



Jupiter Cloudscape



by Ron Miller

Jupiter Whispers

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In very primitive conditions robbery is a moderately profitable enterprise. Where the rewards of labor are small and uncertain, and where all wealth is portable, the size of a man's wealth depends a good deal on the size of his club and the agility with which he wields it. But to the man whose wealth so largely depends upon his credit, dishonesty has become as precarious and profitless as honest toil was in more primitive times.

—Norman Angell

For small creatures such as we the vastness is bearable only through love.

—Carl Sagan

1. Descent: into the clouds of Jupiter

Mike Finn, formerly one of the brightest and most-promising AI programmers on Earth, had been assigned the temporary task of maintenance engineer. What made him accept the job was that it allowed him to visit Jupiter in person.

The cloud-tops grew noticeably larger as he dropped toward them, and the vast globe of Jupiter filled the porthole. The Big Planet seemed

close enough to touch, its brown belts the texture of hardwood, its zones the color of milk poured into a rushing river. Where these opposite-flowing stripes met, vast storms whirled to life. The most famous of these, the Great Red Spot, was a coiling mass of orange spiraling toward its red core. To Mike it looked like an Earth-sized yin-yang symbol tantalizingly out of reach.

“Janitor, you say,” said Chloe, his wife, whose voice and image had left their little condo in Seattle’s Queen Anne neighborhood on Earth nearly an hour ago. “I bet you’re the happiest janitor in the Solar System! Too bad you’ll have to go back to programming computers tomorrow.”

Chloe had surprised him by staying up late to place this call so it would coincide with his trip. She understood him well, knew that this was a peak moment in his life. He laughed aloud.

“Programmer, janitor, I don’t care. Today I’m going to Jupiter, by Jove!” She would groan at that tomorrow morning when she awoke to watch to his recorded response.

Mike turned away from the projection-frame’s camera to look through one of the six portholes spaced evenly around the hull of the vessel. Though it had been designed to seat twelve passengers back-to-back, each facing another with a porthole beside them more than a meter in diameter—“A window seat for everyone!”—JoveCorp’s little pipeline-maintenance climber now held only one. The climber was a donut-shaped lifting-body aircraft the size of a single-car garage, and it rode the pipeline like a bead on a wire strung between Jupiter’s atmosphere and the station tethered in orbit above.

Mike unfastened his harness. He did a quick, hand-over-hand lap around the climber, propelling himself from armrest to armrest, hooting, laughing, and generally goofing off. The climber was essentially in freefall toward Jupiter, the planet’s mighty gravity still barely a whisper at this great altitude and rate of descent, so when he misjudged one launch, he ricocheted off a porthole into the aluminum ceiling and back down

against a seat. He chuckled as he righted himself and continued the lap.

“I bet it’s all you can do to keep from going outside,” Chloe said from around the climber’s cylindrical core. Mike reached his chair, belted himself back in, swung the screen back into place, and smiled at the camera embedded in its frame.

“The only thing keeping me in here is your lovely face,” he said, panting slightly. “That, and the old man would fire me if I needlessly subjected my suit to that mess.”

With a quick wink, he turned and leaned toward the porthole. His suit’s helmet collar bumped the wall, so he couldn’t quite press his face against the shielded glass. Outside, the globe of Jupiter had grown. From this height, nearly half-way from JoveCorp Way Station to the cloud-tops, the cloud belts so filled the view that he had to lean left and then right to see the limbs of the planet.

2. Earth orbit: Virgin-Hilton Station

“Let’s try this again,” Chloe said. She put out her small hand to shake his; he took it instinctively, even as he felt silly for succumbing to such an automatic gesture.

“My name is Chloe Amunsson, and I’m a renowned researcher in the field of cryptography and cryptanalysis. I also occasionally consult with US government officials on matters of national security, helping identify patterns of threatening activity—”

“Chloe,” Mike said, but he couldn’t think of what to say next. She sighed.

“Don’t you see what I’m trying to explain, Mike? What would I do out at Jupiter?”

She gestured toward the panoramic windows surrounding the restaurant. A waiter smiled and nodded as he passed with a tray full of someone’s dinner; the aroma of prime rib and grilled vegetables wafted

close behind. The slight up-curve of the red-carpeted floor matched the station's rotating outer ring. Mike had hoped this special trip to space for a long weekend would put Chloe in the right frame of mind for his big news. He was beginning to realize that he had miscalculated.

"You're smart and capable of anything, Chloe," he said. "They'd hire you in a second, and just imagine what the stock options will be worth once the contract is up. The first employees are full shareholders in the most important company, um, ever!"

"Hire me to do what? Maintain the . . . what do they have out there? Pumps? Manage their computers?" Her tone of voice when she mentioned computers momentarily got under his skin. That was *his* job, and he loved his work. Then he felt ashamed for considering her tone to be a jab, as she had never derogated his profession.

"And what would I do with a lot of money?" she added. "I earn enough at the University to be comfortable, and the consulting gigs allow us to buy nice things when we want them."

Mike changed his tack.

"Chloe, I know how you love to garden." At this, she raised her eyebrows and leaned toward him, placing her elbows on the table and cradling her face in her hands as if to say, *This ought to be good*. "The hydroponics systems on Amalthea—that's a small moon—are vital to keeping the entire operation alive. The offer includes partner accommodation, and they have a list of available positions that come with full shareholder status."

"You want me to be a farmer in the sky? You're serious?" Mike simultaneously smiled—he remembered reading that old book—and felt his hope slipping away.

"Chloe, this is the opportunity of a lifetime! Living and working in the Jupiter system! First colonists beyond the Moon's little Mao City!" A trendily dressed, middle-aged man at the table beside them stared at Mike with an unreadable but stern expression,

and the bejeweled young woman dining with him smiled and looked away when Mike caught her glance. He lowered his voice to the volume of the ambient music, a sort of harpsichord/electric-guitar fusion piece that had been playing since they arrived, imperceptibly evolving as evening gathered its dark skirts across the surface of the Earth. Spreading darkness revealed diamonds embroidered into the black fabric as night spread across the world below, to which the station was tethered by Elevator Toyota.

“This is what I’ve dreamed of doing ever since I was a little boy,” said Mike. “I realized pretty young that I’d never become an astronaut, but this is even better. I’d not only be going to space, but I’d be doing real work, important work for a company paving the highway to the stars. They’ve handed me my dream on a silver platter. I want you to join me. I won’t do it if you don’t go with me.”

Chloe reached over the orchid vase at the center of the table to hold his cheek in her hand, cool against his fevered skin. She smiled so bitterly that Mike felt his heart swell; no one had ever been able to reach inside his body the way this woman could, to reach within and caress his heart and stir his blood. He opened his mouth to draw a deeper breath as his pulse pounded in his ears.

“My dear Michael,” she said. “I understand how you feel. You cannot and *will not* pass up this opportunity to live your dream. I won’t leave you, but I can’t go to Jupiter with you; I’m living *my* dream here . . . well, down there,” she tilted her head toward the long window, “on Earth. I’m doing important things here, just like you’ll do important things *there*.” She smiled again and leaned back into her chair. This was when Mike first realized her eyes reflected the color of the world below, and he hoped to never see a shadow cross them.

“We’ll talk every day if they let us,” she said. “Make sure that’s in your contract. How long will you be gone?”

3. Descent: in the clouds of Jupiter

Seven years. Remembering that conversation now, Mike couldn't recall if he'd said the words aloud. He couldn't remember much of anything after that moment, not what he'd ordered—though he knew their dinner had cost a week's salary—not what she'd said after that—though he recalled how tenderly they had made love in the low-g hotel room, the bed half filling a transparent bubble set into the outside wall of the station's hub; images of her face like cream and stars, her eyes as warm as her skin, the stars wheeling overhead as the station spun, her smile—oh, how her smile even now stirred him—and the Earth just beyond reach.

He remembered very little about the training and schooling JoveCorp had put him through during the following weeks; though he knew he had studied voraciously and learned everything he needed to know, he couldn't for the life of him picture where he had gone to classes or who had taught them. All he could remember right now was the hollow feeling of their parting as he marched from her embrace to the prep building at the base of the space elevator, Hyundai Road, the ocean breeze mussing her hair and the seagulls calling overhead, the scent of brine beyond the boarding platform. But mostly he recalled the heart-pounding emptiness that echoed within, the Chloe-shaped hole inside the shell of him as he left the core of himself behind on Earth. And he remembered the expression she wore so often after that: Warm but distant, concerned but proud, loving but already drawing away.

He remembered a few words she had spoken during his training, such as when she said, "It's all right if you see someone while you're out there. I don't want you to be lonely." He couldn't recall his verbal response to that, but inside he had shriveled a bit more, because if she said this, then surely she wouldn't want to be alone, either, and her allowing this for him was only half of the equation. But Mike had never

been good with people or conversations or emotional complexities, so he had probably only nodded, to which she would have put on a generous smile and kissed him. He wondered what she would think of Rita, the NASA scientist who had been so kind to him since his arrival.

