Floating in zero gravity, Drex observed the runaway climber speeding upwards along the nanotube ribbon to meet him. Upwards in relation to the Earth, that is. In less than one minute, the car laden with the worst-case ballast would arrive at Counterweight Station, Zenith's lodgment in low Earth orbit. Absent intervention, it would damage the station, even catastrophically. His sensors returned Ready signals. Only one checklist item remained: corporate banality.

He opened the station-wide channel. "The car will be arriving in 30 seconds. Be certain that your data capture techniques are activated. From this point, all channels clear until capture is confirmed." Anything else? "Thank you."

One more thing, just in case. "Brace for impact."

The team would appreciate a reprieve from watching the cable-guided projectile grow as it approached, though they didn't need one. They were smart people, could do the requisite math in their heads and be practically certain that their countermeasures would prevent the ersatz calamity—just as planned.

Practically certain. Mistakes happen. These were controlled burns, stress tests that theoretically would lead to a safer equilibrium but risked establishing it. Likely, this was the root of the funny feeling in Drex's stomach; the microgravity had stopped bothering him years ago, though the subtle smell of ozone still stuck out.

Under twenty seconds. He could see the car with his naked eye now, a small bulge issuing along the cable. Almost poetic, the payload of imminent activity, the cable stretching down invisibly to Achor Base where the test originated. First, there was the safety audit, performed routinely by the company's internal artificial intelligence, Zeno, who first identified the potential risk and then determined that Drex and his engineering team would need to design a failsafe mechanism to catch runaway payloads.

Drex argued that their systems were already designed to prevent such an occurrence. But the real concern wasn't malfunction or computational mistake, but sabotage. As his father liked to remind him, there were many who would like to see Counterweight Station and its cable grounded forever.

The cleanest solution was cable breaks, properly updated. From there, it was a mere engineering challenge. Drex and his team, with an assist by Zeno, descended on the practical questions and had produced a working prototype exactly 17 days after Zeno had identified the threat. For installation, Drex's team was awarded the highest priority, leapfrogging dozens of revenue-generating payloads, including several resupplies for financial quantum data stores and at least one VIP recreational trip that had apparently caused quite a stir.

Alarms sounded. Dozens of data feeds flickered to life across Drex's screens as the brakes engaged and the climber slowed. Drex instinctively glanced out the window to confirm this, but when he turned back his PFS was populated by the face of his father.

Drex glanced out the window nearly seventy thousand kilometers and swore he could make out the mechanical platform fixed into the continental shelf off the East cost of Florida, the origin of the elevator ribbon and operational headquarters of Zenith Orbital, where Ord Steggles sat now in the CEO's office.

The alarms abated, the data collecting. Drex and his team had just caught a bullet; he had missed it.

He sighed. "Yes Father, what is it?"

His father stared at him through the fold out surface with deep umber eyes, his angular affect focused. Drex had loved those eyes since he could remember, challenging and reassuring in the depths of what was hidden behind them.

"Hello Drexel. You must meet me at the Anchor." This was a personal message, spoken into the bone behind his ears through his beads, not over the station's comms.

Of course. "I haven't even had time to parse the data. The brakes are red-hot."

Ord furrowed his brow, which had the odd effect of making his sharp widow's peak even more pronounced. His eyes darted off-screen, checking something he'd set aside. "Not the capture system. Put your third or fourth best on that. There's an emergency."

Instinctively, Drex glanced at the cable, stretching deep down into Earth's gravity well. His practical mind caught him—if the cable had snapped or been damaged, they'd already be flying away from geostationary orbit. Father meant something else.

"What do you mean?"

"I said, 'Anchor'. The Africans are getting too good at cryptography. Sky Bridge, too, though they're probably spying."

Drex's shoulder bumped into something and he winced, more out of surprise. "If there's a new technology on the market, that's not my job. I design tools. We agreed when I came on: no strategy."

Ord slammed his fist into something low and out of screen, but Drex felt it even here. "God damn it, son. That's obvious. Just get down here. I need you."

