

EARTH-SIM

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CHAPTER ONE

Definition of SIMULATION

1: the act or process of simulating

2: a sham object: counterfeit

3a: the imitative representation of the functioning of one system or process by means of the functioning of another

3b: examination of a problem often not subject to direct experimentation by means of a simulating device

– The Merriam-Webster Dictionary

A roomful of business-suited graduate students could make the most confident undergraduate feel like a gauche freshman again. With poise she did not feel, Jem Moran wove her way to an empty seat and settled into a chair set close to the ground. Neural receptors built into the chair's synthetic alloy frame analyzed her brain waves; the chair adjusted to her unspoken desires, boosting the seat off the ground and emitting a subtle heat to keep her comfortably acclimated.

Once settled, Jem glanced around. The classroom was one of the smallest on the Itibar University campus, with just enough seats for forty students. She concealed a smirk as a young man scrambled into the room on the heels of Professor Jahn Ptera. *At least I'm not the last to arrive.*

The remaining seat was at the back of the class, but the professor held out his hand before the student could make a dash for the chair. "Just wait here. We'll be heading into the simulation laboratory in few minutes anyway."

Equal measures of excitement and consternation flickered across the faces of her classmates. Jem supposed that the army of drunken butterflies in her stomach could be translated as "consternation." Personally, she would have classified the sensation as "barely concealed panic."

The professor, who looked like an old but still dashing movie star, smiled at the many faces staring at him. "Welcome to SIM-709. I'm not unaware of the effort that each of you put in to be accepted for this class, and I want to thank you for your enthusiasm. Make sure you hold on to that feeling. It is a yearlong class. Enthusiasm and energy can fade. Don't let them; a world depends on you." He chuckled at his little joke. "I'm transmitting a list of team assignments to your personal devices. Check it out, and find your partners while I get the androids in here."

Like most communication and data organization devices, Jem's personal device was built into a metallic band she wore around her wrist and connected to the neural processors implanted in her brain. A single thought summoned the interface; a swirl of colors coalesced in front of her into a palm-sized screen. Another focused thought located the list that the professor had sent.

Jem scanned it quickly. Her name was paired with Kir Davos.

She groaned aloud when she saw the hologram associated with the name of her assigned partner. It was the student who had arrived late for class, and like her, Kir was a senior, the only two in a class full of graduate students.

Damn. They were set up to fail.

She would have to make sure they did not.

Jem did not bother with the name of the android. The androids were all identical anyway, if not in appearance, then at least in function.

A lovely voice, too fluid and cultured to be real, interrupted her thoughts. "Good morning, I am SimOne."

"Jem Moran." Jem stood up and nodded, first at the android and then at Kir Davos who stood beside SimOne. The flash of irritation was so familiar that Jem scarcely felt it anymore. She had never understood the business logic of making androids look extraordinary. Why would anyone want to be overshadowed by a machine? Next to SimOne's long-legged, blond-haired beauty, Jem felt short and plain. The fact that her appearance just then was not her real one was irrelevant; the point was that she liked her spiky brown hair, snub nose, and large brown eyes. Looking ordinary and blending into the crowd were blessings she would never take for granted.

Kir, at least, was as ordinary as she was. He was short, though he still had two inches on her. His dark hair was neatly cropped and his features were unremarkable, save for his bright brown eyes and his enviably long eyelashes.

Her gaze shuttled between Kir and SimOne. They looked back. No one said anything.

Before their silence became awkward, the professor's voice interjected over the noise of other conversations. "Now that you've formed your teams, let's head into the lab. Once you're in there, your android will show you the way to your planet."

The titanium-reinforced double doors in the back of the classroom opened up into the simulation laboratory. Jem followed SimOne into the laboratory and froze when light vanished into the darkness of space. Her jaw dropped, and her eyes were wide with wonder. It was impossible to tell how large the room really was when there were no visible ceilings, floors, or walls by which to measure scale. The simulation extended in all directions around her, even above and below her.

The professor's disembodied voice spoke through an invisible sound system. "You are supported by an anti-gravity system that will allow you to move freely in three dimensions around the laboratory. The simulation's central command system is also attuned to your intended destination, and it will condense space to get you to your planets more quickly. Don't be surprised by the changing scenery. We'll continue the briefing when you've found your planets."

Jem lost sight of her other classmates as their androids led them in different directions. She followed SimOne, occasionally glancing back to confirm that Kir tagged along. Together, they walked into a spiral galaxy as massive as a storefront display on Coronation Avenue. The lights that swirled tightly around them spun apart as the simulation's central command system reversed the effects of space condensation. The faint gleam of the small star closest to them expanded into a large yellow star the size of the SIM-709 classroom. Planets churned into existence seemingly out of nothing, although in reality, they were merely emerging from the unpacking of the space-time continuum.

SimOne stopped on the outer edges of the star system. “We are here.”

For all its apparent size, Jem knew that the star system was tiny. She had personally traveled through star systems with four times as many planets and accompanying satellites.

Kir, however, looked impressed. “Are we supposed to manage the entire star system?”

“No, just the third planet.” SimOne stepped past the much larger planets whirling in elliptic orbits around their yellow star and pointed to a small planet the size of a human head. “Identification number 280-934-6253-4726-349573.”

Their assigned planet was less impressive than the star system. The planet’s surface was covered in water, except for a single, large landmass. Jem ground her teeth. They were starting out with nothing.

The professor’s voice spoke again. “All right, the androids confirm you’ve all arrived at your planets, so let’s get started. First, your android is your team’s interface with the simulation’s central command system. The androids will execute the orders you give. Of course, you can also directly manipulate the planet. The planets are real, as are the things on them, so please be very careful. As I’m sure you’re aware, this is a multi-year project. SIM-709 had its inaugural class last year, and those students set things in motion. They determined the laws controlling the universe—you have no idea how long those discussions took—and then each team was assigned a planet to manage. Your android has access to records of the decisions the teams made. I recommend you take the time to review the records.”

The professor paused briefly. “Adan Treb has a question: can we make different decisions? The short answer is ‘yes.’ The longer answer is, ‘this is your world.’ You’re making the decisions now. Within the constraints set by the greater rules of the game, the universe, you can make any decision you want. Just remember that it is a multi-year game. You’d want to have something—preferably alive—to hand off to the next team. By the end of the year, I’d like you to come up with something to call your planet other than its assigned identification number. Any other questions?”