“Darling,” Chloe said, “I’m going to bed now. I just called to say I’m so happy for you, that you’re living your dream, and that you finally get to see Jupiter for yourself. I’m sorry I can’t be there with you. The holos you’ve sent are astounding. I don’t know if I ever told you this, but it nearly killed me to see you go, to not go with you. If there had been something real out there for me to do, I would have joined you without hesitation. I just wanted to let you know that.

“Be safe, and don’t take any unnecessary risks while you’re down there. I miss you and I love you. Good night.”

“No bedbugs,” Mike said, a reflex from years of sleeping in the same bed. This automatic response made him smile.

He looked at the projection of his wife’s face. Her eyes were the color of the Earth as seen from space: rimmed in blue like the oceans, not bright blue as in photos of the Caribbean, but dark, deep; the irises brown like the color of the soil, rich with potential; with streaks of green the color of cultivated land, of growing things. When the call ended and Chloe’s voice was replaced with the random static of Jovian lightning against a background hiss of its mighty ionosphere, Mike backed up the message to watch her parting smile again; though her mic hadn’t picked up the sound, he knew it to be a noisy smile as her lips parted across her teeth.

He again looked into those eyes he hadn’t gazed into in-the-flesh for almost an Earth year. Here he was, riding a climber down into the clouds of Jupiter, and she was back in Seattle, facing her little green phone as she sat at the kitchen table.

Mike’s smile faded and he looked away, out the window, at stormy

Jupiter. This—life in orbit around Jupiter, the respect of his peers and superiors, working with the greatest AIs that humans had yet constructed, and of course this descent into the noisy atmosphere of the planet he loved above all others—this moment was the shining crown of his life, the goal toward which he had worked for decades, and he had earned it. He listened to the hum of the vessel's helium-plasma shield sheltering the little craft from the ravages of the Jovian environment, the crackling radio, and the quiet hiss of wind—*the voice and breath of Jupiter itself!*—and felt the faintest hint of Jove's mighty gravity, the grip of its hand on his body. He had risen as far as a man such as he could ever hope.

Here he was, yes, living his longest-held dream. But Chloe was sleeping in a bed seven hundred million kilometers away, a distance so great that any conversation included nearly two hours' delay between question and answer. And he could not touch her warm, soft skin; he could not point out the window and say, "See? It is even more beautiful than Earth!" and watch Jupiter reflected in those beautiful eyes.

But she wasn't here. The beauty of this world, this place banded with storm-embroidered belts, many of which could swallow the Earth in a single gulp, whose surface far below the cloud decks was hotter than the Earth's core . . . this place's beauty was pale and cold when he experienced it alone.

Be careful what you wish for, he thought. *You might just get it.*

A light wind buffeted the little maintenance-climber and drew Mike's attention back to the descent. He glanced outside at stormy Jupiter, smiled a little, then closed his eyes. Now, instead of hydrogen washing over the climber's hull he heard a spring's breeze brushing the dust from the roof of the little Ford inside of which he and Chloe had first kissed, waiting for a drawbridge to close near the University of Washington campus.

The siphon that the climber serviced was an eight-thousand kilometer-long pipeline formed of a hybrid carbon-aerogel and carbon-nanotube that sucked hydrogen and other trace elements up to the JoveCorp Way orbital pumping station, a dual-purpose tethered space elevator and pipeline. Erosion and atmospheric accretion deep down in the clouds had briefly halted operations. Don Williams, JoveCorp's founder, chief stockholder, and everyone's boss out here at Jupiter had banned all travel along the damaged pipeline until the repair bots had finished rebuilding it, so eighty Jupiter days had passed since anyone had taken this ride. The NASA guys had screamed when the climber was finally descending back into the skies of Jupiter without them. Margarita Sousa, the closest to a friend Mike had on JoveCorp Way, had looked a little hurt when he told her she couldn't join him. But Williams would only allow Mike: His mission, to direct the climber's AI as needed. Not a few JoveCorp employees had bitched to each other when they thought Mike couldn't hear, one suggesting he had provided "the Don" with sexual favors.

"Too dangerous for scientists," Williams had said in a rare one-on-one meeting with Mike in the CEO's glass-ceilinged office. "Anyhow, I need someone I can trust to do what needs to be done, exactly when it needs to be done, if things go tits-up. Your quick work with the station's AI saved our tanker from floating free when we started up the pump, just two days after you arrived. I don't want any spectators distracting you."

Williams had paused to flash a confidential smile. "Mike, you're the only man I trust with our assets on this one. We can't afford lose our climber, and we sure as hell can't afford to lose any personnel. So you remove the adhesions corroding our pipeline, get that climber safely back to base, and make sure you live to give me a full report. We need to stop this from happening again or we're in deep shit."

That was a lovely way of putting things, Mike reflected. His job was simply to man the ship while it finished cleaning up the residue and

retrieved the builder-bots that had rebuilt the lost kilometer of pipe. When that section broke free, it sent a nasty shockwave along its entire length to the station, halting all of JoveCorp's major operations.

Thus not only was Mike a glorified janitor cleaning up space shit, but he was a janitor pretty much just along for the ride. Sure, the AI—the climber's adaptive intelligence—might need direction and programming when things got exciting, but he was under no illusions that he could do anything if the climber's AI crapped out.

“Adaptive intelligence” was what had created JoveCorp. Rather, it had made Embedded Solutions and its founder, Don Williams, rich enough to create this company-town at the frontier of human civilization. Because true artificial intelligence—what people used to think of as “AI,” sentient computers—had never come to be, Embedded Solutions coined and trademarked the phrase “adaptive intelligence” to refer to the almost-infinitely fast and vastly smart processing blocks that operated most of modern human society. Embedded Solutions created software and, more important, interface solutions for human direction of these intellectually superior systems, and it owned the patents for the interface.

Computer scientists used to say that the old vision of AI would arise when we could build electron transistors; that soon turned out not to be the case. Then they argued AI would arise when we created quantum transistors; this, again, turned out not to be the case. Computers grew to be really, really smart, but they remained computers, machines, lacking true self-awareness or self-direction. Certainly they simulated awareness by keeping the vehicles they operated from running into one another, and they simulated human wisdom when they altered their decisions to reflect new information. Some even simulated emotions for the robo-pets and sim-avatars they operated. But these real-world AIs needed humans to guide them when they encountered problems that required creativity, insight, or direction. Even so, many

could not recognize this disparity and argued that because these AIs were smarter and more capable than humans, they deserved full legal rights. Several nations, notably France and Japan, gave them such rights. For most humans, however, the theoretical argument collapsed when someone thought to ask a computer if it desired rights. At first it couldn't answer the question; when presented with the full history of human rights, it did the computer equivalent of a shrug: "Not necessary."

So we bypassed the feared technological singularity. Though AIs now programmed themselves based on adaptive "learning" regimes, they still needed people with the job title "computer programmer," humans to work in higher mathematics to calculate AI call-equations, humans to man the graphical interfaces to direct the AIs when they hit logical impasses, humans to guide the AIs when their programming or information was insufficient to decide what to do next. Some AIs—especially new processors brought into the world without the advantage of well-sorted programming suited to their novel infrastructures—needed programmers for a month or more to help them through every decision-tree as they adapted to new information and new situations. Mike was one of those who rode the early wave of this new demand.

Contrary to expectations, the world was in greater need than ever of programmers, and not just for the brilliant AIs that predicted weather or performed particle-physics simulations; home computers used Embedded Solutions software to operate household systems, automobile computers used their software to operate the car's systems, the computers that ran the electrical grid used it for the fast-switching that increased overall efficiency, and so on. Embedded Solutions could, therefore, essentially mint as much money as it wished.

With this wealth, Don Williams had grown to be the richest person in recorded history, and with his wealth he had joined forces with other interests to begin humankind's slow transition from the cradle of Earth into the far reaches of the Solar System. A small part of that wealth hired

Mike Finn to act as JoveCorp's lead computer programmer. It meant he was always busy telling the fledgling computers what to do next, helping other employees work through the problem codes their subsystems sent them, and getting the occasional call to act as manager of a janitorial run.

Of course Mike had accepted the job of manning the maintenance climber's AI, damn the risks. This was his first chance to visit the Big Planet since arriving more than seventy Jupiter-days ago. Although many preferred to walk around on the real ground of Amalthea where JoveCorp mined carbon and farmed food for the other shareholder-employees living here on the frontier, a two-Jove-day trip through the clouds was top on most people's list of vacation destinations. That, and riding NASA's fusion-torch back to Earth. But that ship's schedule belonged to the rock-hounds, and the next trip wasn't scheduled until they sent their first shipment back to the resource-hungry home planet.

