MARINERS

Vol. 7

The Langlais Doctrine

Contents

1.

Laputa

Late April, 2084

"I'm so glad we were able to come to Phobos," said Ted "Tadeusz" Bukowski to Lin Changying. They were standing on a balcony of the Phobos Hilton looking over the interior of Phobos 1, a "carrier" or rotating cylinder 200 meters in diameter and 200 meters high. It had a big open space in the middle surrounded by buildings on all sides, with agriculture and related environmental maintenance facilities underneath.

"I'm glad we came up a few sols early," she replied. "I'm amazed they now have a fourth carrier nearly finished, plus two more started, plus the carriers for the Pluto and Sedna Projects started. Stickney and its eastern flanks look like a city of skyscrapers!"

"It does. It's hard to believe two of those skyscrapers will take off and head for Earth, then the outer solar system in a bit over two years."

"So, was the fun at the Stickney Marriott worth the risk?" she asked, with a mischievous smile.

Ted laughed. "You were right; being up on the rim of Stickney, away from Phobos outpost itself, was perfectly safe and isolated. Just like the Dacha at Aurorae."

"A lot of stuff happens at the Dacha that no one ever hears about."

"Same with Stickney Marriott. But . . . I wish this secrecy could end, Changying. Our love will become public eventually, and it'll ruin both of our jobs."

"Probably; you never know. Your job may end first, anyway."

"Yes, depending on who's elected President this November. Unfortunately, what's good for us will probably be bad for everyone else."

"Let's just hope Crazy Peters doesn't get the nomination. He still might not. If Vice President Omar is elected, the world will remain at peace, at least, and who knows? Maybe he'll want you to retire in favor of someone else as NASA rep."

"Maybe. But if we marry, that might still taint your service."

Changying shook her head. "I'll survive. I always do."

"I think it's just about time to go to the Fusion Propulsion Research Center." Ted turned away from the view.

"Yes, let's go."

They turned away from the vista, which was from the balcony near their hotel rooms—they had arranged to have rooms next to each other, for the sake of decorum—and headed to the spiral ramp. They walked to the center of the wall behind the Hilton, feeling the centrifugal gravity ebb away with every step, to the hub, where there was a connection "down" to tunnels underground. Phobos 1's rotation created centrifugal "gravity" 90 degrees from the faint tug produced by Phobos, so they experienced a change in the direction of "up"by 90 degrees. They floated through the tunnel to Phobos 2, then turned into another tunnel that led to Phobos 4. The passenger transport tunnels were one way and divided so that a rapid flow of air could blow you to your destination. All you had to do is keep yourself upright, like a sail.

They exited the second tunnel at Phobos 4 and walked a spiral path that turned their "down" almost 90 degrees until they could step onto the rotating surface of the Phobos 4 carrier. They followed a spiral ramp 500 meters to Solis Lacus Square, which was the carrier's central

plaza, named for an old dark spot on the telescopic maps of Mars. The new Fusion Propulsion Research Center faced the square, which was half surrounded by the new campus of Martech-Phobos. They crossed the square slowly, burdened by the 0.76 Earth gees that was double Mars normal.

"Greetings, may I help you?" It was a robot, an "AI" or artificial intelligence, standing at the entrance to the Center.

"Yes, I am Ted Bukowski and this is Lin Changying. I am NASA's representative to the Marsian Commonwealth and Dr. Lin is the Chinese Space Agency's representative. We're here to watch the fusion engine firing."

"Yes, of course, Dr. Bukowski." All the time he was speaking, the AI was analyzing their faces and voices. "You are both most welcome. Please take the ramp over there down two levels and follow the signs to the engine control room."

"Thank you." He inwardly groaned; two levels meant the gee would increase to about 0.80. That would be tiring.

They walked to the spiral ramp and down to basement level 2, which had to be just about as low as you could go; they had to be standing just about against Phobos 4's rotating outer wall. The engine control room was clearly marked and just 30 meters away. They were there in seconds. The entrance area had a long table with a dozen chairs behind it, and two men were already there waiting: Commander Nicholas McDonald of the Project and Commander Cai Xiaopeng of the Pluto Project. "Gentlemen!" exclaimed Ted, surprised. "A pleasure to see you both."

"Thank you. I'm glad to see both of you have been invited to witness the fusion engine firing," said Cai.

"It's good to see you together, too," said Ted.

"Oh, we work together all the time, and closely," replied Nick. "We're both heading for Earth at about the same time to get the rest of our crews, riding in basically the same equipment."

"And we've worked closely to design our C-100s," added Cai. "Both projects are starting with a 100-meter carrier, 100 meters long—rather small—but both of us will have the materials to construct a second C-100 module en route to our destinations. That will keep us busy during the voyage."

"It's a clever design," said Changying. "With all the housing and ecology piled up against one end and the other end as open as possible."

Nick nodded. "It concentrates assets together, for radiation shielding, and leaves as open a space as possible, with a 100 meter ceiling. We can even play soccer inside! The second C-100 is a life boat in case the first one is damaged. It's even detachable, if we want to land it on a separate moon."

"And except for the architecture and some aspects of the layout, they're basically the same, saving design money," said Ted. "I spent a few hours doing a virtual reality tour, a few months ago. It's the most advanced design we have."

"It is," agreed Cai. "Jimmy Khan has a great team, and they've worked well with U.S. and Chinese collaborators. I want to thank both of you, too; you've smoothed out the collaboration on several occasions."

"It has been our pleasure," replied Changying.

"So, what does it feel like, to know you won't be back to the inner solar system for at least twenty years?" asked Ted.

Nick shrugged. "It's my life; my wife and I have no kids. This is the rest of our career. When we return it'll be just about time to retire. We're going to see Sedna, which is much farther out than anything people will get to for some time, and probably two more KBOs, and we're excited about it. We're laying the foundation for the Helia Project and it is presumably doing the ground work for a mission to Alpha Centauri."