“Can you please explain the rules or goals around the competition?” Jem asked.

There was a barely perceptible lag as SimOne conveyed the question to the central command system, which passed it on to the professor. “Jem Moran had a question about the goal of the competition. It’s both simple and incredibly difficult. Create a world worth living in. You were selected for your depth of knowledge in specific fields or breadth across many fields of study. SIM-709 is where it all comes together—physics, chemistry, biology, geology, mathematics, sociology, philosophy, psychology, the fine arts. The judges are professors from the university as well as experts and leaders in industry. They’ll review your progress throughout the year, and the winners will be announced at the commencement ceremony. Other questions?”

Silence.

“One more thing,” the professor said. “You can directly manipulate your planet, but not other planetary systems or interstellar objects. Put simply, in the event of a planetary war, you cannot stand in front of your planet and swat away alien spaceships. This simulation isn’t a test of your reflexes, though you may think it is. It’s a test of your planetary management skills. All interactions with other planets must be conducted indirectly through the life forms on your own planets, the managers of the other planets,

or the central command system. Don't bother trying to get around that particular rule. The central command system will not permit it."

Jem rolled her eyes. It was a relief to know that no other team would be able to spin her planet out of orbit and into the yellow star.

The professor's voice continued. "No other questions? Well, if you need anything, I'm here during the scheduled class sessions, and of course, your android is always available to interface with your world or give you a tour of the universe. Your names have been registered with campus security to provide you with full access to the laboratory at any time. The simulation is going to take more than five credits worth of time each semester, but I'm sure you were already aware of that. Go ahead and get started. Have fun out there."

Jem swallowed hard. *Great. No pressure.* SIM-709 was the most prestigious simulation competition on Sylvania, the ruling planet of the Etherian quadrant. She looked at her two partners, Kir and SimOne. "Shall we?"

"I guess so." Kir shrugged. "So, what do we know about this piece of rock? Well, SimOne?" he asked explicitly, when the android remained silent.

"Forgive me, Kir Davos. You said 'we.' I wasn't aware that you knew anything about this planet, and I didn't want to speak for you."

Jem suppressed a chuckle. *Androids with attitudes.* Who had programmed her?

Kir grinned, too. "What do you know about this planet?"

"It is young relative to other planets in the universe, and has completed four billion revolutions around its star. The planet's surface consists of liquid and rock. The poles are covered with solid ice or sea ice. The planet's exterior can be considered stable. However, the planet's interior remains active. It has a solid inner core made of iron, a liquid outer core, as well as a thick, relatively solid mantle."

"A liquid core? That doesn't sound stable to me," Kir said.

Jem agreed. "There's probably a fair degree of geological activity. What about the crust? Is it moveable?" Cautiously she poked a finger at the large land mass, and it shifted slightly. Water sloshed over its edges. "It's definitely not stable. It's not even attached."

"It looks like we have our work cut out for us," Kir said. At least they agreed on that point. "Can you describe the crust, SimOne?"

"It is primarily silicate."

"Primarily like fifty-one percent or—"

"Ninety percent," SimOne confirmed.

"So we have silicon-based life forms on this planet?" Kir asked.

"No. The life forms are carbon-based."

Jem's eyebrows furrowed. "Wait, the crust is ninety percent silicate, but the life forms are carbon-based?"

"Carbon-based life is more reactive," Kir interjected before SimOne could reply.

"That would fit with everything we've learned about this planet so far, then," Jem said irritably. "We should just delete the word 'stable' from our vocabulary."

Kir laughed. Somehow, she did not get the sense that he was laughing at her. "Carbon atoms tend to form long chains, making them both stable and reactive, whereas silicon tends to form crystal lattices, making them far less likely to re-combine in different permutations to support life."

“Are you a carbon chauvinist?” she asked him.

He grinned. “As a carbon-based life form myself, that shouldn’t come as a surprise to you.”

“Chemistry major?”

“Mechanical engineering, then I wised up and switched to the Business school instead.”

“Hmm...”

“Is that a good ‘hmm’ or a bad ‘hmm’?”

Jem smiled thinly. “We’ll have an entire year to find out. I’m majoring in Biology and Philosophy.”

“Hmm...” Kir took on an air of studied thoughtfulness. “I’m a little afraid for our world now.”

“Great. You’re catching on. I became afraid for it ten minutes ago. Zero stability.”

“Change is a good thing. If you’re not growing, you’re dying.”

“Dying counts as change too,” Jem pointed out.

“Fair point.” Kir looked at the android. “How are you getting information out of the planet? Do you have sensors implanted?”

“Yes, we do.” SimOne held out her hand. From the base of her palm, light emerged and took on the form of a gelatinous circular mass with long, trailing tentacles. It shimmered, pale and translucent, undulating with unnatural grace.

“Cnidarians?” Jem’s eyes widened. “You implanted Cnidarian sensors on the planet?”

The android inclined her head, the gesture stately. “Zaaf Farron made that decision last year. Given the abundance of water on the planet, Cnidarian sensors appeared to be the most viable strategy for monitoring the planet.”

“But what about the landmass?” Jem asked.

“Blattodea sensors.” The light flickered and the image of the Cnidarian sensor gave way to a much less enchanting picture. Six tri-segmented legs, each ending in five claws, supported a broad, flat body, a small head, and most importantly, two long and quivering antenna. The Blattodea sensor spread its wings to display a set of membranous hind wings beneath the protective layer of its thicker front wings.

Jem sighed, more motion than sound.

“Bad news?” Kir asked.

“It could be better. The Cnidarian sensors will be probably be all right, but Blattodea sensors tend to be more trouble than they’re worth. They’re incredibly hardy though, which—given the instability of the planet—is a huge point in their favor. SimOne, can you please send the archives of the planet’s activity and sensor reports to me?”

“Transmitting.”

Kir did not ask for the planet’s archives, which did not bode well. Jem tried to keep her voice even. “What kind of life forms are on the planet right now, SimOne?”

“There are limited forms of flora, marine, and terrestrial fauna. Would you like me to transmit the information to you as well, Kir Davos?”

