Allegory

The Stairway to Firefly Heaven

By Logan Thrasher Collins

"When I die, I want to go to Firefly Heaven." My younger sister Beatrix told me. I was ten years old at the time and she was nine.

"What kind of a place is Firefly Heaven?" I asked her.

"It's a supercomputer in a satellite orbiting Earth. They put firefly souls in a simulation up there. Scientists built it to see if they could do the same with humans someday." We had been playing together in a meadow near our house that evening. All around us, fireflies like glittering emerald constellations spiraled dizzyingly, dancing to what I imagined as otherworldly bug music. One landed on my hand and stayed there for just a moment. I saw it look up at me with gleaming compound eyes before it flew away.

"Why do they put it in orbit?" I asked Beatrix.

"It uses neuromorphic quantum processors that need cold and microgravity! Isn't that amazing Luisa?!" She replied, her green eyes sparkling with excitement.

That night, I lay in bed after I was supposed to have gone to sleep, reading about Firefly Heaven on the glowing screen of my tablet. I found an article which explained how a robot performed a precise surgery on each insect, removing half of the little brain from the head and placing it in a powerful x-ray machine to map the hemibrain with incredible detail. A special kind of printer spat out an electronic replica of the hemibrain and the surgical robot placed this replica in the firefly's head. The process was then repeated for the other half of the firefly's brain, creating a cybernetic insect with an entirely electronic consciousness. But this was only the beginning.

High above my family's little townhouse, the satellite flew in geosynchronous orbit, its angelic white shell glaring brilliantly in the milky moonlight. Within that carapace, a supercomputer performed septillions of calculations every second, crunching the numbers faster than I could possibly comprehend, recreating thousands of firefly souls in a cyberspace world. But how did the firefly souls go from the electronic brains of the lobotomized bug heads to the satellite computer in the sky? I kept reading.

According to the article, the scientists had built a stairway to Firefly Heaven. Yet it was not really a stairway. It was a kind of email. Piece by piece, the data underlying the electronic firefly brain beamed up through the sky to reach the computer in outer space. By establishing back and forth communication between the cyborg firefly and the satellite's software, the insect's soul smoothly

climbed into heaven, leaving the original body behind. I fell asleep soon after finishing the article, firefly ghosts dancing in my dreams.

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Beatrix got sick when we were teenagers. Mum and Papa sat me down in the living room and told me that my sister had a disease called Progressive Osteonecrosis.

"I'm sorry Luisa. I want to be honest with you. This disease affects the bones. Beatrix probably isn't going to get better. We're looking into specialty hospitals. But it's not looking good." Papa told me. He had dark circles under his eyes and a deep slump in his shoulders.

"We might have to prepare for… for… well, saying goodbye." Mum said tearfully. I couldn't imagine my sister wasting away from some bone disease. She had always been known in our town as both a rebellious socialite and a young genius. She slipped out to late night parties with the seniors, took biochemistry classes at the local college, signed up for dance roles in all the school plays, and worked in a synthetic biology laboratory at the local university after school.

Despite my disbelief, Beatrix indeed began to show signs of the disease. She started having trouble walking and frequently winced in pain as she tried to keep up with me. One weekend, we went to the neighborhood park. She cried out in pain as she attempted to climb onto the play structure. Beatrix sat down on one of the swings instead. We watched the sun set in silence for a while.

"I had all these big plans. Finding love. Visiting outer space. Inventing things to change the world." Beatrix stated wistfully. We watched the cornflower blue sky fade to navy as the tangerine glow of the sun slipped beneath the horizon. Breeze shook the grass gently. I could see bright flecks of light as fireflies rose out of the field into the cool air. Beatrix turned and looked at me pleadingly.

"I want you to help me convince mum and papa to sign me up for that brain preservation thing so that there'll be a chance for me after I die. They'll listen to you."

"But that's not like how it happens with the fireflies." I replied, startled. "Even if they bring you back someday… you won't be you. I mean you'll be a copy of yourself. They'd have to do the whole hemibrain surgery thing for it to keep you as you."