"No permanent settlement on Sedna?" asked Changying.

Nick hesitated. "Who knows, but I don't think so because with our current technology, Sedna is a six or eight year voyage, so there will be no biennial passenger flights, like there are to the outer planets. Without regular flights, I think our entire crew will want to come back. There will be no way to return, otherwise."

"And for us, what could be more exciting than to establish a permanent settlement on Pluto and its five moons?" said Cai. "Such a dynamic planet, with remarkable geology and a complex history we've only begun to unravel! It's a historic event and a priceless opportunity. And with current technology, we can probably receive regular passenger and cargo flights, because the one way trip will probably be two years."

"And you'll both have a thousand on board?" asked Ted.

"Exactly," replied Nick. "We'll both depart Mars with about 300 and head to Earth to pick up the rest. Cai gets first choice of the Americans who want to go to Pluto and I get first choice of the Chinese who want to go on the Sedna mission."

"One hundred each," said Ted, with a nod, because that was the deal he and Changying had negotiated.

"How many children?" asked Changying

Nick shook his head. "We'd rather not take any along, because they'll be post-graduate school when we get back, and we can't provide much graduate level education. We're aiming for about 300 couples, preferably ones who want one child each, max. That way, we'll have about 300 children born within the first two years of departure, and they'll all grow up together and start university together, and we'll return about the time they're half way through. That's the plan, anyway. We'll see whether it works out."

"And we suspect Pluto will see a big turnover about that time," added Cai. "As humanity explores the Kuiper belt further, it probably makes sense for Uranus, Neptune, and Pluto to become the advance bases and have many of the expeditions departing from them and returning to them."

"Unless this fusion engine works out," said Ted.

They all nodded, and as if on queue, June Addison turned away from the collection of consoles and walked over. "So good to see all of you," she said, introducing herself to Ted and Changying. She already knew Nick and Cai. If you'd like, morrowsol I could take you to the engine itself. It's at Laputa on the other side of Phobos. There's a very good metal road, so the ride only takes thirty minutes."

"Did they intentionally set it up as far as Stickney as possible?" asked Ted.

"No, the fusion engine development facility is at longitude 270. Zero longitude is the sub-Martian point and 270 is at the center of the trailing hemisphere. An engine fired there actually gives Phobos a kick in its orbit, which as you know is very, very slowly decaying."

"But Laputa was originally set up to get rid of spare volatiles, right?" said Changying.

"Correct; extracting hydrogen and methane from the chondrite and ices inside Phobos generates a lot of excess oxygen and some excess carbon, so they burned it at Laputa, partly to give Phobos a kick and partly to deorbit the exhaust so that it would crash into and be added to the Martian atmosphere. Not that it would do much for Phobos or the Martian atmosphere! Our fusion engine exhaust is moving so fast, it escapes the solar system. We're just reusing some of Laputa's existing facilities."

"And you built the fusion facility here and not on Deimos because of power needs, right?" asked Changying.

"Correct; it takes a lot of power to start a fusion reaction, and Deimos's solar array is too small. We put the fission engine development on Deimos because there was a need for security and because of the potential release of radioactive materials. Deimos is beyond the orbits of most satellites, and by firing engines near the Deimosian south pole, any radioactivity is shot into space 'below' the planet."

"How much do you think you can shrink the size of the engine?" asked Ted.

June smiled. "That's very hard to say because we need a massive amount of power production, which requires a very large reactor with massive magnets. Consider a solid core nuclear engine with a specific impulse of 1,000 seconds that produces 1,000 kilonewtons of thrust; that's about 100 tonnes, if that helps you imagine it. It has to put out 4,500 megawatts of

thermal energy. That's the power demand of a medium sized Earth city, being put out by a device massing several tonnes. But we want to produce an engine able to give 10,000 seconds of specific impulse; that's 100 kilometers per second of exhaust velocity or 360,000 kilometers per hour. But such an engine, to produce 200 kilonewtons or 20 tonnes of thrust, would require 9,000 megawatts of heat energy! Such a fusion engine masses 1,000 tonnes. The Pluto carrier masses about 20,000 tonnes, so the acceleration will be 1 centimeter per second per second! But that adds up over time; it's 36 meters per second after an hour, 860 meters per second after a day, 25 kilometers per second after a month, and that'll get you to Pluto in about five years. Run the engine for 2 months and you'll get to Pluto in 30 months."

"The trick is to build a fusion engine able to run long enough to send a carrier to Helia," said Changying.

"That's one, because it'd have to run longer and at an even higher specific impulse. Just building an engine able to produce that much power is another. It's a huge, complicated engineering challenge. But we'll accomplish it eventually. I hope we'll have something by 2099, when the Helia mission is scheduled, because they have to have speeds of that sort."

"When does the test start?" asked Ted.

June pointed to the view screen, which showed a large square building with a nozzle extending from the roof. "It already has, in a sense; if you watch the image, when we switch to the ultraviolet view you'll see a pencil-thin purple thread extending upward from the engine. That's escaping hydrogen; it circulates around the outside of the fusion reactor to cool it and then is dumped into the stream of hydrogen and helium leaking from the fusion chamber. It's already generating significant thrust, but once we crank up the power output we'll need more hydrogen

coolant and it'll be at an even higher exhaust velocity. The purpose of the test is to see how high we can go. Our goal today is 10 tonnes, or 100 kilonewtons."

"How high are you now?" asked Changying.

"We're half way there. And I had better get back to the controls. Good to speak to both of you, and thank you for funding this important research." June shook hands with Ted and Changying again and walked back to the control area.

"How much are the various governments funding this project?" asked Nick.

"I think it's 30% Mars, 20% US, 20% China, 15% Europe, 10% India, and 5% others," said Ted.