He shook his head. “Not yet, and it’s just ‘Kir.’ I’m surprised the planet didn’t progress further in four billion revolutions. I’d have expected a great deal more biodiversity.”

Jem did, too. A hard knot formed in the pit of her stomach. “Did something happen recently, SimOne?”

“Yes, Jem Moran. Summer vacation happened. The planet was unmonitored for three months. I am sorry to report that ninety-six percent of all marine species and seventy percent of terrestrial vertebrate species are now extinct. Fifty-seven percent of all families and eighty-three percent of all genera were killed, including the only known mass extinction of insects to date.”

A stunned silence followed SimOne’s announcement. Jem dragged a hand through her short, dark hair. “We lost *everything*?”

“No. Four percent of the marine species and thirty percent of terrestrial vertebrate species survived.”

“I can do the math, SimOne,” Jem said with exasperation as she stared at the ruined planet. “Damn it. This is a piece of crap.”

“The mother of all mass extinctions,” Kir added softly.

Jem squeezed her eyes shut against the tension headache clawing through her skull. “The judges better take into account where the planet started off in the new school year or we’ll never stand a chance of winning this competition.”

“At least everything after this will be an improvement.” Kir grinned.

It had better. Jem shook her head. “I’m going to read through these reports. We’ll need to come up with a plan by tomorrow, or we’ll never be able to reverse this planet off its suicidal path.”

“I’m guessing it’s not as bad as it looks,” Kir said. “SimOne, has the planet gone through other mass extinctions?”

“Yes, but none as severe as the most recent.”

“It’ll probably recover, then,” Kir said.

“On little more than a hope and a prayer?” Jem asked. “Not very likely. We’re going to need a plan, Kir.”

He nodded amiably. “Right.”

He *still* had not asked for the archives. Were facts going to feature in his plan at all? Jem turned to look at SimOne. “What actually caused the mass extinction, other than neglect over the summer vacation?”

“The causes are inter-related. Volcanism, methane hydrate gasification, sea level fluctuations, anoxia, and hydrogen sulfide emissions.”

“What’s that in a language we actually understand?” Kir asked.

SimOne continued without missing a beat. “Volcanic eruptions, including flood basalt eruptions over an area of two million kilometers, resulted in dust clouds and acid aerosols. The dust clouds subsequently blocked the light from their star, disrupting photosynthesis and destroying the food chain. The aerosols washed out of the atmosphere in the form of acid rain, destroying land-based flora and fauna with calcium carbonate exoskeletons. The eruptions also released carbon dioxide, resulting in rising temperatures.”

“Global warming?”

“That is an appropriate descriptor, Kir,” SimOne said.

“What else?” Jem demanded. The headache was unavoidable at this point. The only question was whether it would escalate into a migraine.

“There’s more?” Kir asked, a note of disbelief seeping into his voice.

The android continued. "The oceans became anoxic."

"Anoxic?"

"Severely depleted of oxygen. The anaerobic sulfur-reducing organisms then dominated the chemistry of the oceans, causing massive emissions of hydrogen sulfide."

"That would be toxic, right?" Kir asked.

"That is correct," SimOne said.

In essence, it had been the perfect storm.

Jem sighed. "Life on this planet is so fragile." She looked up when Kir chuckled; he wore an expression of wide-eyed innocence.

"If we had silicon-based life forms instead, they might have..." Kir's face relaxed into a grin when she scowled at him. He chuckled again, his brown eyes crinkling at the edges. "Never mind."

"Very funny, Davos."

"Then why aren't you laughing?"

"Because I'm still wondering if I should cry. Can't you see? This planet is a wreck."

"Yes, but it's *our* wreck."

She turned her back on him.

He rushed after her as she stormed out of the laboratory. "Okay, all right. It was a bad joke. I'm sorry."

She blinked sharply, recoiling from the bright lights in the classroom as the darkness of the universe peeled back from around her. She shrugged off his hand and glowered at him.

He immediately held his arms up in a placating gesture. "I'm just trying to add a bit of levity to the situation"

"Your levity is misplaced. Let me tell you something, Davos."

"It's Kir."

"I only call my friends by their first names. Listen carefully. I am only going to say this once. The competition is everything to me. I intend to win it. I'll do it with or without you, but I'd much rather do it with your help. Take it seriously, please." She waited, meeting his eyes directly.

After a long pause, he nodded. His voice was quiet. "All right. I get it. You want to win."

It was not until he had left her alone in the classroom that she realized that he had not actually said if he would help or if he would just be a burden for the entire year.

CHAPTER TWO

Pangaea (from Ancient Greek pan “entire” and Gaia “Earth”) is hypothesized as a supercontinent that existed during the Paleozoic and Mesozoic eras about 250 million years ago, before the component continents were separated into their current configuration

– Wikipedia, the Free Encyclopedia

When Jem met Kir and SimOne for their second class later that week, she had reason to celebrate. “The planet is holding up,” she announced with a smile.

The Great Extinction had seemingly left them with too little to go on, but the little that remained had been sufficient. The planet was surviving, even thriving. The biodiversity numbers climbed steadily. The oceans had repopulated; shelled cephalopods were diversifying from the single line that had survived the Great Extinction, and the fish and marine reptiles were taking hold, the latter growing to an enormous size.

“What about the land?” Kir asked, looking up from SimOne’s data feed. His dark-eyed gaze shifted to the planet rotating serenely in space, apparently oblivious to the fact that it was once again in play.

“The amphibians and reptiles are doing well. I’d say everything is moving according to plan,” Jem said.

“I think we need to diversify.”

“Not yet, Davos. We need to give them time to stabilize.”

“Cold-blooded life-forms are hardly the height of stability,” he said.

“When did you become a Biology major?” she asked sarcastically.

“I know just enough to be dangerous. I think we need to start moving toward the warm-blooded life forms.”

“Eventually, but not yet. We need to play it safe. I ran my analysis past my Biology professor this morning. He agrees with my assessment. The planet’s too immature. In a hundred million revolutions, we’ll consider it.”

Kir shook his head. “Look, I’m no Biology major, but I understand business. We need to diversify our risk. SimOne, I want an analysis of the reptiles. Which one most closely mirrors mammalian traits?”

SimOne’s serene voice reflected none of the heightened emotions around her. “Planetary sensors indicate that the therapsids provide the closest match.”