Without opening his lids, Mike checked the time display glowing in the lower-right portion of his field-of-view and saw that he was less than seven hours into the seventeen-hour descent portion of the flight.

He sighed. Time for sleep; he'd need to be sharp and focused when he reached the area that had been repaired. He set his alarm to wake him with an hour to prep for the cleanup job.

Mike woke to the plaintive cry of the climber's AI. He opened his eyes long enough to glance at the car's systems readout to make sure everything was intact, then outside to see how deeply he had dropped into the atmosphere: Pretty far, as thin clouds of ice crystals rushed by overhead, sparkling as the sun shone through them. Vast, stepped cloudbanks rose up on two sides of the craft, a cloud-valley thousands of kilometers long and hundreds tall. Lightning flickered within the stacked cloudbanks and pale storms swirled far below. The sun shone near the horizon—he couldn't guess if it was sunrise or sunset—setting the higher wisps afire in yellows and golds. One of Jupiter's moons shone like dull

silver against the blue sky. The view took his breath away.

It took all Mike's will to close his eyes again in order to view the low-contrast Embedded Systems interface information flowing across his lenses. He engaged the encryption schema. From the clock he learned that nearly eight hours had elapsed since he had fallen asleep. He reached out for his interface board and drew it to his lap. He noticed that it had gained weight, nearly half what it would seem to weigh on Way Station's simulated 1g. Mike swiped his fingerprint and sent his encryption packet to the craft's system, then opened his eyes once the readout announced that he was logged in to the AI.

"What's up, Climber?" he asked. They had established verbal rapport during the first few hours of the descent, and it could clearly understand his questions and commands despite his slight Minnesotan accent. Mike much preferred verbal communication with AIs to typing or interfacing with iconic GUI because he could speak more quickly than type or swipe. He watched the screen before him flash to life as it displayed the interface software and monitoring data. A red loop of code informed him that the AI had run into a decision-tree dilemma; presumably this was why it had brought the car to a halt.

"Obstruction on pipe blocking progress," said the AI named Climber. "One-hundred-twelve-point-six meters below present position. This is unexpected. Obstruction could pose a threat to operation. Shall I proceed toward obstruction?"

Mike leaned across the arm of his chair and pressed his cheek against the window, trying to see below. The climber's hull blocked his view, though he could see the pipeline diminishing from a meter-wide, black tube to a fine thread that disappeared into the clouds below, "Jovial Jack's beanstalk," as one wag had named it. A strong gust spun the vehicle a quarter-turn around the pipe so that the window faced a layer-cake of orange cloud decks lit with dozens of lightning strikes. The radio that he had left on provided a steady background hum and crackle. He

switched off the wireless comm speaker—though of course the NASA folks would spend hours analyzing the recording—and switched to the station-comm that used the pipeline’s semi-conductor properties to transmit messages.

“I don’t see anything, Climber. What is the obstruction?”

“Obstruction is of a solid and liquid composition primarily ammonia with methane, complex hydrocarbons, and other trace elements. This is unexpected at this location. Shall I proceed toward obstruction?”

“Hold, Climber.” Mike selected the comm channel for the station. “JoveCorp Way, this is Mike Finn aboard pipeline climber, come in.”

Not five seconds passed before he got a reply. “JoveCorp Way Station here. Go ahead, Mike.” Even though it was shielded against most of the raging electrical storms outside, the Beanstalk still acted as a giant antenna, so the hard line hissed in delayed sync with the flashes of lightning outside.

“Sir?” said Mike. “Mister Williams, is that you?”

“Yes sir,” answered the CEO of JoveCorp. “At your service.”

Mike smiled at this unexpected attention from the boss. “Um, we’ve encountered a new obstruction along the pipeline. Transmitting climber data now.” He instructed Climber to fire the sensor data it had collected up the pipeline to Williams in the station.

“Ah,” said Williams after a short delay. “Dammit. I didn’t think we’d have trouble this high on the pipeline.” He said something in a low voice, the sound swallowed by a series of crackles.

A spray of ice crystals scratched along the vessel’s hull with the sound of a boat sliding across a sandbar. Mike felt his stomach drop with dread; whatever was upsetting Williams so far overhead surely meant danger down here. The climber spun again as its tail kept its aerofoil nose pointed into the wind. On active descent, Climber overrode this configuration; while stationary or on ascent, it used the wind as an assist.

“Sir, is this the same, uh, accretion that initially brought down the pipeline?”

A pregnant pause. More lightning-induced crackling over the comm against a pulsing background hiss of static. Another wind gripped the climber and spun it a quarter-turn so that Mike’s window faced the sun through a halo of ice-rainbows. He could almost feel his tether to the station start to fray. Mike wondered what it would feel like to fall thirty thousand or so kilometers to Jupiter’s surface where hydrogen was solid at eleven thousand degrees Celsius and three million Earth atmospheres of pressure; of course, in Jupiter’s grip the climber’s hull would be crushed like aluminum foil within minutes of free-fall.

“It would seem so, Mike,” said Williams. Mike’s heart pounded against the prison of his chest. “But it looks like you got there early enough to remove it before it became a problem this time. I’m transmitting a command packet for the climber’s AI. Be sure it executes the command immediately.”

Mike saw the packet arrive. “Sir, it’s encrypted. I can’t open—”

“Don’t worry,” said Williams. “The AI has my key. Just make sure it has the direction it needs if it stumbles.”

Mike used the GUI to drag the packet’s icon to Climber’s command stack. He entered it into the queue with top priority. The AI instantly opened the packet and absorbed it into its stack. Mike watched lines of code spread and multiply, then disappear amid the processing background, which Mike had configured to appear as oceans and streams of dots: green for active, brown for awaiting activation, red for issues that needed his attention. The growing red lake was purged and everything went brown and green.

Climber released its brake on the pipeline and began dropping. This got Mike’s attention, and he closely monitored Climber’s processing. All seemed to be going smoothly, as the red looping decision-tree had been replaced by a series of green arrow-straight orders. Mike

could only watch the AI's processing each batch of code, not read the encrypted commands, of course, so he monitored Climber's progress via graphic representations, watching for telltale loops or skitters that might indicate logical faults or process overflows. He couldn't bring himself to look away from the holo-display at the grandeur for which he had crossed half the Solar System to see.

The climber slowed, then braked to a full stop. A new batch of commands targeted the vessel's life-support system. This got Mike's full attention. Was the craft's hull integrity failing? Had it been damaged by the same accretions that had eroded the pipeline?

Mike began to fumble for the helmet beneath his seat. Back at the station, he had trained how to quickly seal it to the suit's collar and had just tested it in front of José, the engineer responsible for survival gear, before he would let Mike seal the climber. Before he could attach the helmet, as he pictured the walls collapsing inward, Mike heard a shrill hiss emanating from below his feet. A line of code stood on the screen before him, counting down a ten-second timer. When the timer ran down, the hissing ceased and the vessel began to climb at top speed.

"Climber," said Mike, the helmet suddenly heavy under his fingers, "what are you doing? Do we have a breach?"

"No, Mike," it said. "Command executed. Progressing toward station as ordered."

"What just happened? What was all that noise?"

"Released one hundred kilos of oxygen into the area of the obstruction."

Mike let the helmet roll back into its sheath beneath the seat and looked out the window. Even though he knew the craft was rushing upward at great speed, he could barely discern any motion against the cloudscape. The clouds outside were of a scale alien to the water clouds of Earth's skies; these towers of methane, ammonia, and ammonium hydrosulfide stood hundreds of kilometers tall, each of the cloud-decks

higher than the lower atmosphere that supported life on Earth. A Caribbean hurricane would disappear in the eye of the frosty blue storm barely visible in the depths below. For a person raised on Earth, the scale was challenging to imagine: From up here, the horizon lay not a few dozen kilometers away but a few *thousand*, and the swirling eddies that whipped through these clouds gusted not in tens of kilometers per hour but in hundreds. And though the sky overhead was blue with oranges and reds halting the highest clouds, it was not the air of Earth but instead a poisonous mix of helium, hydrogen, and hydrogen-based compounds.

A forked bolt of lightning flashed from a nearby cloud, accompanied by a crackle over the comm. As the afterimage of the blue bolt turned red across Mike's field of vision, an orange ball of light appeared below the climber. Moments later, an explosion shook the craft.

"What just happened, Climber?" Mike asked, panic barely contained. "Are systems undamaged?"

"Atmospheric electrical discharge ignited gaseous hydrogen inside the accretions in the region of oxygen release. All vessel systems nominal."

"Is the pipeline intact?" Mike peered outside again, looking to see if the thread leading down into the clouds was still there.

"Pipeline appears substantially unharmed by the explosion," said Climber. "Further study of pipeline surface necessary to ascertain level of damage due to accretion, erosion, and fire. Do you wish to override return command and examine pipeline damage?"