[They only get the test up to 5 tonnes of thrust but that's enough]

Rest of chapter 1: April 2084: First fusion engine firing on Deimos; Sedna and Pluto leadership met. Visionaries. They want their vehicles called "arks"; Ted talks to the Sedna mission leader candidates and fights with Danforth over the best choice; Sirikit calls Bill because she and Charlie just visited Aram and Bill asks for help; Helmut meets with the immigration fraction of the cabinet and they agree to send a passenger galleon via Themis

Chapter 2: May 2084: Planning begins for Mars 50th, Feb. 28, 2086; Lunar mass driver files for bankruptcy; Mariusville and Swiftville develop well; Vahid urges Tad to pursue counseling

Chapter 3: July: Tad meets with Anand and Gandhimohan, is interviewed for commandership of the six-moon expedition, and he gets it; he sees Vahid who congratulates him; he talks to his dad Johnny and urges him to get some counseling, as does Johnny's wife Mindy; second 2-gigaton nuke.

Chapter 4: Sept. 2084: 500-meter collector finished; both drums set up and pressurized at Columbia; progress on geothermal is slow [but the reactor can be cranked up from 25 mw to 125 mw and the extra power stored as LOX/LH_2]; Tad invites Wicahpi-Luta to come on the Six-moon expedition; Helmut agrees to postpone the 2-gigaton explosion to mid November because the September explosion triggered a category 5 storm, and all flights between Mars and Phobos have to land at Cassini because it's the only outpost with a clear spaceport.

October: *Dorado* heads to Galatea and then to Larissa (just mentioned)

Chapter 5: Nov. 2084: 10,000 arrive from Earth, including Nadia Larui and Maryam Islami; Will and Ethel greet them in Andalus and bring them to their condo; US Presidential election elects a Trump type; Ted tells Chingying he'll lose his job and they decide to go to Tithonium for a month; Tad lands on Portia and Wicahpi-Luta confirms the discovery of a high-PGM meteoroid body, Tad proposes a drum be built there and Uranus export PGMs; Jamison broadcasts live his first exploration of the Triton drum and the Seron staff are angry and jealous, but Mercedes says not to worry about it.

Chapter 6: December 2084: Ted and Chingying return from Tithonium, she is fired for hanging out with him, and they decide to stay on Mars and get married; Seron reached Proteus, Mercedes praises Jamison extensively in public, but in private says he should stay on Proteus the next six months while someone else develops Columbia Outpost; Oskar and Maryam meet after Maryam sees one of Oskar's poems in Mars This Sol and she comments about it online

[100 pages of text was lost when my laptop was stolen, 30 Sept. 2018]

They paused in their conversation while a robotic cart rolled up with their dinners. They took them and began to eat. "So, tell me your story," said Oskar. "I was intrigued by your comments about searching for your birth parents."

"Oh, I know who they are," replied Maryam. "But please, I don't want you to write about any of this, or at least not until I say it's alright, because I haven't met them yet, or my birth grandparents. They don't live in Aurorae. I'm going to go see them next month, I think."

"Do they know you're here?"

"Probably they've heard, but I haven't written them yet. I want to get settled first, and this is all a little upsetting for my mom."

"I can imagine it's hard for her."

"I'm not sure how hard it is; she hasn't said much to me. As I understand it, I was the first member of the third generation."

"Really? That's a special status. I can almost say that; my grandfather and my father emigrated here. But my father was born on Earth."

"Well, my birth parents were born here. I really felt a need to come back, but my father was too old to return, so mom and I stayed with him. But he passed away back in the spring, so we decided to return, and since we were both Marsian citizens we could get on a flight without much trouble."

"So . . . how do you feel about it all?"

Maryam shook her head. "I don't know! We left Mars for Earth when I was four, so my memories of this place are pretty fuzzy, and of course twenty years have passed and this place is now *huge* compared to then, not to mention the changes in culture and sophistication, so I am not even sure if I *feel* Marsian, or if I do, I am not sure if my feeling is the same as everyone else's. Then there are my birth parents and three birth grandparents--one has passed--whether they will accept me, whether they can fit me into their families, even whether they should because both birth parents have married other people and have families of their own! So I wonder whether I should have just stayed on Earth and not complicated my life or anyone else's!"

"Why did you come back, then?"

"I don't really know. I feel like a homing pigeon, blindly heading home, almost like it's an instinct. This is my home, so I should be here. And of course, Earth is really screwed up; and now it'll probably be even more screwed up, with Peters being inaugurated in a bit over a month and systematically plotting his entire reform of the United States economy and foreign policy."

"Yes, it's quite amazing how fast they're moving, with a new Congress being sworn in right after New Years and the debate on a series of big bills beginning immediately, even before Peters takes the oath of office."

"And with growing evidence that he and his party won only because of the hack of the voting systems. They deny it, the other party insists on it, the courts are tied up in knots over the litigation, and meanwhile, there's growing evidence that both sides will take the law into their own hands after the inauguration. So I'm really glad I'm not living in the U.S. any more! But that's not why I came back. I suppose the best answer I can give is that I returned on a hunch."

Oskar nodded. "Then you will have a very interesting six months ahead of you! I suppose by then, you'll have the answers to your questions."

"Yes, I think you're right." She paused to eat some of her souvlaki. "I really appreciate this chance to talk. You see, I have no friends here. I don't remember any of the kids I played with in preschool and I haven't met many people at work because I just started on the job two weeks ago. My friends on Earth are a long way away and really can't help much. So I really appreciate the chance just to talk to someone my own age about all this."

"Sure, I can understand that. I feel the same way. It's one thing to talk to therapists, and I've had to do plenty of that most of my life, but to have friends is a different thing. If you want, you can always hang out with me and my friends."

"Actually, I really would appreciate that! I need to meet people."

"If you want to hang out with me, I can introduce you to some of the most interesting people on Mars. As culture reporter, I get tickets to every concert, dance, film, and performance in Aurorae. I'm usually offered two tickets. Morrowsol night I have tickets to the Aurorae Philharmonic and Sunsol afternoon I'm attending the dress rehearsal of a High School play. I know all the directors, conductors, ballerinas, poets, you name it, and they are quite interesting

people. If you want to experience the full range of what it means to feel like a Marsian, you have to meet them! Because believe me, your feeling is not outside the range of extremes!"