“You’re thinking of evolving it into a mammal?” Jem asked.

His eyebrows arched. “Any reason why I shouldn’t?”

“Have you done any analysis on this at all?”

“Of course I did. Carbon-based, warm-blooded life forms—also known as mammals—have historically done pretty well on Sylvania. Why wouldn’t they thrive on our simulated planet too?”

“That’s your analysis?”

He hesitated. “There’s a bit more, but that about sums it up.”

Jem frowned, her eyebrows drawing together. “Did you also analyze the differences between our planet and theirs?”

“No, I’m leaving that to you. SimOne, implement selective evolution for the therapsids.”

The android nodded. "Executing."

"No!" Jem shouted. "Damn it. SimOne, cancel the program."

"The program has been executed and cannot be cancelled. Would you like me to selectively exterminate the evolved species?"

Jem turned on Kir. "You can't just make unilateral decisions. We need to analyze the information and then agree on a decision together."

"We don't have the luxury of time. Haven't you noticed? The planet's revolving too fast. Thousands of their years go by in the time it takes us to finish saying a single sentence."

Jem ground her teeth. "That's what plans are for. We put a plan together and then work off the plan."

"Evolution complete," SimOne interjected. "The species survived the process."

Kir held up his hands. "See? It doesn't have to be complicated."

"They're going to get crushed by the amphibians and reptiles," Jem said.

"Not during winter, they won't. SimOne, identify another division or branch that could be a suitable candidate for evolution into a different branch."

The android responded immediately. "Subgroup Ornithodira appears to be a suitable candidate."

"All right. SimOne, evolve it."

"Executing."

"Into what?" Jem asked, alarmed. "You can't just kick the evolution program into high gear without giving it direction."

Kir rolled his eyes. "As opposed to telling it what it already knows? The program wasn't designed by a dummy. It's not going to evolve something that is unlikely to survive."

SimOne spoke again. "Evolution complete. The species survived the process."

Kir wore a satisfied smile. "See, that's two. We've just reduced our risk by half."

"Your math skills are highly questionable," Jem snapped.

"Warning."

Jem looked up at SimOne.

The android's blue eyes—sweetly vacant by design—suddenly sharpened. For the briefest instant, she appeared human. "Warning: volcanic eruptions in progress."

"What?" Jem lunged toward the planet, but pulled her hands back in time. Touching the planet could trigger far worse things than just an eruption. "The flood basalts again?"

"Yes." SimOne was briefly silent. Was she processing information from the planetary sensors? "Warning: mass extinction in effect."

"No, no, no. Stop it!"

"Planetary disruptions cannot be halted. Global temperatures are rising sharply."

"It's happening again." Jem sank to her knees and buried her face in trembling hands. How could this be? They had been so careful. She had been so careful. It had been going well—the planet was recovering—and now this? She wanted to hold someone responsible, but she knew it was not Kir or SimOne's fault.

If only she could be as sure that it wasn't hers.

"What's the status now, SimOne?" Was that shaky voice hers?

"Speed of extinctions accelerating."

What do you do at a time like this?

She felt Kir's warmth beside her. If he had hesitated before reaching out, it was brief enough to escape her notice. "The planet made it the last time. It'll make it again," he said, his voice quiet.

She shook her head slowly, but did not tear her hands away from his. They were warm in the chill of the laboratory. "Is the planet going to keep doing this?"

"It's the molten core," Kir pointed out. "I'm not sure what you can actually do about it, other than request a new planet with fewer structural issues."

Now, that was an idea.

They waited, seemingly interminably, but for no longer than a few minutes. "The planet has returned to equilibrium," SimOne reported finally.

"What's the final count?" Kir asked.

"Twenty percent of marine families are extinct. Fifty percent of terrestrial species are extinct."

"Fifty percent?"

Jem stifled an ironic chuckle at the tension and disbelief in Kir's tone. It was about time. His unflappable calm and happy-go-lucky attitude grated on her nerves.

She pushed to her feet. "I think I need a short break. You want something to drink, Davos?"

"No, I'm fine. I'll stay here and keep an eye on things until the end of class."

~*~

The sunlight warmed Jem's skin as she sat on the grass in the lower quadrangle with a bottle of nutrition-infused water in her hand. All around her, students lounged on the grass in various states of consciousness. Some personal devices were on, but there was little pretense of study. It was a gorgeous day; there would be many of those through the fall, before the onset of winter.

She loved Itibar University. The buildings were magnificent and delightfully old-fashioned—stately white columns and sturdy red bricks—but that was part of its charm. Behind those ancient walls, technology gleamed, subservient to the needs of the humans they served.

If only planet 280-934-6253-4726-349573 could be as easily managed.

Jem had both facts and experience on her side. Through SimOne, they had incredible planetary management tools at their disposal. And yet, within a single week, they had managed to take the planet from extinction to extinction.

Damn it.

Jem shook her head as she activated her personal device and flipped through her notes. Where had she gone wrong?

Kir's astral image popped up in front of her biology notes. "Hey, you might want to check this out." His disembodied head turned to look back, presumably at the android. "SimOne, transmit the data to her."

Jem reached out with two fingers, plucked the three-dimensional image of Kir's head off from her notes, and moved it to one side. "So, what's this?" she asked as she scanned the data feed from the sensor reports.

"The planet is repopulating. We lost most of the large amphibians and reptiles in the extinction, but the evolved Ornithodira are taking over the vacated terrestrial ecological niches." Kir sounded not just smug. He sounded ecstatic.

She had to see it.

Five minutes later, Jem was back at the simulation laboratory, peering over their planet. She pulled her cardigan tightly around her shoulders to ward off the chill. “What’s going on?” she asked, her tone sharper than she had intended.

Kir gave her a hard look, but did not comment on it. “The Ornithodira are diversifying, and some are growing to an incredible size. SimOne, can you pull up some images?”

Some of the Ornithodira were reptilian in form, bipedal with front feet that were little more than decorative appendages and teeth straight out of a nightmare. Others were even larger, each of their four feet larger than the trunks of the largest trees, their long necks balanced by equally long tails.

Jem shook her head in disbelief. Where had that diversity come from? Their sizes ranged from absurdly tiny to frighteningly large; herbivores, carnivores; bipedal, quadruped, and some shifting easily between both; elaborate displays, including horns and crests; skeletal modifications, including bony armor.