Mike had to fight the instinct to run as far from the explosion as possible, as quickly as possible, but Climber was right: To determine the level of damage, they'd have to go back down there and check it out. The thought of returning to JoveCorp Way not only failing to have completed his initial mission but also as a coward who ran from his first difficulty was too much to bear.

“Climber, override return order,” he said. “Return to site of explosion, but slowly. Report all pipeline damage observed or indicated.”

The climber’s ascent halted and it drifted for a few seconds upward along the electromagnetic field surrounding the pipeline. Mike strapped himself back into his seat as he started to float up and his legs bumped the command deck. As his pulse steadied, Mike began to feel anger grow inside him as he thought about Williams transmitting that encrypted command packet without telling him what he was programming Climber to do. *He could have warned me! What, did he think I’d run when I knew what was about to happen? So much for trust.*

After a while, he noticed a slow gathering of weight. Because the climber used no motors, only varying resistance to the pipeline’s field, he couldn’t identify motion based on sound. The clouds outside were no help, either, because of their grand scale. Only the display’s altitude readout told him they were descending again at ten kilometers per hour.

When the speed of descent began to decrease, Mike asked, “Have you discovered any damage to the pipeline?”

“Approaching site of explosion. No significant damaged detected. However, part of the obstruction remains attached to the pipeline.”

Mike peered outside. He saw what looked like a bedsheet flapping in the wind, ragged and spewing liquid in streams that froze to sparkling crystals as they poured into the air. It appeared to be printed with a pattern not unlike Rorschach ink-blot, only red against the pale brown of the sheet. Soon the streams ceased, the crystal cloud wafted away, and the pattern faded. The sheet began to shred in the wind.

“Climber, how large is the obstruction?”

“Which one, Mike?”

Mike’s eyebrows rose. “How, uh, many obstructions were there? What are they?”

Less than a second passed before the AI responded. “Fourteen intact obstructions appear to be moving away from the pipeline at an

increasing velocity. They are purging hydrogen gas. An indeterminate number were destroyed by the explosion and fire, estimated at three.”

“Intact obstructions . . . ” Mike’s voice faded as he pondered that phrase. He looked outside for . . . for what, he wasn’t sure, more of the sheets, but could see nothing but clouds beyond the shredding sheet still attached to the pipeline below.

“Send an image of an intact obstruction to my display,” he said.

“Mike,” the vessel’s comm system said. It was not the buttery voice of Climber but instead Don Williams’ strong baritone. “You don’t want to see that.”

Williams’ suggestion spurred Mike as much as his curiosity to study the image that appeared on his screen. He felt a hot knot in his stomach. Mike did not respond to his boss as he tried to make sense of what he was looking at. It seemed to be a partially transparent cloud, but when he zoomed in and rotated the 3D image, he noticed that it bore similar markings to the torn sheet. It was roughly round with a flattened underside, like a soap bubble grown in dirty water. At high magnification, Mike noticed a texture like moss lining the bottom edge. Darker tendrils dangled below, twice as long as the bubble itself.

“Climber, how large is the intact obstruction on my display?”

“Zero-point-three-seven kilometer in diameter.”

Mike drew a quick breath. “Is that one larger or smaller than the others?”

“Mike,” said Williams, “come see me when you get back. Over.” Mike ignored the interruption.

“It is of average size,” said Climber. “They decrease in diameter as they purge hydrogen and lose altitude. They increase in diameter due to an unknown cause as they gain altitude.”

“Gain altitude . . . ” said Mike. “Son of a bitch.”

He looked out the porthole again, only this time he knew what to look for. And there they were: Barely discernable among the similarly

colored clouds and wind-swept sheets of ice flowing through the valley between mountainous cloud-decks. Dozens of them floated—no, *flew*, he realized—away from the pipeline, from the site of the burn.

“Jovians,” he whispered, his breath leaving fog on the glass. As he watched, he noticed that one of them was not far away, though it was nearly impossible for him to judge distance. It appeared to be at about the same altitude as the climber, its patterned surface pulsing in syncopation with the tendrils dangling beneath it. The surface—no, the *skin*, Mike realized—was like stained glass, transparent except where the darker reds of its patterns obscured his view of the clouds beyond. A long, brown streak marred the side facing him, and Mike noticed that something was spraying out of the bubble and turning to sparkling crystals on the wind. The Jovian’s pulsations decreased in frequency as it appeared to shrink. Mike watched as it crumpled in upon itself and sank into the clouds below. Finally it disappeared, too small or too far away for him to see.

Mike drew a deep breath, held it a moment, then released it slowly. He couldn’t tell if he was about to cry or scream.

“Climber, return to station.”

4. Orbit: JoveCorp Way Station

Don’s office was only about a tenth the size of his corner room in Safeco Tower in downtown Seattle, but he had it built near the zero-g hub of the station so it could have a full-glass ceiling. The view overhead was literally filled with Jupiter, the globe of the planet hundreds of times as wide as the full Moon in Earth’s sky, its roiling cloud-tops reflecting as much light as the sun on Earth during the four-hour Jovian daytime. Night was fast approaching, a hungry black shadow devouring the limb of the great planet; Mike could see bursts of lightning searing the clouds, some of those bolts as long as the Grand Canyon and generating as much

power as the combined output of all the electrical plants back on Earth.

Growing a bit dizzy with the lop-sided rotation of Jupiter across the sky, Mike looked away. Even now, many hours later, he was still full of anger and confusion, but the adrenaline had long burned out. JoveCorp Way continued its stately rotation about its axis, the great hydrogen siphon that was the reason for all this to exist here, so far from Earth.

Because the office sat a few dozen meters from the station's axis, it wasn't quite zero-g here, so objects tended to drift toward the outermost wall. Visitors and supplicants needed to pull themselves along the rope-mesh gangway from the door to Williams' desk. Mike reached the end and hooked his feet into the web, situating himself "up" according to the wooden desktop.

"Sir," he said, "is that what you sent me down there to do? To kill the first aliens we've ever encountered?" As it poured out of his mouth, Mike cringed. All the careful rehearsing he had done on the way back up here, all the words, how he was going to say this, all this evaporated in Williams' presence like Jupiter creatures burning in their hydrogen sky.

Williams' gaze fell away from whatever virtual work he'd been doing, and he focused on Mike. The skin around his hazel eyes tightened for a moment as he inspected Mike; Mike felt his cheeks grow hot beneath the scrutiny, like an ant being studied by some vast and unimaginable creature with a magnifying glass, the sun baking his hide. Williams looked up at Jupiter and drew a deep breath.

"Do you know why we're out here," Williams said, gesturing at the planet, "a billion kilometers from civilization?" Mike followed the man's gesture and watched the progression of night across the cloud-tops.

"To support the exploration of the outer Solar System, provide fuel for the asteroid miners—"

"I'm glad you read our charter," Williams said, dropping his gaze back to Mike's face. Now his eyes held their usual, laser-sharp focus. Mike couldn't look away if he wanted. "That's all true, and without us

exploring and exploiting this part of the Solar System wouldn't be viable. Coordinating what the miners are doing and what we do is a huge and hugely complex operation requiring everything to work as planned or all will fail. But I think you know what I'm *really* asking."

Mike paused for a moment. Even though he'd worked for companies owned by this man for nearly a decade, he was still a bit hesitant to express too much of what he held in his heart. Williams raised an eyebrow and began to look a bit disappointed at Mike's slow response. That got Mike to speak; better to get it out now, to gush his wild-eyed, fan-boy notions, than to disappoint the great man during a rare, one-on-one meeting.

"Sir, I don't know what you mean, exactly, about why *we're* out here," he said, "but *I'm* out here because I've been in love with Jupiter since junior high school. Discovering aliens . . . well, that's just so much bigger, something I hadn't even imagined."

The older man smiled. "Right. You're out here because you read *Farmer in the Sky* and *The Grand Tour* and fell in love with this place. You wanted to 'be a part of Humanity's future, and the nursery of our future rests at Jupiter.'"

Mike felt a rush of excitement: These were his own words! "You read my application?"

"Of course I did," Williams said. "I *am* JoveCorp, much as I *was* Embedded Solutions, before I sold most of my interests to form this company. Just like *you're* now JoveCorp, too. This is not just a company, it's a new model of stakeholder society. Would you want to drag someone forty light-minutes across the Solar System if you didn't feel you knew them inside and out? Each one of us is vital to this operation, and this operation is vital to the future of humanity. In a closed society like this, where one routine screw-up can destroy everything, you have to know and trust every single citizen.

"So of course I read your application. And your resume, your blog,

the code you wrote for Embedded Solutions, the AI direction scripts for our clients back when ES was just establishing itself as the premier software company . . . you name it, I read it. Just like I did for everyone else I brought out here, down to Jon Li in waste engineering. I feel like I know you from your work, Mike, and I trust the man I think I know. Don't tell me that I was wrong."