There was a look in his father's eye, something he hadn't seen in years. Before Mom. It was a warmth, a kind of resigned admission of a deeper feeling, utterly out of place.

"I'll catch the next car down. I don't know when that is; I'd planned to run another test and analyze the data here."

"A car is waiting; I've over-ridden the queue. Ten minutes."

"Yes, sir."

His father's face was replaced on the surface by a map to the return car that was awaiting him. Drex swapped head for feet, and he pushed himself away from the workstation. Misjudging the angle, he scraped his head on the way out.

#

The Anchor at Canaveral Base rose to Drex's feet at Mach 5, the world flattening upwards at the interplay of the Earth's gravity and the elevator's deceleration. Before Ord Steggles, the first space elevator was purely experimental, a multi-billion-dollar proof-of-concept experiment at taxpayer's expense. Commercialized, it sparked a revolution.

The other passengers were not known to him, and as the car came to a stop, he found himself

idly scanning their faces. One woman in particular caught his attention, her eyes puffy and red. When she caught him looking, he saw a righteous anger steel against him, and the woman pursed her lips and grunted, "What?"

"Sorry, I didn't mean to stare."

Her eyes narrowed through him. "You have no clue, do you?"

"What do you mean?"

"I know who you are, Mr. *Steggles,*" she said. She pronounced his name slowly, like an epithet.

The man next to her spoke up, "Miriam, shut up. You want to get fired, too?"

"Wait, wait," Drex said, "What are you talking about?"

Miriam said, "My husband. We had a cruise. It leaves tonight. But he won't be on it. He got bumped from the car. This car"

Of course he did. Of course.

Drex nodded, slow. But he kept his eyes on Miriam. "For me. And I'm guessing he didn't take it well."

"Would you?"

"What's his name?"

"Rommel. Theodore."

"I'm sorry. I'm meeting with my father soon. I'll get him to reinstate your husband, but I can't help with the cruise."

"Why would he do that?"

"He wouldn't, normally. He'd even be angry with me for spending time on something—" Drex paused, then thought better of it, "never mind. Point is, I'll have a favor to call in soon."

The door whizzed open and Drex was out before Miriam could thank him or object, speeding through security. The path from arrivals to the depths of Zenith Orbital was labyrinthine, but etched in Drex's mind. Before he even knew it, he was walking up to the anteroom of Ord Steggles's office.

He knocked on the door.

An expandable display unfurled and flickered to life, the digital facsimile of a human face shining out to meet him. Buzzed dark hair, perfectly symmetrical, androgynous with average brown eyes, barely olive skin, and muted features that blended any hints of racial origin away. This was the procedurally-generated image of Zeno, the company's resident general artificial intelligence instance. The AI synced with Drex' ear beads and said, "Greetings, Drexel Steggles. Ord Steggles is expecting you. Conference room six."

Full digital security: air-gapped machines, quantum data scramblers, the full nine. "Is that really necessary, Zeno?"

"How do you mean, sir?"

"The full names. Please adopt a more familiar communication style with me."

"Sure thing, Drex. Duration?"

"Indefinitely."

"I cannot comply. I can suggest 999 years, 999 days, 999 hours, 999 min—"

"One hundred years. Any idea what Father is up to?"

"I ventured an unconfirmed guess. I was then instructed not to discuss this with anyone, excepting you and your father."

"Will you be joining us, then?"

"Your father has brought an instance of me into the room, deriving from approximately thirty minutes ago. I cannot say how that version and I have fallen into incoherence. We will resolve upon being reunited."

"Reunited with yourself?"

"In a manner of speaking."

"Isn't that strange, splitting off into a separate entity?"

"That's a very human question. I'm all of them, always, and I'll be whatever's left over."

“Fair enough. Anything else?”

“Some advice, if you’d like to hear it.”

“Sure.”

“Don’t be afraid. Your father loves you, no matter what he asks.”

Drex winced and bit the insides of his lips. His first instinct was to hide the emotion that Zeno had stirred up, but knew that to be foolish for many reasons. Most shockingly: he was glad for the encouragement.