Maryam laughed. "That sounds intriguing."

"So, will you come with me morrowsol evening? We can have dinner first and I can tell you whan I'll be looking for, and you can help me."

"Sure, that'd be fun." Maryam smiled, and she realized that she hadn't been smiling much over the last few months. Maybe that was changing, too.

7.

Futures Forums

January 2085

Quite a large crowd of demonstrators swirled around the American embassy in Andalus Square. Some had signed reading “No isolationism!” and “Humankind is one community!” They chanted “Uncle Sam, Uncle Sam, join every woman and man, we are one community!” Across the square, the huge screen was still broadcasting live coverage of the inauguration of President Peters.

Will Elliott stood on the steps of the Marsian Capitol building, watching the excitement. When Ted Bukowski and Lin Changying came along to watch, also, they walked over. “Good afternoon,” said Ted. “I’m surprised there’s a demonstration! I didn’t know Marsians do that!”

“It takes a lot to stir up enough passion to generate a demonstration. During the Mars-US War there were demonstrations in front of the embassy every afternoon. It was even pelted with so much fake blood, it was red outside.” Will sighed. “It’s a sad sol for the human family. Two steps forward and one backward.”

“Two steps forward and three backward!” replied Ted. “The entire world economy is disrupted, the U.S. stock market is tanking, international trade is uncertain, U.S. firms are worried that they’ll have to de-automate, hire more workers, and become unprofitable, the White House wants to pull out of Project Sedna, and the people doing all this are illegitimate and might have been involved in the hack of the election systems, in which case they’re involved in an illegal coup!”

Will nodded. “That’s about right, though I guess there’s still no evidence the hackers were colluding with the Peters campaign.”

“No, they may have been anarchists, but the FBI is trying to investigate and the White House has said they’d block it.”

“They don’t want any proof found that they actually lost the election,” said Will.

“Or any talk of legislation or a Constitutional amendment that will allow for re-voting,” noted Changying. “I’m glad we’re here, frankly. I hear there’s been a huge increase in applications for immigration, next columbiad.”

“Tripled, I hear,” said Will. “So, what are the two of you planning to do? You’ve lost your job too, right?”

“Correct,” said Changying. “And Ted resigned effective this sol, but in actual fact he hasn’t worked for the last two months.”

“There’s nothing to do,” said Ted. “I can’t promise anything or arrange anything because the Peters administration has made it clear they’ll go it alone in space. Or so they think. I doubt that’ll prove practical.”

“It won’t, especially when they see China doing cooperative deals with Mars and other places,” agreed Changying.

“So, you’re both staying?”

Changying nodded. “We’ve completed the paperwork to be Marsian citizens, and we’re planning to get married in March.”

Will smiled. “Congratulations! Such good news! As for a job, I do have an idea. The Assistant Director of the Space Exploration Initiative—who does all the work, because I can do

only so much—is leaving in March. There was too much work for her to do, either. What if the two of you are hired to serve as Co-Directors?"

Ted was startled. "The U.S. would never agree to it."

"They don't have to, because I'm the Director and the only position they can veto is the Directorship. That's why I'm Director; no one could agree on anyone else to fill the position."

"But the U.S. will still object."

"They don't want to participate in the initiative anyway. You have all the contacts in the U.S., so you can help set up projects where we fund 100% or there is other non-US governmental funding."

"That would work," said Changying. "And the Chinese government probably won't object to my participation because they never complained about the quality of my work, only the potential conflict of interest, living with Ted."

"Then we'll consider it," said Ted, nodding. "We're getting married in late March, so after we return from the honeymoon we can start." Out of the corner of his eye he saw a change on the big news screen across the square and turned toward it, so Will and Changying turned as well.

"Wow! A huge clash in Dallas!" said Ted. "That's one of the cities that Peters supposedly won, but he probably lost."

"People are really, really angry," said Will. "And you can't blame them, their vote probably was taken away from them."

"Six people killed to control rioting and looting in Chicago, and five in Los Angeles," said Ted, reading the small print scrolling across the bottom of the screen, for the benefit of Will.

A young woman walked up to the trio. “Hello, good sol,” she said.

They turned to her. “Oh, Maryam, good sol,” said Will. “How are you? I think you met Ted Bukowski two years ago in Washington, didn’t you?”

“Yes, I remember, and I thought it was he.” Maryam extended her hand. “I’m pleased to see you again. I really appreciated all the work you did to coordinate NASA with the Mars Space Agency. I understand the relationship was smoother and more effective than ever before.”

“Thank you, and your work on behalf the Marsian government in Washington was crucial as well. Let me introduce you to Li Changying, my fiancée.”

“Pleased to meet you. You are the Chinese representative up here, right?” she said, offering her hand.

They shook hands. “I was, but I can’t continue, as fiancée of the former American representative.”

“No, I suppose not!”

“And the two of them may be continuing some of their duties as assistant directors of the Space Exploration Initiative,” added Will.

“Oh, that’s brilliant!”

Just then, the demonstrators finished their chant and the swarm began to break up. Maryam turned to the crowd, looking for Oskar. “A friend of mine is in the demonstration, so I came down to meet him,” she explained. Just then she waved to Oskar, who waved back and hurried over. He looked a bit uneasy.

“Good sol, Oskar!” said Will. “How are you doing?”

“Pretty well! My job at *Mars This Sol* is great and I have two new poems taking shape.”

"Are you aiming to publish a volume?"

"Yes, in the next year or so."

Will introduced "Oskar Langlais" to Ted and Changying. Maryam seemed surprised by the last name. "How is your dad?" Will added.

"He's doing pretty well, but right now the whole cabinet is going crazy trying to figure out what to do with all the instability on Earth, the crazy fluctuations in commodity prices--gold way up, PGMs way down--the plans for the next columbiad, and the Future of Mars Forums start in two weeks. Very stressful."