Mike felt a certain horror at letting down this man, but then he was struck again with the image of the Jovian creatures bursting into flame. He—Mike Finn, AI programmer and janitor—had murdered those gentle aliens, if not by direct action, at least by his inaction, by his lack of knowledge. Now that he had started letting it out, he grew animated.

"Mister Williams, sir," he said, composing his thoughts as best he could while his hands shook from emotion, "working here is the realization of my life-long dream, one I gradually let go as I grew older and learned how the world works. People don't get to live their dreams; heck, we watch them crumble as we age, and our dreams diminish. I know I did."

"That's why I built this company," Williams said. "To help people like you and me realize our dreams."

Mike frowned. He looked up at Jupiter. To either side of the Equatorial Zone above which JoveCorp Way hovered in nearly synchronous orbit, the North and South Equatorial Belts whipped in opposite directions, their differential speeds more than a hundred meters per second. Mike could almost watch new cyclones boiling up where they met, could imagine he felt the force of those winds transferred via the pipeline. The station's orbit was planned to carefully match not only the rapid spin of the planet but also the average winds whipping through the Equatorial Zone into which their pipeline dangled. Nearby, Jupiter's atmosphere swarmed with hundreds of storms each powerful enough to destroy Earthly continents, and dozens powerful enough to swallow the whole planet. Deep beneath the clouds burned the heart of a failed star,

an entity as massive as all the other planets in the Solar System, combined.

Despite these things, from this vantage point insulated by vacuum and separated by the entire length of the pipeline, Jupiter appeared serene. This duality calmed Mike.

“Without my even noticing it,” Mike said, “the scope of my life narrowed until all I could see was the work I did day by day. That and the people in my life, mostly Chloe. I was happy back on Earth, but maybe only because I no longer harbored those childhood dreams.

“But then, like you say, you started up this company! I couldn’t contain my excitement. I don’t mean that I didn’t enjoy my work back at ES, but, hell, I’d have signed up to clean toilets if it meant I could do it *here*.”

He gestured out the panoramic dome at Jupiter looming overhead in all its violent glory. Against the odds, alien creatures had evolved in such outrageous conditions. They lived and died in that horrible, beautiful maelstrom.

“This,” Mike pointed up, “is why I’m here.” He leaned toward Williams.

“But what we’re doing to the Jovians . . . that’s poisoning my dream. It’s like dumping filth into the river of the future, like all the sulfur and ammonia and other crap that pollutes the pure hydrogen we’re here to pump. If the future of Humankind requires killing the first aliens we encounter, what does that say about what we’ll do when we encounter the next? I don’t know if our future is worth the devastation it leaves in its wake.”

Mike breathed hard, caught between fear for his job and of disappointing this great man, and the anger and sadness that had prompted him to talk to Williams this way.

Williams nodded. “I understand what you’re saying. I don’t like this, either—”

“You don’t *like* this?” Mike said. “Sir, I didn’t *like* it when those radicals sabotaged the Boeing Space Elevator, and I really didn’t *like* it when hundreds of people died when it crashed down. That’s kind of a parallel dislike, I think. But these are *aliens*, sir, the first we’ve ever found, and I can’t accept that we have to kill them to keep the hydrogen flowing.”

Williams looked hard into Mike’s eyes. “Are you done? Because you might like to hear what I’ve learned about Jupiter’s gasbags.”

Mike licked his lips, but he had never been someone to think on his feet, and had said all he meant to say. He felt his pulse rise at the suggestion that anything Williams might add would sway his feelings about what they had done.

“All right, Mike, here’s the part you don’t know. Those ‘aliens,’ as you call them, are hardly even alive, three evolutionary steps below a jellyfish. They make slugs look like brilliant physicists. They’re dumber than barnacles, and nobody feels bad scraping barnacles off a ship’s hull.” Mike couldn’t stay quiet at that.

“Are you telling me that we shouldn’t feel bad about killing *native Jovian creatures* because they’re not very smart? And how do we know how smart they are? A lot of people don’t realize that their watches can compute faster than they can. Good luck giving aliens an intelligence test.”

“Mike,” said Williams, putting on a slight smile, “if they have brains at all—and you can examine what we learned from one of the specimens yourself—the highest form of thought we might expect from them is on the order of pollen deciding where to alight. The neural-type cells we have identified are fewer than you’ll find in a flatworm.”

Mike blinked a few times. “We have a Jovian here, on JoveCorp Way? But they’re so huge . . . we would have seen them. How come I’ve never heard of this before? That would have been huge news back home.”

Williams' smile broadened, and the man radiated his famous movie-star charisma. "You're right, Mike; we only have the remains of the solid parts, the organs, hauled up in the net we were going to fit to the pipeline's intake. The important parts of the thing aren't much bigger than a cow. The rest is just a thin membrane filled with hydrogen and a few hundred liters of sludge. I'll show you myself after this. You'll understand what I mean."

He rose from his chair and leaped over the desk, grabbing a handful of webbing to bring himself to a halt beside Mike.

"And I think you understand why this hasn't become news."

Williams smiled and nodded at the men and women they passed on their way to the storage room. He and Mike pulled themselves hand-over-hand along one of the station's spokes, a hallway painted with amateur murals depicting life on Earth, that led from the CEO's office to JoveCorp Way Station's core. Perpendicular to the core, the station's spokes radiated from there to the toroidal habitation ring sixty meters out.

After sealing the airlock behind them, the two men began climbing "down" the core. This was a tube thirty meters long and six meters across that housed the station's major electrical systems, capacitors, and related wiring, and through which the pipeline ran from Jupiter to the tanker docked at the "top" of the station. Jupiter's vast electromagnetic field charged the skin of the pipeline, and this collected energy in turn powered the pump, the station's electrical needs, and the helium-plasma shields that protected them from radiation and orbiting debris. A hum filled the chamber and resonated in Mike's chest as if they were inside a great oboe. He placed his hand against the protective mesh surrounding the pipeline and felt the same sensation he had felt as a boy touching a pipe leading away from a dam, water rushing through it.

"The pipeline's running again?" he asked, speaking loudly so

Williams could hear him over the hum.

“Yup, ever since you got back. But it’s losing efficiency again.”

Mike felt a chill creep over his skin as he realized what that meant.

When they had descended nearly to the base of the core, Williams ran his finger over a reader set into the wall beside a sealed door and keyed in his code. They entered a small room so cold Mike’s breath turned into clouds, much like during a Minnesota January. Williams closed the door behind them. The only objects in the room were two darkened display frames standing atop an inset desk, a pair of AI control boards wired to the desk, two chairs bolted to the floor, and another door. The inner door had a small porthole bolted into it at eye level.

“Mike,” said Williams, “only you, me, and three other stakeholders have been in here since we recovered this specimen. Everything we see in this room stays in this room. Do not talk to anyone, especially not the NASA folks; I wouldn’t trust them not to shut down our entire operation over a squished space-cockroach. And don’t call home to talk about it, no matter how carefully you think you’ve encrypted your call. You understand?”

Mike looked Williams in the eye and saw a wall of ice. He normally couldn’t read the man, but now the only thing he could sense was danger. Williams stood a few inches taller than Mike, was muscled like an athlete despite his age, but more importantly wielded more power than any thousand powerful men back on Earth, combined. On JoveCorp Way Station, Williams wielded absolute power over the two hundred or so living here and on Amalthea. An accident could happen, and no one would know what had caused it. Accidents happen on frontiers. He also wondered who these other employees were who knew, wondered who would be watching him now. He wished that Pater, the station’s AI, was an AI the way people used to imagine them: Coolly wise, above petty considerations, able to make decisions on its own. He wished it could tell the world and remove this weight from Mike’s shoulders. But despite its

vast intellectual capabilities, it was just another machine, dutifully fulfilling the instructions it was given, happy to perpetuate the cover-up.

Mike nodded. The moisture from his breath was cold against his upper lip.

Williams' fierce expression softened as he offered a quick smile and a curt nod. He sat and strapped himself into a chair facing the desk, then gestured for Mike to do the same. He spoke as he fired up the display and logged on to Pater.

"I'm granting you full access to the data we have on the specimen," said Williams, facing his holographic display. When Mike's display came to life, he keyed in the verbal-command UI. Williams turned away from his display and looked directly at Mike again, this time wearing an amiable expression that suggested they were life-long friends.

"Mike," he said, placing a hand on Mike's shoulder, "I'll leave you to this. You learn whatever you need to about these Jupiter jellyfish. Find out why they're attaching themselves to the pipeline like damned barnacles. Find out how they dissolve the carbon nanotube structure and why they do it. Find out how to keep them from shutting down our operations again—and I encourage you to find a way that stops them without making us have to burn them off the pipeline, if you can."

Williams smiled and looked suddenly tired. "Mike, I don't want to destroy them, either, unless it's the only way to maintain operations." He sighed deeply.

