last 20 years (Giacobino et al.).

A variety of stressors endanger managed bees and wild pollinators. For managed honey bees, Varroa mites are a major cause of winter mortality. Collaborative studies conducted by Pennsylvania beekeepers and researchers at the Penn State Center for Pollinator Research have shown that beekeepers that use multiple methods to manage Varroa mites have much higher survival of their honey bee colonies, and organic management methods are just as successful as non-organic methods (Gray et al., Underwood et al.). However, lack of foraging resources, exposure to pesticides, and extreme weather conditions provoke stress in honey bees, as well as other pollinators.

Everyone can do their part to ensure the health and well-being of not only our honey bee population, but other bee and pollinator species and the Earth we share.



"WHAT CAN I DO?"

- Visit The Center for Pollinator Research @<https://www.pollinators.psu.edu/>
 - Use the Beescape tool to evaluate the quality of your landscape for bees and other pollinators, and get guidance on what you can do to help: <https://pollinators.psu.edu/resources-tools/beescape>
 - Use the Bee Winterwise tool to understand bee colony winter losses in Pennsylvania: <https://pollinators.psu.edu/resources-tools/bee-winterwise>
- Learn about beekeeping from online courses and Extension materials available through Penn State Extension: <https://extension.psu.edu/insects-pests-and-diseases/pollinators/beekeeping>
- Read the Pennsylvania Pollinator Protection Plan, which includes chapters on best practices for beekeepers, designing forage and habitat, and using pesticides. Each chapter provides information on what people can do in urban, agricultural, and natural landscapes: <https://pollinators.psu.edu/bee-health/pennsylvania-pollinator-protection-plan-p4>
- Learn more about honey bees, native bee species, and other pollinators
 - Download apps like iNaturalist to engage with local flora and fauna
 - Support local beekeepers and pollinator conservation/research efforts
 - Note: The Penn State Berkey Creamery sells honey and honeycomb harvested from the

honey bees managed by the Entomology Department!

- Certify your property as a Pollinator Friendly Habitat through the Penn State Master Gardeners and Center for Pollinator Research: <https://pollinators.psu.edu/landscaping-for-pollinators/pollinator-habitat-certification>
 - Provide appropriate food sources
 - Provide water sources
 - Provide shelter and nesting sites
 - Remove invasive plants
 - Reduce pesticide use
- Advocate for bee-friendly policies
- Volunteer for environmental and sustainability initiatives
- Reduce your carbon footprint
 - Carbon dioxide (CO₂) emissions lead to climate change, influencing weather patterns that affect bees and the plants they depend on. Springs with extreme temperature fluctuations and late frosts that kill flowering plant buds, like what the bees experienced in the narrative, are two of the many outcomes of climate change.

OTHER RESOURCES

- Bee City USA/ Bee Campus USA
 - <https://beecityusa.org/>
- Local Honey Map
 - <https://localhoneymap.com/find-local-honey/pennsylvania/state-college>
- Museum of the Earth (Online bee exhibit)
 - <https://www.museumoftheearth.org/bees/>
- Pennsylvania State Beekeepers Association
 - <https://www.pastatebeekeepers.org/>
- Pollinator Partnership
 - <https://pollinator.org/>
- State College Borough Website
 - <https://www.statecollegepa.us/820/Pollinator-Conservation>
- The Environmental Protection Agency (Carbon Dioxide Emissions)
 - <https://www.epa.gov/ghgemissions/carbon-dioxide-emissions>
- US Fish and Wildlife Service Center for Pollinator Conservation
 - <https://www.fws.gov/program/center-pollinator-conservation>
- Xerces Society for Invertebrate Conservation
 - <https://xerces.org/>