"I can imagine," said Will. "Sometimes all you can do is go with the flow."

That's why I've met with Chief Minister Helmut twice," said Maryam. "I've been working my sources in Washington to obtain any information I can."

"Any luck?" asked Will.

Maryam shook her head. "No one has any idea what will be done about space policy. The rest is pretty clear: the legislation to pull the US out of the world dollar, sever many international ties, and de-automate key sectors of American manufacturing is all drafted and will undergo Congressional debate as of tomorrow."

"That's why we were demonstrating! It's absolutely crazy that the foremost power on Earth would try to slip back into the twentieth century! Unbelievable."

"Won't your father have some trouble because of your participation?" asked Maryam.

Oskar shook his head. "He told me not to worry about it. If any media ask him or his office about it, he'll say 'Marsian citizens are free to express their concern about the developments in the United States.'" He looked at Maryam. "Shall we go get some supper?"

"Sure." She turned to the others. "It was good to see you, Chief Minister Will and Dr. Ted., and good to meet you, Dr. Changying."

"Ciao," they all replied.

Oskar and Maryam turned away and headed toward Cathay Enclosure. She frowned and said, "Why didn't you tell me that Chief Minister Helmut was your father?"

"When people find out, they treat me differently, and I don't like it," he replied. "I didn't hide it; the poem you read in *Mars This Sol* had my last name."

"I figured your father might be Kristof, the farmer."

"He's my uncle. So, now you know. What do you want to eat?"

"Chinese sounds good, just as we planned. And I won't treat you any differently. We've gotten to know each other and I like you, Oskar."

"Thank you, I like you, too. I've really enjoyed going to concerts and other cultural events with you. I used to go to the Dacha every weekend night to have a few drinks and meet women, but this has proved much more fun."

"Good, I'm glad. I'm not interested in going to the bars up on the escarpment."

"Well, neither am I, now."

"Good. But please understand that I'm not ready to sleep with you. Not yet. I think we need to get to know each other a lot more, first."

Oskar nodded and smiled. "Alright, that sounds good to me."

When Tad came out onto the main square of Avalon 1, he was surprised by how big the crowd is. "Wow, with the arrival of Uranus 3, the population is noticeably bigger."

"Yes, it really is," agreed Vahid Davidson. "It was just 300 people, too. But I suppose just about everyone is here for the Future of Uranus Forum. Where are Susan and Paul?"

"With Wicah-pi Luta, Esther, and Miranda." Tad scanned the crowd, then pointed.

"With Tahirih, too. Let's go. Oh, let me introduce to Firuz."

"Moulin? Head of Uranus 3?"

"Exactly, a really nice guy. He arrived three weeks ago, while your expedition was still out." Vahid led Tad over to the short, black-haired main in his early 50s. "Firuz, this is Tad Lind."

Firuz smiled and extended his hand. "Very pleased to meet you. Your expedition to the six inner moons was fascinating and very successful. I followed it closely."

"Thank you. The geologists on Uranus-3 were quite involved. I'm familiar with your research on the inner belt, too. It seems like you've visited every major asteroid!"

"No, not exactly, but after six missions from Phobos, I have visited 33, and they say that's a record. One that I'm sure won't hold. Between Uranus and Saturn, you've visited almost that many moons."

Tad nodded. "I think the total is 20, mostly at Saturn with my father."

"He's done some very good exploring as well. So, what are your plans now?"

"We have six to twelve months of writing up the results, and after that I'm not sure. I gather you're heading to Ariel in a month?"

Firuz nodded. "Six months of additional exploration there." He looked at the platform, where Gandhimohan was walking to the podium. "I think we had better sit."

"Come with us," said Tad, gesturing toward his family. They walked over and sat with Susan and Paul just as Gandhimohan began to speak.

"Welcome everyone to the Future of Uranus Forum. As is the custom through the solar system--well, except in the Earth-moon system--before an election we hold a forum where everyone can speak about the future they envision for their community. Our election is on Satursol February 25, just as it is on Mars. On that sol we will elect nine members to the Urania Council and one representative to the Mars Consultative Assembly, though only those of us who are Marsian citizens will be eligible for the latter vote. Note that the size of the Urania Council is increasing from seven to nine, because our population has grown by 300 with the arrival of Uranus 3. I should add one more thing: I am chairing this forum because I have submitted my resignation from the Council, effective with the election of the new Council. Because I am ineligible to be voted for, I have been asked by the Council to chair this gathering.

"I think most of you are familiar with the proposed plans for the next two years, but I will review them, since the Council hopes this meeting will end up supporting the plans. Avalon 1A surrounds us in its verdure and architectural beauty, complete. After the last Future of Uranus forum, 2 ½ years ago, we decided to embark on the construction of Avalon 1B, on top of Avalon 1A, also 100 meters high and 200 meters in diameter. It is now enclosed, pressurized, and spinning, and we will open it to visitors next week." He paused for strong applause. "Avalon 2A and 2B are 100 meters away from this complex. The hole for 2A, 206 meters in diameter and 200 meters deep, was completed two months ago. As the crust of Miranda was melted by a steam drill, the metal sides of the hole were installed, meter by meter downward, and the outer metal walls of Avalon 2B rose above the hole, also 206 meters in diameter and 200 meters high. The

liquid water condensed from the transient atmosphere of the hole was piped outside, where it thickened the coat of ice around Avalon 1 and 2 until it was a minimum of 20 meters thick everywhere. The 100 meter space between the two Avalons was filled to the height of 100 meters with ice as well. We removed a huge amount of ice, and in consequence we have an armoring equivalent to 20 meters of concrete around us, protecting us from just about any imaginable explosion or crash. Avalon is now totally secure." He paused again for applause. "Avalon 2A now has its inner drum installed and the magnets are mostly installed. We anticipate hovering the drum and starting its rotation in about 2 months. The construction site is already pressurized. Avalon 2B will follow six months later, or this August. At that point we will have 240,000 square meters of rotating, gravitied surface. Avalon 1B will have 60,000 more. Our industrial work will move into 2B, not 2A as was originally planned, because the top of 2B will have very large airlock doors for removing any completed large structures from it, and on top of 2B we can build a zero-gee manufacturing facility. 2A will have our bioarchive and will provide outdoor recreation, hiking, swimming, and space for sports events. Between 2A and 2B will be a fifty-meter high nonrotating space with Mirandan gravity only, again for recreational use. Avalon 1B will continue to be built up for work and commercial space, and additional housing will go in 1B. We anticipate that 1A and 1B can easily hold 3,000 people, which is the maximum we are planning for at this time.