Kir peered over her shoulder. “The sensors are struggling to accurately track the count, but the estimate is close to four thousand genera.”

“Wow. That’s...that’s amazing,” she conceded. “But there’s just one problem.”

“And what’s that?”

“Your mammals are going nowhere.”

“I know. They’re restricted in both size and niche because the evolved Ornithodira have been so successful. But hey, at least one of those evolutions paid off in spades.”

She rolled her eyes. “That would depend on what you’re trying to accomplish.”

“A living world?”

“That’s so unambitious. What about your original plan to have the mammals take over?”

“Look, we need to adapt to the situation,” Kir said.

“Even if it’s sub-optimal?”

“Could you be pursuing a perfection that’s just not possible?” he asked pointedly.

That question was always at the top of her mind, but she did not think she was jaded enough to give up on perfection just yet. Nothing short of a perfect world would win the competition. “We need more than the Ornithodira,” Jem insisted.

“We can’t control everything about this planet. We take what we get and run with it.”

Jem flung a hand out at the planet. “If you’re not planning to actively shape its direction, why did you evolve the therapsids and the Ornithodira? Why did you even join the simulation?”

“I told you. Risk diversification. You hedge your bets and then you let the game play out. This simulation isn’t about active intervention. How would you feel if God was always actively intervening in your life?”

“A whole lot better than if he were completely indifferent.”

“What about doing things for yourself?” Kir challenged.

“What the hell do you call this? I am trying to do things, as opposed to hedging my bets and then sitting around.”

“What about free will?” he asked.

“Free will?” Jem scoffed. “The evolved Ornithodira have brains the size of a pea. They barely have enough computing power to figure out where their next meal is coming from. SimOne is light years closer to free will than those creatures will ever be.”

“Thank you,” SimOne said simply.

“You’re welcome.” Jem turned her scorching gaze back on Kir. “The Ornithodira are *not* the future.”

“The rat-sized mammals aren’t the future either.”

“And they never will be as long as those monsters are stomping around.”

“You’re going about this all wrong,” Kir said.

Jem scowled. “Funny. I was just thinking the same about you.”

“Is there a problem here?”

Jem jumped at the sound of Professor Ptera’s voice. She looked over her shoulder as the professor strode past the gas giants and the asteroid belt. He stepped around the red planet and stopped next to their little planet with its single satellite. “SimOne indicated that there were some interesting developments on this side of the universe. Anything you care to share?”

“No,” Jem said.

“Yes,” Kir said at the same time.

Professor Ptera looked from Jem to Kir. “Well, which one is it?”

Kir looked at her. She refused to reply. She would be damned before she admitted to the professor that they could not even agree on a plan.

“We’re having a philosophical discussion on our approach,” Kir said finally.

“Ah, those are always fun,” the professor said, a youthful grin lighting up his face.

“Where did you come out?”

“We haven’t yet,” Kir said.

“You should know that those philosophical disputes may never resolve. Some members of last year’s teams still aren’t on talking terms with each other.”

Jem resisted the urge to roll her eyes. *Yeah, we’re well on our way to that same state, and it’s just the first week.*

“There is a simple way around it, though,” the professor continued.

“Change teams?” Jem asked, speaking up for the first time.

“Well, that’s an option, but it’s not what I had in mind. You can split up the planet.”

“Someone take the land and someone else the sea?” Jem asked.

“Or split up the landmass. Spread it around the planet. That could give you a bit of breathing room from each other and buy you time to test various philosophical approaches to world planning.”

“Excuse me, Professor Ptera,” SimOne said. “Central command reports that planet 541-837-8503-2650-376057 has just launched an assault on planet 249-306-7463-6580-694038.”

“An interplanetary war? I have to watch that. Well, I’m off. Let me know if you have any other issues.”

“Any other issues?” Jem muttered once he was safely out of earshot. “Other planets are well into the space age and here, our dominant life forms have no brains worth mentioning.”

Kir shrugged. “I suppose that telling you that it’s not the destination but the journey that counts isn’t going to help much.”

“The journey is pointless if you don’t have a destination worth the time you’re investing in the journey.”

Kir looked at the planet. “So, shall we split this up?”

“Yes.”

For a long moment, they stared at each other in sulky silence. Kir then turned to the android. “SimOne, can you execute a separation of the landmass?”

“Negative. You need to do that.”

“Why?”

“The action required exceeds the bounds of my authorization.”

It was good to know there were things that androids could not, or were not allowed, to do.

Kir shrugged. “We can do this slowly and carefully.” He stepped around the planet to stand on the other side, across from Jem. “You hold the top. I’ve got the bottom. We’ll just pull it apart gently.”

Jem clenched her teeth. Her eyes narrowed with concentration as she gripped the top half of the landmass. Water from the oceans sloshed over the side of the continent. How many creatures had died from the tidal wave she had inadvertently triggered?

Kir looked up at her, his dark eyes unusually focused and intent beneath his mop of brown hair. “Ready?”

She nodded.

“All right. Gently now.”

The continent tore apart, slowly. The rift started in the east, the ugly gash deepening and lengthening as they pulled the continent apart. The ocean rushed in to cement the separation. Jem and Kir paused, looking at each other across a tiny sliver of land that held the two pieces of the continent together.

Just a bit more.

The last tug was the hardest, not physically but psychologically.

It was done. One continent was now two.

Jem tugged the piece she was holding toward the north, rotating it slightly as she pulled it through the water. On the other side of the planet, Kir carefully broke his continent into smaller pieces. One piece he sent drifting toward the pole.

“What are you doing?” she asked.

“Hedging my bets.”

“Careful,” she warned, her tone sharp. “One of those pieces is about to collide with mine.”

“Whoops, sorry.” Kir caught it in time. “Don’t want another accident.” He positioned it carefully and then stepped back. “It looks good.”

“It’s more interesting, that’s for sure,” Jem agreed. “SimOne, how long until the next basal flood eruption?”

“The planet is ecologically stable. There is a one point six three percent chance of volcanic activity large enough to result in another mass extinction.”

She sighed. Just when she needed a mass extinction, she was told that the odds were not good. Her portion of the planet needed a fresh start. *She* needed a fresh start. Surely, there had to be another way to trigger a mass extinction.