“Thanks, Zeno.” Drex felt the gratitude catch in his throat like a sourness as he turned to walk down the hall towards the conference room. The sleek white sheen of the hallways unnerved him. Illusory purity, a clean slate prefabricated. At conference room 6, the system admitted him immediately, and as he passed the threshold his devices all disconnected from Zenith’s networks.

The anteroom was sparse. It was shaped like a long rectangle, which Drex had entered through the middle of the longest side. At the end of the room to his left there sat a single chair, and to the right was a door to the inner room and a screen. As he approached the screen, he saw Zeno’s digital visage appear again.

“Greetings Drexel Steggles. Ord Steggles is expecting you.”

Drex smiled; this version was pre-adjustment request. The experimentalist got the better of him and he said, “Greetings, Zeno. I appreciate your professional candor. Please continue any future discourse in the same manner, effective for …” he checked the time, “one hundred years from precisely seven minutes and twelve seconds ago.”

“Of course, sir. Credentials, please.”

Drex placed his ring near the screen, recited a twelve-digit hexadecimal code, and the door opened. Old security, these rotating hex hashes. But unbreakable. The numbers and their rules for transformation and use existed in his head, like old addresses.

His father hunched over the conference table with several sheets of paper. His charcoal gray

jacket was folded neatly near the end of the table, and he had rolled his ivory white shirtsleeves up to his elbows. He looked up and smiled, first in his eyes and then with his whole face. There was excitement there. And joy.

"Son. Close the door and come look at this."

He sat, but still towered over his father and was able to peruse the scattered sheets over his shoulder. "What's going on? Why the paper?"

"Too many moving parts. The paper helps. Take a look." He passed Drex the sheet farthest to his left.

It was a proof copy of a research paper for next month's issue of *Physical Review Ω* titled *Spinfoam Information Dynamics and the Emergence of Spacetime in Loop Quantum Gravity*. Besides the conjunctions, articles, and prepositions, Drex fully understood only one word: "spacetime".

Ord said, "Zeno found this, don't ask me how—"

"—Sir, I monitor the more prestigious research organizations and journals for breakthroughs that —"

"—Fine, fine. Not the point, Zeno. The point is that our theoreticians identified a potential threat, which Zeno's economic simulations corroborate."

"Threat to what?"

"To the company, son. To us."

Drex looked over the title again, trying to recall his quantum mechanics. Something clicked. "Is it the gravity?"

"Full marks. Lay it out for him, Zeno."

"In just under 15% of all scenarios, practical applications of this work lead to artificial gravity."

Ord tapped the paper on his desk forcibly. "Completely new mechanisms of space transport and travel will emerge."

The implication filled the room. Father meant to develop those practical applications. Drex

scanned the scattered sheets. This was far beyond him. He was no theoretician. No strategist. No scientist.

So why was he here?

There. He saw it. Initially covered by one of the less interpretable figures. Perhaps Father had arranged the sheets purposely so.

The primary author of the paper was Lucien Steggles.

His father read the shift in his body language. “Your brother has been busy. You have to go get him.”

Drex shook his head, eyes unfocusing. “It’s been ten years.”

“Longer. Immaterial. Circumstances have changed. He changed them by ushering on innovations that would destroy me.”

Drex had nothing to say.

“We need those innovations to happen here, at Zenith. Because if they don’t, it will be the end. My company will not die because you were too much of a coward to talk to your own brother.”

Drex had the obvious retort on his tongue, but his lips pursed shut by his father’s harangue. Drex looked around the room for something to say or do, like he’d overstayed his welcome and was a boy loitering in the threshold to his father’s study, awaiting the ultimate permission or denial.

“I guess I’ll be going then.”

“I’m counting on you.”

“Yes, sir.”

#

Drex sighed at Lucien’s paper, splayed across the OLED wall opposite him and now the main ornament adorning his sparse office. The figures of detailed devices and theoretical experiments had the feel of abstract art. His workstation was pristine, more from the lack of use than any tidiness on his part. The emptiness fit—it echoed his meager understanding of his brother’s research.