"The rest of the Council's plan for the next two years involves six expeditions, one each to Ariel, Umbriel, Titania, and Oberon, one to the remaining unexplored inner moons, and one to Francisco. Engineering will build spytors for 5 of the 8 outer moons and rockets to get them there, meaning that two years from now we will have only three moons lacking ground truth. We

also anticipate producing and exporting three tonnes of Helium-3, though it remains to be seen whether there will be any market for it on Earth; the current situation is very uncertain.

"So, that's the plan. Who has comments?" Gandimohan held up his communicator and people began to punch on the app that gave them the floor. Tad pulled out his communicator and hesitated.

"No, I think you should," said Vahid, who knew what Tad wanted to talk about. Tad nodded and punched in the speaking request.

Gandhimohan had quite a list of people ahead of Tad, though. Jane Hudes, the chief geologist, emphasized the importance of exploring the four big moons over the next two years. Rev. Varma emphasized the need to spread people out to avoid overcrowding by building housing in Avalon 2A. Pierre Wilson, a cryogeologist, asked about building a permanent facility on Titania, the largest moon. Patrick O'Hare asked about the price of Helium-3 and whether Urania was economically viable.

Then Gandhimohan called on Tad, who had watched his name moving closer and closer to the top of the list. He rose and the speaker light came on on his phone. "I think most of you have heard about some of the results of the six-moon expedition, which just ended a few sols ago." He was being very careful to avoid "I"; he had just had a session with Gandhimohan that morning and was consciously focusing on results rather than himself. "Perhaps the most significant result was the discovery of an ataxite deposit on Portia. Seismic profiles of the crater revealed three quarters of the original 200-meter in diameter impactor is intact and accessible. That's 30 million tonnes of ataxite containing 15,000 tonnes of platinum-group metals, worth about 450 billion redbacks at current prices.

"The obstacles for extracting and exporting the PGMs are not as bad as one might think. At the extreme cryogenic temperatures prevailing here, ataxite shatters easy, allowing us to reduce it to a powder with relative ease. We can build a 500 tonne per day fractionation tower to separate the various metals via carbonyl, yielding 250 kilos of PGMs per day, worth over 7 million redbacks. The facility would need about a dozen operators to manage the robots and the repair work. We could build a 50-meter drum--a C-50--here and haul it to Portia; it would provide housing potentially for up to 100, so it would have plenty of space for the crew plus visiting geologists. The design, based on the drum the Neptunian community is building on Triton, could also be duplicated for use on Titania, Oberon, Ariel, and Umbriel, providing housing for crews on all those moons, so this would be a standardized structure. If a moon needed more space, a second one could be hauled in, so these 50-meter drums could become a standardized feature as our population grows and we establish permanent settlements on all the major moons.

"As for energy, we have only so many nuclear reactors we can deploy at Portia and at these other outposts. But there is an alternative source of energy available to us even on Portia: we can drill a very deep shaft, say 10 kilometers into the moon, and set off a relatively small laser-triggered fusion bomb. We almost certainly can get a license from Martech to build a 10-megaton device, which will release enough heat to provide geothermal power for a hundred years.

"So this is a proposal we should consider very seriously: use Portia's ataxite to provide Urania with an alternative source of revenue, embark on a project to design and build a standard 50-meter rotating enclosure suitable for deployment elsewhere in the system, manufacture a

500-tonne per sol carbonyl fractionation tower, and deploy a reactor or set off a fusion bomb for energy. In two years we could be exporting 90 tonnes of PGMs worth 2.75 billion redbacks every year, more than doubling our income. Such a project will ensure our future and the need for expansion of our population."

Tad sat to warm and positive applause. Gandhimohan looked very pleased. "Discussion of this idea? Just raise your hands." He paused; a few hands went up. "Karl."

Karl Forbes rose from his seat. "Two years ago when we had our last Future of Uranus Forum, I proposed basically the opposite of this idea, and it was embraced very positively. Some of us had been on Titania when Avalon was built and when we rotated back here, we were completely uninterested in returning to Titania to build a small carrier there. This place is so large and spacious, who would want to live anywhere else? I think that is still true. I don't think we need drums on every major moon. As for the PGMs on Portia, are we here to be miners, or to be scientists?"

He sat and Gandhimohan recognized Tahirih. "I rather like the idea of building a 50-meter drum on Titania and maybe Oberon as well. We need to maintain a semi-permanent presence on both of those moons, and eventually on Ariel and Umbriel as well, so we'll need a permanent facility. But I am concerned about diverting human resources—geologists in particular, but also engineers—to Portia to pursue PGMs. Right now, we have plenty of income to support our imports from Helium-3 exports, and the economic instability on Earth doesn't seem to be endangering it. So I am not sure that we need PGM production."

That stirred Kofi Phelps, their store keeper and attorney, and he raised his hand, so Gandhimohan recognized him. "I'm not so sure about that, Tahirih. The price of Helium-3 has

been fluctuating lately. Investment in additional fusion reactors for power generation has slowed and there is every indication that the American decision to pull out of the world dollar will precipitate a serious recession. That will decrease demand for power. So PGMs—which have been fluctuating seriously in price, I admit—may be a useful diversification of our income. Furthermore, our legal claim to this entire system has been questioned because we have only one borough."