Jem turned to stare at the gas giants in their elliptic orbits around the yellow star. Her gaze fell onto the fragments of rock, spinning in the asteroid belt. She smiled as she picked out a few small rocks from the asteroid belt.

“What are you doing?” Kir asked.

“Giving mammals another chance.”

“We may not get another volcanic eruption for millions of planetary years,” he said.

“We don’t need to wait for one.” She tested the weight of the rock in her hand. It was little larger than a pebble, but it would be enough. “SimOne, are you ready?”

“To report on a dying planet? Yes, I am.”

She was going to file a complaint on whoever had decided to program sarcasm into androids. Jem inhaled deeply. Her plan could be a huge mistake, or the single largest turning point in the history of the planet.

The rock flew through the air, hurtling toward the planet, spinning and accelerating as it fell. It brightened into a glow as it burned through the planet’s atmosphere.

Kir squeezed his eyes shut. “SimOne, evacuate Niseag’s family.”

“Executing.”

“What’s Niseag?” Jem asked.

Kir flushed. “Just a name I gave one of the evolved Ornithodira that I adopted as a pet.” He winced as the pebble collided with the planet.

SimOne’s vacant eyes flashed brightly. “Infrared radiation killed all exposed organisms at the crash site. Mega tsunamis are sweeping across the adjacent continents. Global firestorms are igniting from the heat pulse and the fall back of incendiary fragments from the blast.”

Jem listened. At that point, it was all she could do.

“The dust cloud from the impact and sulfuric acid aerosols have reduced the light of the star reaching the planet by twenty percent. Photosynthesis is severely inhibited; the effects are likely to last for ten planetary revolutions around the star.”

It would devastate the food chain for herbivores and carnivores alike, resulting in mass extinction, for the third time in a week. Jem dragged her hand over her eyes. Surely it had to be a record.

Kir did not look at her. He stared down at the planet, his lips set in a tight line.

“Belemnoids, ammonoids, rudists, and inoceramids are now extinct. Fifty-seven percent of terrestrial plant species at the impact boundary are now extinct. All major mammalian lineages survived, though damage is much more severe at the impact boundary.”

“And the evolved Ornithodira?” Kir asked softly.

“The evolved Ornithodira are now extinct.”

“All four thousand genera?”

“A single avian group survived, as did Niseag’s family.”

Her jaw tight and shoulders tense, Jem looked across at Kir. His eyes were closed. His chest rose and fell with a heavy sigh. When he finally looked at her, the flash of energy and gleam of good humor were gone. “Are you happy now?” he asked with quiet bitterness.

Without waiting for an answer, he turned his back on her and walked out of the laboratory.

Damn it. She had upset her partner, and she still did not know if she had made the right decision for the planet.

Jem assessed the scar left by the pebble. She could separate her continent into two, and give one part a chance to flourish while the other healed. She pulled the continent apart vertically, neither evenly nor well. The edges trailed jaggedly, some smaller pieces breaking off into islands.

“Please advise on further actions for Niseag,” SimOne said.

The right thing to do would be to terminate it. Its species, its world, everything it had known, was gone, but Jem could not terminate it, not when it was all Kir had left to remind him of the world he had created.

Jem leaned in and peered at one of the northern islands. “That looks private enough. Relocate Niseag and her family to a suitable habitat on that island.”

“That will not work,” SimOne said primly. “Niseag is a cold-blooded reptile and requires warm, tropical waters. The average water temperature on that northern island is five point five degrees.”

Jem’s temper snapped. “You know what, SimOne, I’m tired of running into roadblocks. I want you to find a way to keep Niseag and her family alive out there. Evolve her.”

Was it her imagination or did SimOne’s blue eyes flash mutinously for a fraction of a second?

SimOne said, “Executing.”

Jem waited.

“Evolution complete. The species survived the process.”

Jem took a single step back. From her vantage point, the planet orbited serenely on its tilted axis. She could see the damage from the pebble, but life was returning, slowly yet inevitably, to its seven continents. Charred brown gave way to verdant green as photosynthesis started up again. The oceans shimmered, blue and inviting, beneath the scattered white clouds.

The planet still wasn’t much to look at, but it was her planet.

Hers and Kir’s.

Jem glanced at her personal device as it beeped a warning at her. She would be late for her next class on Aesthetics unless she left immediately. She rolled her shoulders to release the tension locked in her upper back. “Take care of the planet, SimOne. We’ll be back tomorrow.”

“Certainly.” The android moved closer to the planet. A rare smile curved SimOne’s lips as she looked down at the blue and white orb. The android’s eyes shone.

Jem chuckled to herself as she left the laboratory. Planet 280-934-6253-4726-349573 was their planet: hers, Kir’s, and SimOne’s.

CHAPTER THREE

The Cenozoic Era (meaning "new life," from Greek kainos "new," and zoe, "life") is the current and most recent of the three Phanerozoic geological eras and covers the period from 65.5 million years ago to the present. It is marked by the Cretaceous–Tertiary extinction event at the end of the Cretaceous that saw the demise of the last non-avian dinosaurs and the end of the Mesozoic Era. The Cenozoic Era is ongoing.

– Wikipedia, the Free Encyclopedia

“How is it going?”

Jem looked up from her half-eaten sandwich and quickly slid her astral workstation back into her personal device. “Uh, it’s going well, professor.”

Apparently oblivious to the noise and chaos of the student cafeteria at lunchtime, Professor Ptera sat across from Jem without waiting for an invitation. “I like to check in with all the teams after the first week. If they have a handle on things by then, they’ll likely make it through the entire year.”

Scratch us out then.

He continued without missing a beat. “I reviewed the reports from the central command system. Your planet seems to be doing well.”

“Yes, we’ve only had three mass extinctions within a week. We’re aiming for four next week.”

He laughed. “Don’t get bitter too early. Your planet is a toddler in the grand scheme of the universe. Other teams may be embarking on interplanetary war, but that’s because they’re dealing with a dying planet or a dying star, and they need to get out to find a new home. On the other hand, you have a healthy young star and a healthy planet. For bonus points, there’s actually still life on it, the three mass extinctions notwithstanding.”

“Right.” Would the professor have thought the same if he had seen Kir’s face at the moment when the pebble smashed into the vulnerable planet? Jem twitched in her seat. “How do you know if you’ve made the right decisions?”