Works Cited

- Barron, Andrew B. "Death of the Bee Hive: Understanding the Failure of an Insect Society." *Current Opinion in Insect Science*, vol. 10, Aug. 2015, pp. 45–50, <https://doi.org/10.1016/j.cois.2015.04.004>. Science Direct.
- Dale, B. A. "Onwards!" *Fiddlehead*, vol. 300, no. 2, 2024, pp. 38–65.
- Geffre, Amy C., et al. "Honey Bee Virus Causes Context-Dependent Changes in Host Social Behavior." *Proceedings of the National Academy of Sciences of the United States of America*, vol. 117, no. 19, May 2020, pp. 10406–13, <https://doi.org/10.1073/pnas.2002268117>. Proceedings of the National Academy of Sciences of the United States of America.
- Giacobino, Agostina, et al. "Preliminary Results from the 2025-2026 US Beekeeping Survey: Honey Bee Colony Loss and Management." *Apiaryinspectors.Org*, Apiary Inspectors of America, 31 Apr. 2026, <https://apiaryinspectors.org/US-beekeeping-survey-25-26>.
- Gray, Darcy, et al. "Effective pest management approaches can mitigate honey bee (*Apis mellifera*) colony winter loss across a range of weather conditions in small-scale, stationary apiaries." *Journal of Insect Science*, vol. 24, no. 3, Oxford Academic, May 2024, <https://doi.org/10.1093/jisesa/ieae043>
- Grozinger, Christina M., and Harland M. Patch. "Resilience and Collapse in Bee Societies and Communities." *How Worlds Collapse*, Routledge, Feb. 2023, pp. 296–312, <https://doi.org/10.4324/9781003331384-19>. Taylor and Francis Group.
- Grozinger, Christina M., and Harland M. Patch. *The Lives of Bees*. Princeton University Press, 2024.

- Laici, Nadège. *Secrets of the Bees*. 1-2, National Geographic, 31 Mar. 2026, www.nationalgeographic.com/tv/show/99802a2f-9b71-40fe-b3e0-39042897fa26.
- Moritz, Joshua M. “What’s It like to Be a Bee?” *John Templeton Foundation*, www.templeton.org/news/whats-it-like-to-be-a-bee.
- Muldowney, Micah. “Apis Mellifera.” *New England Review*, vol. 44, no. 3, 2023, pp. 23–34.
- Paull, Laline. *The Bees*. Harper Collins, 2014.
- Rueppell, O., et al. “Altruistic Self-Removal of Health-Compromised Honey Bee Workers from Their Hive.” *Journal of Evolutionary Biology*, vol. 23, no. 7, May 2010, pp. 1538–46, <https://doi.org/10.1111/j.1420-9101.2010.02022.x>. Wiley Online Library.
- “The Center for Pollinator Research.” *The Center for Pollinator Research*, The Penn State College of Agricultural Sciences, www.pollinators.psu.edu/SCR_026635.
- Tofilski, Adam. “Honey Bee | Honey Bee.” *Drawwing*, 2019, honeybee.drawwing.org/.
- Underwood, Robyn M., et al. “A Longitudinal Experiment Demonstrates That Honey Bee Colonies Managed Organically Are as Healthy and Productive as Those Managed Conventionally.” *Scientific Reports*, vol. 13, no. 1, Springer Science and Business Media LLC, Apr. 2023, <https://doi.org/10.1038/s41598-023-32824-w>.
- “Varroosis.” *USDA Agricultural Research Service*, U.S. Department of Agriculture, 27 Jan. 2021, <https://www.ars.usda.gov/pacific-west-area/tucson-az/carl-hayden-bee-research-center/research/varroa/varroosis/>.

"THE VARROA MITES... ARE THE MOST THREATENING, WIDELY DISTRIBUTED PARASITE OF BEES ON THIS PLANET."

- DR. SAMMY RAMSEY

The hive is collapsing.

Varroa mites scuttle between brood frames, liquefying pupae and vectoring diseases; seizing foragers return with empty pollen baskets, dragging the tang of pesticides behind them; and unexpected spring frosts destroy the budding flowers needed to fill the hive's depleted food stores.

Mell, #620, is a honey bee larva, content to eat and grow under the watch of her older sisters as she dreams of her future among them.

Fera, #2006, is a precocious forager who must brave the hostile and barren environment to feed her family despite the overwhelming stakes.

As pestilence sweeps through the hive, the two sisters are forced to confront the reality of the increasingly unstable world beyond their hive with help from an unlikely guide.

*Visit the Center for Pollinator Research to read online:
<https://www.pollinators.psu.edu/>*



Autumn D. Mitchell graduated magna cum laude from The Pennsylvania State University in May 2026. She earned her B.A. in English, a technical writing minor, and a creative writing concentration with distinction from the Schreyer Honors College. She will pursue an M.A. in English as a member of Penn State's B.A./M.A. Graduate Creative Writing Program and as a Steven Fisher Family Fellow. Autumn's work has been published in *Kalliope*, *Folio*, and *KLIO*.