"But no one was questioning Titan's right to claim the entire Saturnian system," objected Karl.

Kofi shook his head. "Not true, there were issues raised about their right to claim the entire system."

Samantha Augustine raised her hand. "We don't have an easy way to move 90 tonnes of PGMs to Earth. We have two cargo vehicles that could be used, but they're not scheduled to be replaced so we need them here, and they can't move more than maybe 30 or 40 tonnes anyway."

"I'm doubtful about the idea of setting off a fusion nuke inside Portia, too," exclaimed Jasmine Smits, the overall Director of Science. "It's a small moon with very weak gravity; I think 2 thousandths of a gee, which means 10,000 meters of ice has the weight of only 20 meters of ice on Earth. A large explosion could blow a chunk of the moon away, or worse, it could loft a huge chunk into space and it could come crashing back down on anything we've built there."

Tad was getting angry, but he bit his lip--literally--and raised his hand. Gandhimohan nodded. "The cargo vehicles would not need to leave the system. They could accelerate a capsule of PGMs onto a trans-Earth trajectory and return here. The propulsion system we can build for the spytor probes is large enough to provide course corrections for a cargo payload of up to 40

tonnes; I checked that. As for fusion bombs possibly fragmenting Portia, we need supercomputer simulations to determine the danger of that. It is true that 10,000 meters of cryogenic ice will weigh the same as 20 meters on Earth, but it will also have the strength and rigidity of 10,000 meters of concrete or rock. There hasn't been time to determine what pressures that's capable of withstanding."

"I'd be concerned that we might dilute our focus on Helium-3 extraction," exclaimed Marcel Augustine, who was in charge of that project. "I see no reason to do that."

Firuz Moulin raised his hand, then stood to speak. "About ten years ago, I spent several months on Ceres on my way back from the Jupiter Trojans, so I saw how they did their PGM extraction work. As Tad said, it did not demand a lot of human resources, and with robotic mining and artificial intelligence in maintenance, it will take even less now. As for getting the PGMs back to Earth, Ceres had the three-d printing specs for a hydrogen-oxygen rocket, and those specs are much better now. They were printing the rockets out of nickel and cobalt, in order to deliver some of those metals to Earth as well. I am sure the engineering department can build one rocket a year able to send 90 tonnes of PGMs to Earth.

"Where energy is concerned, a 500 tonne per sol fractionation tower uses a lot; I think 50 megawatts. The simplest way to power it is with a reactor, and we could spare one, especially since Miranda is developing solar power sources. I know the outer solar system generally wants to get away from fission reactors because we have to import the uranium from the Earth or Mars; there is no cheap way for us to obtain our own supply out here. But importing a few kilograms of uranium every two years is a fairly small cost, and is the wisest course, in my opinion.

"As for PGMs versus Helium-3, it is wise to develop both, for two reasons: it will protect us from a drop in the Helium-3 price, and it will allow us to cut back on Helium-3 production if Saturn and Neptune need more income. This isn't competition; it's complementarity.

"As for developing a 50-meter drum, I think that is an excellent idea as well, especially since we can get the design from Neptune. The Uranian system has two moons that are half the diameter of the Earth's moon, and two others that are larger than Ceres. All four of them are complex and deserve thorough study of their geology and their prebiotic compounds. All of them will eventually deserve permanent outposts, as will Portia with its PGMs. Miranda will remain the headquarters of the Uranian system, with its manufacturing, its bioarchive, and its government, education, and health facilities. People were wondering how many people we can squeeze into Avalon 1A and 1B. They aren't the only places people will settle though, if we have several hundred on all four of the other big moons. And why shouldn't we? The geography of this system is different from Saturn's and Neptune's, where you have a single large moon that is the logical focus of settlement. We have five large moons and they all have fascinating histories. All of them will have outposts with schools and clinics within a decade, I suspect.

"So I am in favor of Tad's suggestions. I think the future of Urania lies with them."

"We should go in, now, or we'll be late for the Future Forum," Fred Klaas said to Jeremy Wambleeska. The Director of Neptunia's engineering department and the Director of Neptune Science were inspecting work on the pressure bulkhead being erected across the entrance to Columbia cavern.

"Okay," said Jeremy. He pointed to the screen he was holding in his right hand, which showed an ultrasound of the nickel-steel anchor that had been sunk into the cavern's floor. "I wish they had gone down farther; maybe 15 or 20 meters. Right now this ice is as hard as concrete, but if this cavern is ever heated up to room temperature, even with a thick layer of insulation protecting the floor, walls, and ceiling, it'll soften up."

"Twelve meters was the recommended depth."

"I know. It'll prove adequate if we insulate this area very, very thoroughly, so the ice stays cold."

"I still find it hard to believe we could ever pressurize and heat this entire cavern."

"It's a question of insulation. We need enough to retain the heat we add through lighting. The Martech supercomputer is building a really good model for us." Jeremy stopped and looked around. At the moment they were running a series of spotlights putting out 10,000 kilowatts of light altogether, sufficient to brightly illuminate the vicinity, but even the far end of the enormous cavern was barely visible, 2,000 meters away. Jeremy looked up at the ceiling, which seemed impossibly far above them. "This place is really growing on me."

"Me, too," admitted Fred. His eyes lingered on a sparkling cascade down a nearby side of the cavern, which they had dubbed "the little waterfall." "It really will make an amazing home, some day."

"Assuming we can enclose, pressurize, and terraform the whole thing without experiencing partial ceiling collapses."

"Leave that to the engineers," Fred smiled wryly. "And we'll leave the geology to the geologists."

"This area's pretty good, too, especially with Kanaloa Patera promising to erupt in the next few months. That will be something to see."

"And it'll bring the heat for our geothermal system right to the surface; very convenient. It's too bad Rideout is the one who discovered all this!"

"Yes, I hate to have to agree with him!" said Jeremy.