“You don’t usually, until the very end, and even then, the future may make liars of us all. I have a tip for your team, though. Slow it down.”

“Slow what down?” she asked.

“The simulation. It’s hard to make decisions quickly enough when thousands of years go by in a flash.”

“We can slow it down? But doesn’t it have to keep pace with other planets?”

“What gave you that impression? Time is as much a dimension as space, and they are both variable. Unless interplanetary travel is involved, you can choose to operate in a vacuum. Even if interplanetary travel is called for, the central command system can adjust and account for the rift in the time-space continuum.”

Damn. The craziness of the past week—making decisions and seeing their impact on a macro level across millions of years—had been completely unnecessary. Jem flushed. “You’re telling me I should have paid better attention in Physics class.”

“You can never go too far wrong investing time in understanding the rules that govern the universe. It’s hard to break them otherwise.” Professor Ptera pushed to his feet and nodded briskly. “Well, I need to keep moving to catch up with the rest of your classmates. I’ll see you at class this afternoon.”

Jem also shoved to her feet, flicking open her personal device as she gathered her belongings. "Find Kir Davos."

"Locating... Kir Davos is currently in FIN-302 Financial Derivatives. Ames 259. The class is scheduled to end at thirteen hundred hours. His next class is SIM-709 World Simulation, beginning at fourteen hundred hours. Wilson 630."

She could have waited for the campus transporter, but Kir's class was not far. She ran from the cafeteria in Levering Hall to the Ames building and skidded to a stop as students spilled out of Ames 259. Kir was among the last to walk out. His animated conversation with another student fell silent the moment he set eyes on her.

The other student excused himself. "I'll see you later, Kir." He walked away.

"Hey," Kir said with a jerk of his chin, which she supposed was intended to replace a handshake. He did not stop to talk.

She kept pace with him as he marched toward the student center at Levering Hall. "I wanted to talk before class."

"I'm thinking of dropping the course," he said.

"Why?"

"I thought it'd be a great learning experience. I wasn't counting on it to eat up all my time, and completely stress me out in the process." Kir shook his head. "I couldn't sleep that night. I kept seeing the pebble hit the planet. I told myself it's just a game, but it's not working out like that in my head."

"Niseag's family is safe."

"I know. I checked the planet's archives the next day." He paused and turned to look at her. "Thank you, but I still don't think I'm cut out for this."

"Look, Davos, it was just the first week."

"Exactly, and I don't think I can take two full semesters of this."

"We've barely started, and I know we got off to a bad week, but think of everything we've learned so far."

He snorted. "Such as avoid mass extinctions?"

"Yes, and the fact I excessively plan and you don't, and the fact that you're imminently more adaptable and I'm not. Maybe there's some way we can make it all work together."

He seemed to consider it for a moment, and then he sighed. "I need some food. I can't think on an empty stomach. Can we talk over lunch?"

"As long as it's not a date," she said.

"Trust me, we're a long way from a date, Moran."

Fifteen minutes later, they stared at each other across a tiny table in the cafeteria. "So, what is this plan of yours?" Kir asked after a spoonful of soup.

"Professor Ptera talked to me today," Jem said.

"He did?"

Kir did not sound as surprised as she had expected. "Did he talk to you too?" she asked.

"Yesterday afternoon, when I went to the registrar's office to drop the class."

"You did?"

"Yeah. The registrar's office said they couldn't process it yet. Apparently, all drop requests have to be approved by the professor, and there were at least six people ahead of me trying to drop the class."

Jem did not manage to disguise her snort of laughter in time.

Kir gave her a dirty look.

With effort, Jem wiped the smirk off her face. "So you went to see the professor?"

Kir nodded. "He asked me to stay, wait it out another week or two. It seems like the first week is the worst for most teams. He also said he'd review our archives and see if he could make any recommendations."

"He had a recommendation when he came to see me earlier. Slow down the simulation."

"But doesn't our planet have to keep pace with the rest of the universe?"

"You failed Physics too, huh?" Jem asked.

"I got a C," Kir said defensively.

"Apparently, the time-space continuum is less like a law and more like a gently worded suggestion. If we can slow down the revolutions, we'll have time to make better decisions."

"And interfere even more directly than you already have?" Kir asked.

She bristled. "This is a simulation, not a movie. If you want the latter, just drop the class and save us both the trouble."

"This is a *real* planet. You can't treat them like lab specimens. 'Whoops, added the wrong chemical to the stew. Let's just toss it down the drain and try something else.' It doesn't work like that."

"What part of 'SIM-709: World Simulation' do you not understand? This is a simulation. This is where you're allowed to make mistakes safely, before you enter the real world and screw up there too. Think 'petri dish' instead of 'planet' if that helps. There's very little difference between this planet and the colony of bacteria I'm growing in my genetics lab right now."

Kir tilted his head, the subtle gesture challenging. "So why did you save Niseag?"

"I didn't. You did."

"She and her family survived the impact, but they should have been wiped out in the aftermath. Yet after I'd left, you told SimOne to relocate her, and evolve her so she'd survive. Why?"

"You went to all the trouble to save her in the first place, so I figured why not just see the damn thing through?"

"That's it?" he asked.

"Yeah, that's it." Damn him for putting her on the defensive.

Kir was briefly silent. "Two weeks, Moran. I'm giving this project two weeks."

She folded her arms across her chest. "Fine."

"So why are you still sulking?"

"Because you can't commit. Are the two weeks some kind of probationary period for the planet, the class, or for me? Why do I or anyone else have to prove something to you? Why can't you grow a spine and decide that you *are* going to do this, come hell or high water?"

Kir laughed. *That* reaction she had not expected. His tone was almost affectionate as he said, "You're funny and cute in an earnest do-or-die way."

Funny and cute were not the traits she had been striving to display. They got nowhere in the real world. She slammed to her feet. "Go ahead and drop the damn class, Davos."

He caught up with her before she had stalked out of the cafeteria. "I seem to find myself running after you pretty often," he remarked mildly.

She snarled at him.

Kir shook his head. "Relax. It was an observation, a fact, the same kind of thing you're always so hung up on in class." He flashed her a wide grin. "You're right. I'll do this. We'll probably drive each other crazy before the year is out, but we'll do it together."