"Operations' is such a passive, clinical word," Williams said, "such a small way of viewing the value of our work. We do more here than support the asteroid miners, and I think you understand that. Without us, there would be no asteroid mining. Without the lure of the resources hidden away in those asteroids, Humankind would never have taken this grand and great risk to expand our universe beyond the safe, decadent orbital destinations. We are paving the highway from the cradle to the great unknown."

Williams gripped Mike's shoulder. His hand was warm. "Do you understand?"

Almost against his will, Mike nodded. Williams smiled and continued.

"Mike, I think you understand that we here at JoveCo hold the future of the human species in our hands. The resources we recover will one day put the stars one within our reach. But there's more to it than that. I built this company not just because I, like you, have always dreamed of working out here, but because I fear for the day some group of petty radicals sets loose a virus that wipes out all life on Earth."

Williams unfastened himself and rose to his feet, gripping a handhold set into the wall above the desk to keep from drifting away.

"Mike, politics are dangerous, a threat to humankind's survival. The work we do here is more valuable than anything that anyone back home is doing to combat terrorism or develop safe food sources. All that does is delay the inevitable. What we do here secures the future of our species and keeps our dreams alive.

"The future of Humankind is more valuable than the politics of protecting a few jellyfish, alien or not, Mike. I think that if you look into your heart, you'll find that you understand that."

Williams smiled again. A few seconds later, a puff of warmer air entered the room from the station's core as he opened the door, then he was gone.

Mike couldn't identify how he felt. He reminded himself that he was an engineer, not a psychologist, so he did what engineers did best: After warming his hands by rubbing them together, he set to work.

5. Descent: back in the clouds of Jupiter

Climber woke Mike from sleep, but this time it used a tone like a gentle ringing of a brass bell. Mike blinked awake and noticed that the

car was stopped and that he had weight again. Except for the AI, he was alone.

“Climber, is everything okay?”

“All vessel systems nominal,” said the AI. “Obstruction on pipe blocking progress. One-hundred-fifteen-point-two meters below present position. Stopped per your command and awaiting updated orders.”

Mike looked out the porthole and saw that the storms’ orange and blue cloud-decks had evolved quite a lot since his last descent, spreading farther into the calm valley between. From above, as the climber dropped from the station, he had watched the two storms spin like nothing on Earth; they were like a cross between hurricanes and something more defined and solid, like cloudy gears of a great machine, counter-rotating along the boundaries between Jupiter’s bands and zones.

Watching this and picturing the insubstantial remains of the Jovian he had examined in the little cold-storage locker aboard JoveCorp Way, Mike wondered how the dirigible-creatures survived in such violent conditions. What storm-resistant form had they first worn, and how had they evolved to their fragile present form? What did they eat? How did they mate? He had a million questions and doubted that this mission would answer many of them, but he had to find a way to prevent the creatures from damaging the pipeline or else they were doomed. He could not accept that.

“Send the optical data from camera one to my display,” said Mike. The GUI of colored dots vanished and was replaced with a staticky view from the camera he had mounted to the bottom of the vessel. He had neither the time nor the ability to hard-wire the device to Climber’s systems, so he had simply hooked it up using wireless. Conditions being what they are in Jupiter’s atmosphere, he felt he was lucky to see anything at all. He had also attached every other type of recording device he could appropriate without getting too much attention.

Margarita Sousa, one of the NASA scientists, had been happy to

supply the camera and atmospheric sampling sensors, but Mike had to stop her before she offered too much—which in turn would require her accompanying Mike on the descent: “This isn’t a full survey mission, Rita,” he had said. “I just need to sample the accretions so we can identify how best to clear them and prevent them from forming again.” That had earned him some grumbling. *If you only knew*, thought Mike.

At first, he couldn’t identify anything in the image besides a fuzzy shot of the surrounding cloud-decks with the pipeline diminishing from tree trunk to nearly invisible thread far below. He watched for many seconds, squinting during moments of poor reception and greedily drinking in the view when the image cleared. During a moment of relative electrical calm, Mike gasped. There! A Jovian!

“Awaiting command,” said Climber.

“Oh, sorry,” said Mike. “I didn’t mean to forget about you. Hold position until further command.”

Now that he had identified it, Mike could trace the Jovian’s outline even with the holo awash in visual noise. This close, it looked huge, nearly as wide as the camera’s narrow field of view. Mike looked up and out the porthole, and he immediately saw what he had missed last time.

Because it was mostly transparent except for its ink-blot markings, the Jovian looked more like a huge soap-bubble than any form of life found on Earth. According to the autopsy, the person who had recorded the data (and had left his or her name off the report) estimated its total mass at about three hundred kilograms, most of that concentrated in the mushy underside that was about ten percent of its total diameter at the climber’s current altitude. It had something akin to blood diluted in ammonia, and its long tendrils were formed mostly from hydrocarbons and sulfur. Most of this had evaporated on the trip to the station, leaving only a core lump that the unnamed researcher had labeled “vital organs.” Here were identifiable features like a fish’s cartilaginous mouth attached on one side to the long tendrils and to the other to a stomach filled with

a web of oily strands. Other organs were photographed and scanned in other frequencies, but bore no labels.

One, however, was identified as the brain. The image of the creature's brain had been obtained using a series of electron micrographs. It was comprised of structures that looked much like Earthly neurons though devoid of cell nuclei. These had grown from elemental carbon, sulfur compounds, and complex hydrocarbons. The brain's total number of neurons was approximately one thousand; they were connected by approximately twenty thousand synapses, thirty thousand gap junctions, and six thousand neuro-muscular junctions. The pattern of synapses showed little variation except for the neurons along one side of the brain; there, neurofilaments as long as a centimeter spread across the substrate of hydrocarbon goo held in place by the creature's ammonia-based skin. These appeared to terminate in the skin rather than linking to other neurons, so their purpose was not identifiable based on Earthly creatures' brain structures.

"The creature's brain is less complex than that of many worms," was the researcher's final comment on that organ: a condemnation. Mike wondered if people read science fiction anymore, if people had forgotten how to feel the sense of wonder.

The Jovian directly below the climber was attached to the pipeline sideways; that is, its dense underside and tendrils were attached perpendicularly, placing its mouth in direct contact with the carbon-nanotube surface. *It's chewing on the pipe*, Mike thought. But the material must have been far too hard for the bony mouth to do any physical harm, so some other reaction must have caused the damage. *Chemical?*

"Climber," Mike said, "how many more obstructions do you identify below the nearest one?"

"Seven within sensor range," Climber answered in its buttery-smooth voice. "Three currently attached to the pipeline. Four more on

approach. Shall I re-execute Director Williams' prior orders?"

"No," Mike quickly said. "No, hold for my command. Let me know if the pipeline becomes unstable or severely damaged."

He zoomed in using the camera's highest magnification but couldn't see anything new. *If only I could go down there and take a look for myself. . . .*

"Climber, bring us closer to the obstruction," he said. "Rate of descent one meter per second."

As they approached, the Jovian filled more of Mike's display, but he still couldn't see anything to suggest how the creature was damaging the ultra-tough material of the pipeline. He noticed that the tendrils, some as long as a hundred meters, were wrapped several times around the trunk of the pipe. They looked wispy up close, covered with something not unlike hair.

"Go away," said Mike. "Please. I don't want to hurt you." He turned on the wireless comm system and repeated his plea. The animal neither complied nor replied. *Worth a try.*

"At current rate of descent," Climber said, "vehicle will impact obstruction in ten seconds."

Mike drew a breath.

"Nine, eight, seven—"

"Stop," said Mike. He felt the vessel brake and bounce on the electromagnetic field it rode. "Climber, could the surface of the obstruction damage our vessel?"

"Impact would cause no damage," the AI answered. "However, gas pressure within the obstruction is unknown. Vessel is too close to safely release oxygen. Ignition at this distance could breach vessel's hull."

Mike sighed and looked outside again. This close, the creature's skin looked more like cellophane than soap-bubble, and Mike saw that its markings were translucent. He turned to stare at his display, zooming in and out, hoping to see something, anything, that might provide a clue

to help him solve this puzzle.

After a while, Mike began to notice the comm system's static noise the way one becomes aware of, say, a change in a car's engine sound during a long trip: The drone fades into the background after some time so that new sounds become immediately apparent. Between the static coming over the speakers and the visual static of the camera display, Mike began to notice a pattern. He held his breath and counted: One, two, three, four: *hiss-hiss-hiss*; five, six, seven: *hiss-hiss*; eight, nine, ten: *hiss-hiss-hiss-hiss*; eleven, twelve: *hiss*; and so on, repeating the Morse code-like signals in the same four groups in the count of twelve.

"Climber," he said excitedly, "analyze the pattern of ambient radio static and put it on my display."

The camera visuals disappeared and were replaced with an oscilloscope-like graphic. Climber showed the random background noise as a varying-density spackle of gray pixels, and what appeared to be lightning bursts as bright white spikes rising above and below the center of the display. But amidst all this noise, Mike recognized the heartbeat-like pattern he had seen interrupting the camera's wireless signal and heard over the comm.