"Yeah, I'd prefer it be the first me. But I've got important things to do in my life. So, I want there to be a chance that they can bring some version of myself back to finish them."

"Okay." I told her. "Yes. I promise. I'll get them to do it." I could feel myself tearing up. I tried not to think about the fact that my sister was going to die. She stood up carefully and hugged me tight.

It took some back and forth, but I did get our parents to agree to Beatrix's request. I don't like to think about the months that followed. Watching my sister suffer. Crying uncontrollably at the funeral and holding onto Mum. My only consolation was that we did get her brain preserved, locked away in a brain bank so that a simulacrum of her might someday finish the life she had started.

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During college, I signed up for an internship to perform research at the Carmichael Institute, the organization that had built Firefly Heaven. On my first day, I was led onto an elevator by one of the postdocs working at the institute and taken to the eighth floor. Bundles of multicolored wires were intertwined among rows of laboratory benches. Every tabletop surface was covered in bottles of various fluids, electrical breadboards, piles of resistors and capacitors, micropipettes, and boxy analytical instruments. Chromium pipes ran all across the ceiling like shiny pythons.

"Dr. Raphael will explain more later. But for now, I'll just say you'll be helping me study how the virtual environment influences the behavior of the fireflies. We're especially interested in long-term behavioral development." The postdoc told me. "Anyhow, welcome to the Raphael lab!" She strode over to one of the benches. "Know what this is?" She asked, picking up a translucent block of acrylic plastic. Looking more closely, I saw a pair of fireflies preserved at the center of the block, apparently locked forever in some kind of mating position.

"Uh…" I trailed off.

"Sometimes we like to take a sort of snapshot of their brains and peripheral nerves at interesting behavioral moments. Like here where they're… well y'know." The postdoc giggled. "Anyways, it's important to understand how synaptic weights and hormones and such change over time. We've got hundreds of these little cubes where the bugs get flash frozen and embedded. It's kinda sad actually. These two will never finish their little tryst."

"They could still be reborn as duplicates of themselves though." I replied defensively. Though it made sense that only a select few insects could go directly to Heaven with current technology, it did seem sad. I thought of Beatrix and wondered about her last wish. I knew she had felt that a duplicate of herself would in some way carry on her legacy. But I still felt frustrated that the original person who was my sister would not get to directly experience that legacy for herself.

"That's right. We could make copies of them if we wanted, but the originals will still be locked in this cube of plastic until it breaks down and they rot away a million years from now or however

long it takes for plastic to fall apart." The postdoc put the block down. "C'mon. Lemme show you the break room and introduce you to everyone."

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Part of my work at Dr. Raphael's laboratory involved putting on a VR suit and stepping into the world of Firefly Heaven. It somewhat resembled ecological field work, though the ecosystem here was virtual. Yet this was no mere video game. Dense racks of quantum neuromorphic processors in the geosynchronous satellite rendered an evening meadow with a level of detail that felt more real than reality. The breeze had just the right elixir of warm and cool to match the most luxurious of summer nights. I could hear the rustle of the grass in the dark and smell the musty spicy odor of the meadow's pollen. When I looked up, I saw a glimmering canvas of stars set against the blackness of outer space looking back at me, going on forever and ever and ever. When I looked across the meadow, I saw the fireflies. So many that the night seemed to drip with their whirligig lights, a coordinated constellation of tiny suns jittering and swirling as if playing out an astronomical story at accelerated speed, a stellar evolution of a billion years passing in a moment. Nebulalike clouds of fireflies twirled with ballerina pattern precision, shimmered, rose into the air, and dissolved before reforming and doing it all again. All the more strikingly, I knew that each and every one of these brilliant insectoid ghosts was the soul of a real firefly, transmuted into a cyberspace agent.