~*~

Jem had to admit that Kir Davos could be charming, but she was far less interested in his charm than in his willingness to put in whatever effort was necessary to get the job done. By the time they arrived at the simulation laboratory after lunch, SimOne was already in position next to the planet.

"How's Niseag's doing?" was Kir's first question to SimOne.

"Niseag's descendants are thriving in their new habitat in the northern lake. They have no natural predators, but limited resources reduce the possibility of a hostile takeover of their adopted habitat."

"Have you been reading my business books, SimOne?"

"I am programmed to adapt to the preferred communication styles of my team members."

If Jem did not know better, she would have thought that the android was flirting with Kir.

"The professor suggested slowing down the revolutions in the simulation. What do you think?" Kir asked the android.

"I am glad the professor conveyed my recommendation to you."

"You came up with the idea?" Jem asked. She shot Kir a quick glance. "Why didn't you just tell us?"

"On a scale of one to ten, you and Kir Davos score one point eight and two point one respectively for listening skills."

"All right." Kir nodded thoughtfully. "Our goal for today is to nudge those scores up by at least a quarter of a percentage point. Got that, SimOne?"

"I will continue to monitor your scores."

Kir looked at Jem. "We'll need to get a sense of humor programmed into her."

Jem shrugged. "She's already got sarcasm down pat. Humor is just a small hop, skip, and jump from there."

"Thank you," SimOne said.

Jem grinned. "See? I rest my case. All right, SimOne. What speed do you recommend?"

"Whatever works at any particular time. Would you like me to make those decisions based on the sensor reports from the planet?"

"Uh..." Jem hesitated.

"You will be able to override those decisions at any time."

"And she's a mind reader, too," Jem muttered. "All right, SimOne. You manage the speed of the simulation, and we'll see how we do. How's the planet holding up?"

"There were several continental collisions ten million revolutions ago, but the continents have since settled into a relatively stable state. The planet is cooling, and the forests are receding, to be replaced by savannah. The mammals have diverged from a few

small and simple forms into a diverse collection of terrestrial, marine, and flying creatures.”

“Really?” Kir leaned forward eagerly. “Can we see them?”

SimOne held out her palm, and light coalesced into flickering shapes. Some animals seemed similar, at least if one was willing to make broad generalizations, to mammals that existed on Sylvania. The resemblance, however, only went so far. “Look at the teeth on that cat. How does it even close its mouth?” Kir wondered.

Jem peered over his shoulder. The cat’s curved incisors were completely disproportionate to the size of the cat. “Very carefully, I’d imagine. Anything humanoid, SimOne?”

“Not yet.”

“What are the chances of that happening without direct intervention?”

“Negligible,” SimOne said.

“I guess it’s time for some well-intentioned interference,” Jem said, looking at Kir. He shrugged. “The road to hell is paved with good intentions, so why not?”

Jem chuckled. “SimOne, please identify suitable targets for evolution into humanoid life forms.”

“What is your final goal?”

Even the android knew that the destination would determine the path taken. Jem looked at Kir, her eyebrows arched in a silent question.

Kir shrugged. “What would it take to make people just like us?”

“There are no suitable targets for evolution,” SimOne reported.

He sighed. “So we’ll have to start from scratch?”

Jem inhaled deeply. She would find out if all those years she had spent in biology laboratories were worth anything. “SimOne, let’s connect.”

The android extended her hand, and Jem reached out. Fingers joined at the tips. Jem braced for the jolt, for the physical contact between biological and artificial intelligence.

It was not her first time. The first time had been like losing her virginity, a loss of innocence, a loss of the birthright of invulnerability that came with being the dominant species on the planet. She had not enjoyed that feeling, but she had gotten used to it. After all, it was part of life.

SimOne’s touch was cool but not uncomfortable. The android’s pleasantly cultured voice spoke directly to Jem’s mind. *Connection established.*

It was much faster and far more accurate than communicating ideas verbally, though her father used to say that the biological-AI connection allowed humans to make bigger mistakes faster.

She missed him still.

Deliberately, Jem pushed the thought aside. The one problem with biological-AI connections was that the accuracy of the transmission was entirely dependent on the human. It was not the right time for mental distractions. Instead, she focused her thoughts on the human archetype designs she had created over months of hard work. If Jem could hold the thought clearly enough for the AI to map the pathways of knowledge through her brain, the AI would accurately extract all the information embedded in the design.

Primary target acquired. Mapping neural pathways. Please hold...

Neural pathways mapped. Downloading data...

Data download complete. Please hold for verification...

Data verification complete. We have all the information we need. Thank you for your cooperation.

As SimOne disconnected, Jem shook her head, breaking out of her trance-like state.

“You all right?” Kir asked.

“I’m fine.” She shrugged his hand off. “SimOne, what do you think of the plans?”

“You have plans for two humanoid species. Which one should I execute?”

“Both of them, one after the other.”

“Executing.”

Jem was silent as the information was meticulously crafted into a humanoid.

Light shimmered from SimOne’s open palm. Jem held her breath.

“He’s not going to win any beauty contests soon,” Kir remarked as he watched from over her shoulder. “But at least there’s more than just a glimmer of intelligence in his eyes.”

“The beauty contests start after the invention of high heels. That’s going to take several thousand years,” Jem said absently. “All right, turn it loose.”

“Executing.”

After a slight pause, the astral image shimmered again, this time with Jem’s second concept of a human.

“Looking better.” Kir even sounded approving. “Are you going to turn this one loose as well? Will they be able to cross-breed?”

“Conceptually, yes. Realistically, unlikely. Paranoia is highly developed among prehistoric humans; it keeps them alive. More likely, the second version will wipe out the first if they ever come into contact.”

“And so human history begins in war. Typical, but that’s bloody depressing regardless.”

Jem grinned. “We can do better than that. We’ll give them a clean slate by putting some distance between the two groups. Environmental factors on our beautifully unstable planet will determine which group survives.”

He smirked. “Sarcasm’s not necessary, Jem. Why don’t we put the second batch right there?” Kir pointed to a spot on the planet, strategically positioned at the juncture of three continents. The land was unusually verdant, watered by the meeting of four rivers. There, life frolicked in glorious abundance.

“Perfect,” Jem agreed.

SimOne’s blue eyes glowed. “Executing...”