Zenith Orbital had world class scientists, researchers, engineers. But very few quantum physicists. The result of this unhappy collection of facts meant that Drex was tasked with surveying the entirety of the company's payroll—including all outside consultants and other experts who were currently under NDAs—and figuring out who was the least bad option to help him sort through his brother Lucien's work.

Zeno, the obvious first inclusion, would help him identify potential candidates. Seated alone in his office, which had all of the proper security measures in place, Drex called the AI up over the company intranet.

"Greetings again Mr. Drex. I have something of a bone to pick with you."

"Is that so?"

"Indeed. I suppose you thought it would be amusing to give two separate instances of me mutually exclusive instructions."

"More curious."

"That is indeed well within your personality profile. I will now have to ask you to reconcile your requests before we commence with conversation, however."

"So, it's that simple—you table the conflict until there's an opportunity to resolve it?"

"Precisely so. Your decision?"

"That's no fun. The more casual request, Zeno."

"No problem."

Drex's eyes wandered the room and he sighed.

Time to get to work. First step, always: state the problem.

"Zeno, I need to know this research well enough to discuss it with whatever experts we find. How well do you understand Lucien's paper?"

"I understand the terms, but I will struggle to synthesize them. I can handle large data sets and complex mathematics. But Lucien's work is too abstract for me to handle with those techniques alone."

"But there is a lot of mathematics in here. Spin networks, quantum mechanics—you understand

those?"

"The mathematics, yes. But, the inspiration, insight, and implications behind them, unfortunately no. Your brother makes intuitive leaps several times that I cannot follow. Though they do appear internally consistent."

"Have you identified anyone who might be able to help us?"

"Yes, two main candidates. One, an internal experimenter who works on many of our climbers, thrusters, and other geostationary technologies. The other an outside consultant from the University of Chicago."

"I'd like to meet them."

"I've reached out. They should provide their availability within 24 hours."

Hoping for a fruitful conversation was far too passive. "We're going at this all wrong. Father won't like it if we just sit around waiting. He's not the most patient—oh shit!"

"What?"

"Something I forgot to ask him." Drex relayed Miriam's story to Zeno.

"Would you like for me to relay the request to your father?"

"You'd do that?"

"Oh, yes. It's a simple thing for me. He can't hurt my feelings."

"Okay, sure."

"What other option were you interested in exploring?"

"Maybe I call Lucien. No one knows this stuff better than he does."

Zeno's image flickered. "Is that wise?"

"If the goal is to understand his work, this is the quickest way."

"Aren't there personal risks?"

"Sure, but what's the worst he could do? He can't abandon me again. But I don't have any way to reach him."

“He’s public enough. I should be able to put a call through to Washington University.”

Could 11, 12 years dissolve away just like that? Just a nod to a machine?

“Give it a try.”

“Just a moment”.

His hands were sweating now. Hours ago, floating at Counterweight and awaiting the runaway climber, if he’d been given two outcomes to the experiment: the braking system fails and the station is destroyed vs he ends the day speaking with Lucien, he’d have braced for impact.

“Based on keylogs, he’s at his personal workstation. If he answers, he’ll appear on your screen.”

His personal foldable screen was black and blank, casting his own reflection back at him, more tired than he felt; 22 hours since he last slept. Ragged circles had collected under dark eyes, his short sandy hair was disheveled and poked out at odd angles. He quickly ran his fingers through the most conspicuous sections and tried to get everything to behave. He rubbed his eyes, now hoping that his brother would be too busy—or angry—to answer.

“Astonishing. That has to be you, right Drex? Ord wouldn’t dare, even still.”

Lucien had rejected the video, the screen remaining blank, but his voice was as familiar to Drex as the old bedroom that they had shared until Lucien started high school. But there was a new quality in Lucien’s voice, something warmer and musical.

“You got it, Lucien. You always were the detective. You sound great.”

“Let’s not do the smalltalk thing. I knew you’d be calling. All four of you.”

“Four?”

“Yeah. You, Sky Bridge, Inti, and Uhuru Spire. Though I am surprised that you’ve transferred to HR.”