My task involved gathering video data on specific members of the firefly population each week. This amounted to walking around in the VR suit and tracking them with a simulated camera. For any given firefly, I could later access the neuronal activity recordings of every cell in its virtual brain. This allowed me to correlate neuronal activity metrics with behavior. Over time, I gained familiarity with a subgroup of the insects. One of the fireflies I nicknamed Jitterbug because she did a jazzy dance when she was hungry. Another of them I called Lumpy because of the irregular adipose bodies under his dorsal region. Still another I referred to as Moongirl since she frequently flew into pools of moonlight. The uniqueness of the fireflies manifested not only in their behavior, but also in their minds. Mathematical tools revealed distinct patterns in their thoughts, memories, and ways of experiencing their simulated world.

In the emerald glow of the firefly ghosts, I saw Beatrix's eyes. In the symmetries of the countless rows of electrophysiological membrane voltage recordings describing the firefly minds, I imagined Beatrix's mind. In the weekly Raphael laboratory meeting discussions, I wished that Beatrix was there beside me. I found myself missing her intensely. I called my mum and tried to explain.

"I feel like she should be here doing all those things she always talked about." I said over the phone.

"Luisa, I know it's hard to let go. But in the brief time your sister was here, she made the most of her life. I remind myself of that."

"It's not enough! She had so much more to experience and to accomplish."

"We can't do anything about it now darling." Mum told me.

"That's not true." I stated quietly. Mum paused for several seconds before answering. She knew I was talking about Beatrix's preserved brain, quietly lurking inside of a dark cryogenic container somewhere in California.

"You can't spend your whole life trying to salvage her dreams that way." Mum said at last.

"Watch me." I replied ferociously before hanging up.

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Ten years later, I was hired as a research group leader at the Carmichael Institute. I wish I could have said it was due to my unique talents or the scientific contributions I made along the way. I could have pointed to any number of my published research papers or funded grant proposals. But I knew that it was not just me who drove these accomplishments. Beatrix had died many years ago, yet it felt as though she was still beside me, telling me what to do.

As Beatrix had predicted when we were kids, the technology to map a living human brain and recreate a person in a computer had almost arrived. The Carmichael Institute was on the verge of doing this. We would first upload preserved brains before trying the process on living volunteers. Most of the components had already been put into place. Roboticists had adapted the firefly hemisphere replacement system for use on the human brain. The orbiting supercomputer of Firefly Heaven itself had undergone extensive upgrades to accommodate the expected influx of human minds. Software engineers had installed a virtual human town near the meadow where the fireflies roamed. Dr. Raphael himself, now the head of the institute, also represented the head principal investigator on the studies of preserved human brains. My research group focused on building a new stairway to Firefly Heaven, one which would possess the bandwidth to transmit human souls into orbit. Beaming up the fireflies represented a relatively easy task due to their much smaller brains, so new techniques were necessary to transfer the full load of human data safely and efficiently.

With Dr. Raphael's plans for preserved brains already in the works, I decided to take a chance. I scheduled a meeting with him and went to his office. Frost lined the tree outside of Dr. Raphael's

third-floor window and late afternoon sunlight sparkled through the icy crystals, making them look like diamonds on display.

"I know you've been making plans to source some human brains from the Brain Bank at Oxford General Hospital." I told him. "I'd like to call in a favor and add one more brain to the list." Dr. Raphael ran a hand through his thinning white hair and looked back at me thoughtfully.

"I assume you are talking about your sister's brain?" He responded. "What was her name again… Beatrix I believe?"

"Of course. Yes. I realize it may or may not be possible from a regulatory standpoint, but I'm not aware of any particular barriers." I said as calmly as I could.

"I've known you a long time Luisa. We've all gotten into this business for one reason or another. I can understand where you are coming from. So, I'd be happy to help you. Just send me the relevant information and I'll try to get it approved."

When I left his office, I sighed with relief. I had known him for a long time too, yet this had only amounted to a professional relationship. I had not been able to predict how the meeting would turn out. With the possibility of Beatrix's technological resurrection suddenly more real than ever before, I experienced a wave of nostalgia. I spent that evening remembering the nights we had played together as kids in a real meadow not too dissimilar from the simulated one in Firefly Heaven.