"Chloe," he whispered. "I wish you were here. You'd have seen this right away." He lapsed into silence for a long time, watching the pattern but seeing his wife's quick smile and bright eyes, listening to the static but hearing her easy laugh, sensing the climber's shifting in the winds but feeling her warm mass against his skin.

"Is this display satisfactory?" asked Climber. Mike blinked a few times to free himself from his vision of Chloe.

"It's great, thanks."

Mike watched for several more full cycles and became convinced that what he was witnessing was a form of communication. He grew so excited that he couldn't sit still. He unfastened the seat belt and climbed onto his knees on the seat to get a better view out the porthole.

“As dumb as a jellyfish, my ass,” he said, looking out at an alien as large as a sports stadium. “You’re talking, aren’t you? Who are you talking to? What are you saying?”

Mike drew a sharp breath. “That’s it!” He buckled in again.

“Climber,” he said, “take us up to a safe altitude for oxygen release,” he said. He felt the vehicle accelerate, then slow again. A strong gust spun them nearly ninety degrees as they settled to a stop.

“I calculate this to be a safe altitude,” said Climber. “Shall I re-execute Director Williams’—”

“No,” Mike said. “As soon as the wind dies down, release zero-point-one kilogram of oxygen, one tenth of a kilogram only. Do you understand?”

“Acknowledged, releasing zero-point-one kilogram of oxygen.”

Mike heard the purge solenoid click twice, but the release was so quick that he couldn’t hear the liquid oxygen flowing from the vessel’s tank into the air of Jupiter. He studied the radio pattern on his display. As he had suspected—hoped, really—the pattern of radio static changed, but he could still recognize a pattern: A *new* pattern.

He looked out the window and saw that the Jovian had let go of the pipeline and was floating away.

“That’s it!” he said. He laughed aloud. “Climber, are the other obstructions still approaching the pipeline?”

“No, all obstructions are moving away from the pipeline. Three are rapidly descending below the visual cloud deck. The rest are slowly losing altitude while moving radially away.”

Mike looked out the window and watched the nearest Jovian drifting toward the storm on his left. As it accelerated, it seemed to shrink a bit, losing altitude as it flew through the clear sky.

“You can talk to each other,” Mike said. “You have radio voices.”

He grinned so hard that he seemed to be cramping unused cheek muscles. “You don’t like oxygen very much, do you? ‘Fly away!’ you’re

telling each other. ‘Danger here!’ But how? You’re not smart enough to talk, are you?”

He pondered that for a while but could find no answer. Then he was struck with a notion that both frightened and excited him.

“Maybe you have a boss somewhere telling you what to do, huh?” Mike peered out the porthole in search of something, anything, that appeared Jovian-like but looked . . . *different*. Then he spent several minutes scanning the skies with the camera in search of his hypothetical Jovian shepherd. He pictured it as similar in form to the other Jovians but bearing a heavier under-body gondola, one shaped like a human face, with big brown eyes and a huge brain-case. However, even with eyes now attuned to seeing living things in the shape of clouds, he could identify no such Jovian.

“Climber,” he finally said, “bring us down to where the obstructions were attached to the pipeline and examine the surface. See if you can find any damage, and if so, if you can identify any chemicals or, well, anything that might have caused the damage.”

Now we’re getting somewhere. I’ll look for your shepherd later.

6. Descent: back into the clouds of Jupiter

Mike had gotten one of the maintenance crew to install the climber’s remote-control service arm—it was only attached when needed due to its fragile hydraulic and mechanical parts—along with better radio gear. The arm held a weather-proof, paper-thin transmitter that said only one thing: “Fly away!” At least, that’s how Mike interpreted the second pattern of radio signals he had detected when he released the short puff of oxygen at the Jovians. When he had returned to JoveCorp Way Station and studied the radio recording from his first descent, he saw the same initial pattern that he had recorded when the Jovians fed on the pipeline—what he called their “Come eat!” message. Then he saw

the second pattern—what he called their “Fly away!” message—upon being doused with oxygen. Most important, he discovered that the signal hadn’t changed in magnitude, even after the Jovians had perished. Thus he hypothesized that the small-brained Jovians, themselves, weren’t the signals’ source: Something beyond this little herd of worm-brained dirigible jellyfish was telling them what to do: *An intelligent Jovian!*

They did, however, seem to emit a third, short-lived, signal when lightning set off the mix of oxygen and hydrogen, and Mike hadn’t seen that pattern repeated any other time. He had given it a name, as well: “Mourning.”

“Affix transmitter,” he told Climber. They had found the Jovians feeding on the pipeline once again, this time a few dozen kilometers lower than before. This altitude was where they had brought down the long section of pipe eighty days ago.

“Transmitter affixed,” said the AI.

Mike watched the radio pattern on his display. They were telling each other how tasty this big beanstalk was: *Come eat!* He imagined that this much carbon was a treat they couldn’t pass up, as elemental carbon was rare in Jupiter’s atmosphere. Because they seemed to use a lot of carbon compounds in their organs and nervous system, Mike hypothesized that they needed it to stay healthy and, perhaps, reproduce.

“Switch on the transmitter.”

He watched his radio display. The Jovian message of *Come eat!* and the new message of *Fly Away!* overlaid one another for a few seconds. Then the feeding message faded, and only the transmitter’s message remained. Soon, the Jovians reinforced the new phrase: Mike watched a duplicate pattern emerge, not quite in sync with his, but clearly the same pattern. Its amplitude was much stronger than the little transmitter’s signal.

He turned to the porthole and saw the Jovians float away. While planning this test, he had been unsure if the transmitter’s short range

would be able to affect the creatures: Jupiter's massive atmosphere and violent electrical activity swallowed up radio broadcasts in short order. But it seemed he had guessed correctly that the creatures, themselves, would help get the message out once they heard it.

Mike released a heavy sigh. He hadn't realized how much stress he had been carrying, how much he had feared that this wouldn't work. Success felt like removing a backpack full of stones, one he had carried for so long that he hadn't realized he was still wearing.

Mike Finn: computer programmer, janitor, and now Jovian whisperer. He drew a deep breath and smiled.

"Climber, let's go back to the station. I have another test I need to run."

7. Orbit: Margarita Sousa's office

In order to use the NASA-owned atmospheric probes, Rita had insisted that Mike operate them from her office. "I'm not letting anyone fly those things who isn't rated to fly them. The NASA officials back home told us that if we lose anything out here, it's lost. No replacements. I fly the probes or they stay on the station."

Rita's office looked much like any other room aboard JoveCorp Way: About three meters long by three wide, just over two meters floor to ceiling, with an airtight manually sliding door on the inner wall and a wide window on the outer wall. She had set four display frames atop a long desk, and two rolling office chairs faced the screens. A desk on the opposite wall housed another display frame, this one turned off, and some low-tech photographs of people, presumably her family or friends. Below the window, a planter sprouted a variety of plants that Mike didn't recognize except for the fruit-bearing tomato plant. He had smiled at that: Did she believe starlight and moonshine would help them grow faster? Seeing this little garden made him wonder how Chloe might use

such a space. Rita's office sat at the "top" side of the station's spinning wheel, so the window provided a view of stars and Jupiter's moons rather than the planet itself.

Mike and Rita studied the four screens, three of which showed visuals of Jupiter's many-colored cloud-tops rushing beneath the probes. However, Mike's attention remained fixed primarily on the fourth screen, the one that displayed three sets of radio data as well as the GUI for the station's AI, Pater. This display he angled such that Rita would have to roll her chair over to where he sat in order to see what he was really watching. Once when he glanced at a probe's visual display, Mike caught a glimpse of a Jovian. He quickly looked to see if Rita had also noticed it, but saw no recognition in her eyes; to her it must have seemed yet another drifting cloud.

"Mike," Rita said, "do you see that storm formation on Probe Three's cam?"

Mike turned to the screen marked 3. He wasn't sure what he was supposed to see, and he felt the skin around his eyes wrinkle as he inspected the holo-image. Had she finally caught on? Had she seen a Jovian? He felt both nervous and elated at the prospect, hoping that she had so he could end his silence and bring another in on his secret. He studied the image for several seconds but could see nothing except the usual stormy skies.

Rita chuckled. Her dark eyes sparkled, reflecting the holo image of the screen before her. "*Water*. It's a Type Nine cloud formation. That means it's made of water boiling up from deeper in the atmosphere that turns to ice just below visual altitudes. If we had a pipeline into a region like that, we wouldn't ever need to import oxygen again."

The only reply that Mike could think of was, *That must be a toxic cloud to the Jovians*. He nodded but remained silent, disappointed that she had seen merely another storm.

Mike realized that her eyes were turned to him now, not her

display. He glanced up.

“What are we looking for, Mike?”