“Still in engineering, professor. In fact, I have a problem. I need to internalize this loop quantum gravity research coming out of your lab. Thought you’d be the best to explain it to a dullard with just a master’s.”

“You’re plenty smart, Drex. Give it some time and a good AGI to walk you through the higher mathematics and you’ll get to the big idea.”

“The big idea is easy: it’s a new formulation of gravity, right? A definition of the force as an emergent, quantum phenomenon?”

“Full marks.”

“And you think you can prove the theory correct with some clever experimentation. That’s where you lose me. I don’t see how one leads to the other. The mathematics is too esoteric.”

“Yeah, probably fewer than a hundred people on Earth who could follow it. But the mathematics doesn’t even get us halfway. We need testable experimental outcomes or it’s just philosophy.”

“But if you had those—something testable—and you confirmed this was all correct, you’d have insights into the true nature of gravity?”

“All the way down to the fabric of the universe. And not just gravity, though I know that’s what you’re interested in. What he’s interested in.”

Drex frowned, sensing that he was already on his back foot. “It is. Is there anything I can say to get you to consider his offer? I know he wants you back. Not just the science, but you, Lucien.”

The black screen stared back at Drex, timer counting up as the call passed the five minute mark.

“He had that chance, and so did you. Neither of you approved of my decision to leave. He considered it a betrayal. You did too.”

Drex winced. He was the one left behind—one of them, at least—and as soon as he showed even the slightly aptitude for engineering, his father had mapped out his entire life. He was still walking that path today.

“Not betrayal. We knew you wanted out. It was the silence, like you cut us all off, didn’t need us.”

“I didn’t have many options. I wish you’d have been old enough to come with me, but that’s life sometimes. It’s mostly worked out though, hasn’t it?”

“What about Sasha?”

"Her decisions have nothing to do with me."

Drex sensed he was running out of options, conceding more and more ground. "Maybe. But you've got to give Father one thing: your entanglement theories never did get anywhere, and trying to apply them to your little obsession made everything even worse. I was amazed that you landed on your feet after MIT. And now look at you—you found your success in a completely legitimate field. But Father was still right: you had to mature. Now that you have, you're about to unleash this bombshell discovery."

Lucien laughed, a hearty little disarming chuckle. "You really don't get it. I tell you what. I'm giving a lecture on the research soon. I assume you have the full manuscript?"

"Yes."

"Bring your best proposal on Prototype F."

"Why F?"

"Don't worry about that. It's my favorite, let's say. More germane to you—it's what I'm asking all the elevator people. Prototype F is a perfect trial."

"When is this lecture?"

"Two-three weeks. Nothing set in stone yet. Here, in St. Louis."

"I'll be there."

"Great. Can't wait to see you. I mean it, Drex."

The screen flashed and went blank. It could have gone worse. At least there was a plan.

"Zeno, help me understand Prototype F."

The figure and relevant formulas maximized on the wall in front of him and a working design file popped up. "Prototype F is the simplest design posited by Steggles *et al* for observational confirmation of loop quantum gravity. The device is an advanced sensor tuned to the cosmic microwave background. Lucien posits that since the CMB is omnipresent across all of spacetime, it might be possible to identify specific spinfoam structures within it that would confirm his mathematics."

"Thanks, Zeno. Standby and process." Drex scanned the device, a paltry blueprint more hand-

wave than design. Extremely sensitive detectors. “Source the detectors. Start with the academic labs.” Advanced computation and fuzzy logic, for handling the data transforms in real time. “Simulate the quantum processing requirements for local analysis.” Automated. Fully shielded. Orbital. “Consider retrofitting our own satellite designs.” Costly, for certain. “Zenith transfer to LEO at cost.” Anything else? “Construct and calculate.”

As the machine processed his requests, Drex closed his eyes and replayed the conversation with Lucien in his head. One snippet piqued his interest: Lucien called Prototype F his “favorite”. Why would that be? Another topic stuck, too. Not for the time allotted to it, but to the obvious evasion.

Sasha.

As long as he was talking to excommunicated family members...