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Six months later, the day of the experiment arrived. I stood beside Dr. Raphael and the other group leaders of the Carmichael Institute in a control room full of postdocs and software engineers monitoring data on rows of computers. Beatrix's preserved brain would be exposed to x-rays powerful enough to capture images of all eighty-six billion neurons and glial cells along with its five hundred trillion or so synapses. These data would flow into one of the supercomputers in the Carmichael Institute's basement before transmitting piece by little piece into the deep blue sky and eventually up to orbit and the waiting Firefly Heaven. We only had one chance since the x-rays were so bright that they would also break down the preserved brain tissue even as the images were acquired.

Dr. Raphael nodded at me and smiled kindly before initiating the imaging sequence and the estimated time to completion appeared on a screen at the front of the room. Six hours and twenty-six minutes. I nervously chatted with the other scientists about the technical details of the project, ate a small lunch of pickled cabbage and dumplings, and waited. All these years of work could at last fulfill the last wish of my sister a few months before what would have been her sixteenth birthday. As the

clock counted down, I began to wonder what I would say to her. I had tried to plan out some kind of speech about a week ago but ended up abandoning the attempt. At that point, I had decided to follow my heart in the moment instead.

"Luisa!" Dr. Raphael called urgently. "There's a problem with the data transfer! Come quick, take a look at this!" A terrible spike of adrenaline surged through me. I dashed to the nearest computer terminal. Error messages scrawled across the output window.

"Critical Error. String assembly-network-adaptive not recognized. Critical Error. No input key found. Critical Warning. Backup storage buffer ninety percent full." I tried to make sense of them but could not identify what was going on.

"We're in danger of losing the data!" One of the technicians called out. I felt dizzy. I closed my eyes to think. I imagined insect souls flowing into the ground-based computer before shooting up to Firefly Heaven, hurtling through the sky on billions of electromagnetic wave packets. Then I understood. The instructions for transmission depended not only on the size of the data chunks, but also on their interrelationships as dictated by the adaptive software I had built with the help of my research group. Given the incredible complexity of the human brain, the adaptive software had reached a point where it could not accurately juggle the data chunks into place for reassembly into the complete connectome file. I began typing commands into the computer as fast as I could. For a few seconds, the error messages continued to repeat themselves. But then a green line of text appeared.

"System stability restored." I exhaled and sat back as the upload continued transmitting the contents of my sister's brain up to Firefly Heaven.

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A few hours later, Beatrix's brain had successfully climbed the stairway to Firefly Heaven, though the final loading process for converting her connectome into a functioning mind was still underway. We had prepared a simulated body for her in one of the apartments of the virtual town. After putting on a VR suit, I stepped into the room with her and sat down on a pale wicker chair next to the bed. She seemed to sleep peacefully there, looking exactly as I remembered her from when she was fifteen. The virtual body had been carefully reconstructed by artisans using my family's photographs of Beatrix as reference.

Her brilliant emerald eyes flashed open. She took a deep breath and turned her head to look at me.

"You did it." She stated happily. "You actually did it!" I reached out and took her hand. It felt warm.

"Do you really remember everything?" I asked. I was trembling.

"Well, I think so. No weird gaps as far as I can tell. Wow."

"Good. Good. Okay. That's amazing!" I replied.

"You look a lot older Luisa! How long has it been?" Beatrix inquired.

"About fifteen years."

"Not as long as I'd feared." She noted wryly. "What is this place anyhow? Is it something like Firefly Heaven?"

"Beatrix… this is Firefly Heaven." I told her. "Do you… do you want to go outside and see them?"

"Absolutely I do."

I walked her out of the apartment, along the cobbled streets of the virtual town, and into the meadow. In the cool evening air, millions of firefly souls lit up the field like a living galaxy of vivid green stars, dancing their primordial disco dance. I knew that this Beatrix was a copy of my sister, but she seemed so intensely alive, that it did not seem to matter anymore. The first Beatrix had wanted this. I could feel the crackling energy in my computationally resurrected sister. This reborn soul could at last fulfill the dreams for which the original had always yearned. Beatrix looked up and I could see the light of the fireflies reflected in her eyes.

"They're beautiful." I remarked.

"Just as they always were." Beatrix replied.