“I’m just doing a broad survey—”

“Yes, yes,” she said. “I heard you the first time. But my team already ran countless surveys of the Jovian atmosphere long before you arrived on station. Why the full-spectrum scans? Did something in the electromagnetic spectrum damage the Beanstalk? And how did you ever get the Don to approve all this?”

Mike was almost as surprised to hear her use the popular names for the pipeline and Williams as he was to hear her guess so accurately at what he was really seeking. He cleared his throat.

“Actually, yeah,” he said, feeling his cheeks grow hot. “I’m interested in electromagnetic disturbance as much as chemical. Something is eroding the pipeline’s carbon-nanotube structure, and Climber’s data show that whatever it is also dissolved the carbon aerogel inside, too. I doubt that chemicals alone could do that, so I suspect ambient energy in Jupiter’s atmosphere is responsible, too. Williams is set on solving this problem. We also need to collect as much data as possible on what trace elements are blowing around down there. What kinds of acids form in those clouds?”

Rita drew a deep breath and leaned back in her chair. “Well, if you’re looking for trace compounds, you name it: hydrofluoric, sulfuric, nitric. These are all acids that combine with elemental carbon. But surely the trace amounts we find down there couldn’t have brought down the Beanstalk so quickly? You’re considering some kind of electro-chemical activation . . . ? Interesting notion.”

“That’s what I’m hoping to learn,” he said. This was at least partially true, because the Jovians had to do something besides chew on the pipeline in order to dissolve it. But he had solved the immediate crisis by installing the *Fly Away!* beacon—the real reason Williams had thrown so much support behind this experiment—and Mike’s latest

descent showed that the pipeline was clear all the way to its hydrogen-hungry maw, deep in the clouds. The *Fly Away!* signal was also still being amplified throughout the vicinity. That had been a happy trip. So what he desperately wanted to learn was if smart Jovians existed, or if life on Jupiter was no more complex than what he had already witnessed. He felt that the only way he could continue to dissuade Williams from killing Jovians was to prove that *intelligent* life existed down there with the jellyfish-brained creatures.

The voice of Pater, the station AI, spoke through the office comm speaker. "Probes are now releasing graphite payloads," it said. Mike and Rita turned back to their displays. The probes were spaced approximately equidistantly around Jupiter's Equatorial Zone.

"All probe systems nominal," said Pater.

Rita's eyes glanced from display to display, while Mike watched his radio readout. "How long can the probes stay in position near where they dropped that graphite?" Mike asked.

"At that altitude, they can't remain geostationary for any time at all," she said. "That's why I programmed such a hard burn. Each of them will reach the next probe's cloud of graphite dust in a little less than forty-three minutes to gather new data."

Mike felt his stomach drop. *In forty-three minutes, the Jovians could find the carbon, gobble it up, and disperse.*

Rita smiled. "Don't worry, Mike," she said. "We have data on atmospheric composition at the drop sites and can compare that with the new data the probes collect on subsequent passes. I'm sure that we'll be able to calculate how fast Jupiter's atmosphere oxidizes carbon. If that's all we learn, even if we can't watch the processes at work, this will be a valuable mission."

But it's the process that I need to record. He felt like a deflated balloon. For the next several minutes, Mike absently watched the radio data on his display, already starting to plan his next experiment. He

wondered how long Williams would continue to indulge him now that he had solved the immediate problem of the Jovians damaging the pipeline. Tests like this collaboration with NASA didn't come cheap in resources or the politics that Williams detested. Mike began to lose hope of ever finding a Jovian shepherd, and he wondered if anyone would ever witness the graceful movements of a regular, stupid Jovian again now that he had installed a beacon warning them away from the climber.

A small smile lifted his lips when he realized that at least *he* had seen them in person, perhaps the only human ever to have laid eyes on a living animal from another world. That was something.

Then a flicker on his display caught his eye. He drew a quick breath.

The probes were recording the *Come Eat!* signal. *All three* recorded it. Even though each probe had now flown hundreds of kilometers from the dump sites, they all picked up the message. What amazed Mike even more was that they all picked up the signal *simultaneously*, adjusted for the speed of light.

"What is it?" he heard Rita ask.

"Uh, just a sec," he said, mind racing as he tried to decipher what this meant. He watched the signals closely and noticed something he hadn't seen before: Behind the primary signal lay a complex secondary signal that looked at first glance like static. The only reason he saw it this time was that the static pattern recorded by each probe was different from each other probe—yet as he watched, Mike felt certain that he perceived a pattern to the static background. It was like a form of simple cryptography, a message buried within a larger signal. The fact that it varied based on location, yet the primary signal was the same across the entire globe of Jupiter

"They're all one," he whispered.

“What’s that?” Rita asked.

Mike cleared his throat. “You’re right. This is turning out to be an incredibly valuable mission.”

8. Final descent: into the mind of Jupiter

Mike had gotten backing from Williams for one last experimental mission, then he would be back to work directing the station’s AIs. He watched out the porthole as the climber descended once more into the clouds of Jupiter, marveling that only twelve days had passed since his first descent; that translated into only about five Earth-days. He felt that he had learned more astounding things in these few days than the entire human species had learned since it had first discovered that it shared the world with other thinking, feeling animals. Even if he discovered nothing new today, tonight he would go to sleep content—heck, elated!—with the knowledge that he was the first human being to ever talk to an alien species, never mind that all he had said was *Go away*. At that he felt a wan smile form on his lips, and he thought, *Typical*.

A gust of wind dragged its icy burden across the hull of the vessel like claws against glass, turning the climber to face the sun. Old Sol was rising over a bank of red and gold clouds. Rainbow-like haloes of ice outlined the distant sun in broad arcs. Directly overhead, a moon—*Ganymede?*—shone as a silvery disk floating in a dark blue sky.

“Third transmitter affixed,” said Climber.

Mike glanced at his display and noted the signal. Using the GUI, he moved the packet named *Hello* from his control deck to the transmitter’s command stack.

“Climber, activate transmitter,” he said.

“Transmitter activated,” said Climber.

Now Mike’s display showed not only the ambient *Fly Away!* signal, but also his new message. He had programmed it to transmit a simple

pattern: three consecutive prime numbers, then a gap of three, then the next three. Though this was a purely speculative experiment from which he held little hope of learning anything new, Mike felt that he had to at least give it a shot now that he had abandoned his theory of Jovian shepherds. After analyzing the radio data collected by the three NASA probes, he had estimated that as many as ten billion Jovians lived in the clouds of Jupiter. Each appeared as a point-source that served to amplify the collective radio network. This network was the *real* Jovian. They were all merely nodes in a far larger, collective brain. Mike hoped to learn if this brain was just a distributed network of jellyfish, as Williams called them, or if it was as smart as the amalgamation of its individual components. If the latter, this Jupiter Mind could be many times more complex than the human brain.

After eleven repetitions of this prime-number signal, he got a reply.

9. Orbit: Mike Finn's cabin

Mike finished recording his message to Chloe. He had carefully constructed it to look like a routine call home to the wife to ask once that she come join him at JoveCorp when the fusion transport reached Earth again in a few months. He was almost as surprised as he was pleased when Williams learned of the Jupiter Mind and asked if Mike thought Chloe would be willing to come out and learn how to talk to it.

"She's our best hope of talking to this thing," Williams had said. "I'd invite her myself if I wasn't worried that would draw undue attention. Give her whatever she wants, but get her out here. We can't even begin to estimate the value of this discovery until we start to understand what it's telling us."

Hidden inside Mike's recording was the real message, encrypted in an attached holo of the Jovian ice storm that had so pleased Rita. He locked his steganographic message in a second layer of encryption, using

the private key she had provided for him to use in messages he might want to keep absolutely private. They had used the key to encrypt erotic notes to one another, but they hadn't had any more important uses for it before now. Including an attachment would encourage her to scan it for secret messages, especially when accompanied by his off-hand comment about seeing the Stegosaurus skeleton at the Chicago Field Museum. They had never seen a Stegosaurus, nor had they ever visited that museum.

The real message, using simple text, read:

Chloe, how would you like to be the first person to hold a conversation with an alien intelligence? It thinks in maths far more complex than anyone out here can decipher. Here's a sample.

He added the long algebraic formula that he had been picking up since his prime-number experiment. Part of the response included a version of the *Fly Away!* signal, which made Mike a little nervous. Did it mean humans were dangerous? Was it ordering us to leave?

Please hurry. I'm afraid it's getting impatient. The complexity of the Jovian mind is far greater than ours, and I'm concerned that it might consider us to be trespassing.

I love you.

Mike looked at the image of her in his other display frame and smiled. "Let's see if you can turn down a challenge like this."

He hit *Send*.

Whether humanity will consciously follow the law of love, I do not know. But that need not disturb me. The law will work just as the law of gravitation works, whether we accept it or not.

—Mohandas Gandhi