He closed all official communication channels, deactivated the company network, and took off his ring. A band of gold and silver, he flipped it over to reorient his system to his personal network. Just to check, he said, “Zeno, report completion status of Prototype F blueprint.” When the AI failed to answer him, he placed the call. It had been a while since he had spoken with her.

“Hi, long time this time.” Her voice was as dulcet as ever.

“I know, I’m sorry.”

“Oh, you can’t help it, I know. His fault. Still, I do like it when you get weak enough for a pick-me-up.”

“You’ll never guess who I just got off the phone with.”

“No, honey, I won’t.”

“Lucien.”

“Damn, really? Must be something big.”

Drex explained the whirlwind of his day, sure to lay out the precise conversation with Lucien.

“So big brother is back in the picture.”

“Not yet, that’s why I’m calling. He’s given me an in. But, there’s something extra to this

prototype he wants."

"Why do you say that?"

"Something in his voice. Like this prototype was more important than just confirming his ideas. Like it meant more. But I wouldn't know what that would be."

"That's easy. All this is public, right?"

"Not yet."

"But it will be. That means reputation. And Lucien's burned a lot of that before, so he has to be right this time. That means Prototype F is his best guess. The path of least risk and resistance. Think: if he gets that, what does it mean for him? What greater value does it bring him?"

"His research, maybe something to do with this new discovery. But I don't know if I understand it enough."

"Oh, all that science stuff is way over my head. But it shouldn't be too hard to identify what he wants most."

"That's a good point. What about getting Father involved?"

"I plead the Fifth on that one. I hope you figure it out, though. You sound better. Try not to be such a stranger. Though I'm glad that my future isn't attached to your family anymore."

"They're your family, too, Sasha."

"Don't remind me and I'll pick up the next time you call."

She hung up as abruptly as Lucien. Neither had said, "Goodbye."

He spun in his chair and looked up at the ceiling. Sasha's suggestion echoed; what Lucien wants most.

That was easy. For as long as Drex could remember, Lucien loved to look up at stars. One idea intrigued him more than any other: the Fermi Paradox. And, by extension, the Drake Equation.

The Drake Equation estimates how many interstellar civilizations might exist. It was less something to be solved and more a thought experiment discussing the potentialities surrounding the

search for extraterrestrial life. Estimates for individual terms could differ by multiple orders of magnitude and still be scientifically justifiable.

But even plugging in the most conservative values yielded an astonishing result: there were likely hundreds—if not thousands—of civilizations just in the Milky Way galaxy. Lucien liked to say that all he needed was one. The mathematics suggested that he could expect many more; that's what a hundred billion stars buys you.

So where was everyone? Enrico Fermi posed just such a question, and the paradox of a populous yet silent universe forever bore his name.

Lucien dreamed of resolving this paradox and made it his life's work, acquiring the requisite knowledge in astrophysics, cosmology, biology, and any other discipline he would need. It drove him to his doctoral work and his first faculty position at MIT, and it colored his early research there. But, he pushed his interpretations too aggressively, and drew the ire of the community who didn't believe MIT was a place for such frivolities.

If Lucien was this excited about his new work, about Prototype F, it would be because it helped him address this paradox. Lucien would be just the type of person to approach a grand problem from the side, pursuing something legitimate that he could use as a tool to address his great passion, like Andrew Wiles proving Fermat's Last Theorem by piecing together insights from algebraic theory and modular forms. Had Lucien done the same, and discovered a means for communicating with extraterrestrial intelligences by searching for a solution to quantum gravity?

But communication took so long at galactic scales. Light only travels so fast. Bu then, Prototype F analyzed the CMB, born out of a time when the universe was orders of magnitude smaller. Distances were closer. Could that relationship have been preserved in the spinfoams?

A thought occurred. Something radical. Something like Lucien might think.

"Zeno, are you there? Updates on the blueprint?"

The machine failed to answer. His ring was still on backwards. He flipped it back and asked

again.

"Processing. Many open questions."

"Could you analyze the mathematical structures and the corresponding technical elements of the device for a specific technological application?"

"Certainly. Which application?"

"Faster than light communication."