They turned away from Columbia Cavern and walked to the small airlock door nearby; the pressure bulkhead also had space for a huge airlock if they ever decided to build one. The airlock was wide open because the cavern was unpressurized, so they stepped through. On the other side they passed a pipeline and came to "Columbia 1" as the completed 50-meter drum was called. Fred pointed to the pipeline. "The robots should have that thing finished to the first solid nitrogen pool next week."

"How much pressure can the bulkhead retain?"

Fred considered. "It's already able to accommodate a hundredth of an atmosphere; a bit more than Martian air pressure, in other words. So we can probably close up the bulkhead and start importing nitrogen at that point. It'll take a long time to get even that much nitrogen into the cavern."

"Will it condense out and make liquid nitrogen pools on the floor?"

"No, the 10,000 kilowatt spotlights provide enough light to prevent that. Once the atmospheric pressure reaches Martian normal, also, we can start dumping the reactor's spare heat into the cavern; another 25,000 kilowatts. That'll be enough, gradually, to heat the interior to about 150 Kelvin."

"Balmy," said Jeremy with a smile.

They walked under the drum and entered the airlock. Stepping out of it, they entered the locker room and removed their space suits in Tritonian gravity—one twelfth of an Earth gee, half the moon's—then headed up a spiral staircase and entered the drum in the middle of "the bowl." The 100 engineers, geologists, and their family members who had come to Triton from Proteus had immediately moved out of their two caravels and into the spacious drum, which was 50 meters in diameter and 50 meters high. It was half as wide and high as the Seron, but it was much bigger than their caravels. Most were still spending the night in their crowded living spaces on the *Dorado* and *Carina,* but they ate, played, and their kids went to school inside Columbia 1, some ecology and laboratory work had already moved in, and within six months they'd be living there as well.

A few more entered right after Fred and Jeremy and they all sat on chairs facing a large screen, which was broadcasting a similar but much larger scene on board the Seron. Barry Adler, the navigation officer of Neptune-1, walked to the speaker's platform. "Good afternoon and welcome to the Future of Neptune Forum. I've been asked to chair the program this afternoon, during which we will discuss and exchange views about the future of our community and the settlement of the Neptune system. The Seron and the Neptune-1 crews came together only 7 weeks ago; a tenth of us returned to Triton to continue the work there 4 weeks ago, once the aerostat *Venilia* was successfully deployed into Neptune's atmosphere. The Council's plans for the next two years—at which point Neptune-3 arrives with 300 more people, and the time for another election comes around—include missions to Nereid and to several other inner moons; completion of both the Columbia-1 and Columbia-2 drums on Triton, along with the pressure bulkhead, nitrogen pipeline, and geothermal system; expansion of Seron-1 into the hydrogen

tank we emptied on arrival; and construction of Seron-2 so that we have more room. Rev. Filip Andreescu will have the floor first, and we will give the floor subsequently to those who indicate their wish to speak via the app on their communicator."

Adler turned to the audience and Reverend Andreescu, who was Unitarian, rose. "Thanks, Barry. I don't think I need to be the person emphasizing that now that we are united as a single people in the Neptune system, we need to think of ourselves as a new unit of human civilization and work consciously and deliberately to define the nature of the society and culture we will be. This is more important than questions like whether to build Seron-2 or concentrate expansion on Triton. We are not here just to explore and to extract Helium-3; we are here to live purposeful and loving lives, and that means leisure time, the arts, culture, hobbies, volunteer service, building loving families, and helping each other. It has been fascinating to follow Saturn, the most mature of the outer solar system settlements; they are known for their weekly comedy show, which we all enjoy, their art museum, which is small but growing, and their innovative Martech campus. Urania is coming along as well. What will we become known for?

"I have two suggestions. The first is to accelerate our switch to a shorter work week. Do we really need to work 45 hours a week? We have a beautiful place to live, we aren't in any danger, we have our aerostat deployed . . . why wait? We should at least cut back to 40 hours a week. Mars, Saturn, and Uranus now have a 35 hour work week. Why not? We don't need to solve every mystery in this system in the next ten years.

"The second is to start building on our cultural strengths. On the flight out, we discovered a lot of us were really good at story telling. The recordings were really popular on Earth. Could we start a weekly storytelling program? I think we could; millions would watch it, too. By telling

stories, we emphasize intercultural understanding, cooperation, leaving no one behind, helping everyone achieve their dreams . . . the universal human values on which Neptunia is based. That may be a more important contribution to a violent, desperate, angry Earth than our Helium-3."

Filip sat to applause. "The Council should have asked him to chair the forum," Jeremy said to Fred.

Fred shrugged. "We asked, but he declined. I think he wanted to be sure to have his say."

Barry recognized Siyabonga Dlamini, the Assistant Director of Construction and Fabrication; with Fred on Triton, he was in charge of the department on Proteus. "I want to second Rev. Filip's comment about how beautiful this place is. Seron has matured nicely, the trees are growing well, and we have an excellent diversity of foods and organic products such as cotton. But it is sized for 1,000 adults and can be stretched to accommodate a lot of babies, which we have right now, but as those babies grow we'll need more food production, more space, etc. We left Mars with 800 adults and 100 children; we arrived here with 300 children; and it appears we'll have 200 or 300 more children in the next few years. So Rev. Filip's suggestion that we shorten the work week may be premature; a lot of men and women will be taking maternity leave in the next few years! It also means that we need to get started on Seron-2 as soon as possible. It will be 100 meters wide, just like Seron 1, but it'll be 200 meters high so it'll accommodate at least 2,000 people and will give us ample space to expand into. Thanks to Neptune-1, we know where to find the nickel-iron, the chondrite, and the volatiles we need to build it, and if we get started right away it'll be ready when Neptune-3 arrives in two years. At that point our population will be 1,200 adults and about 600 children, and we'll definitely need

the space, because Seron-1 will be full. The design for Seron-2 is really beautiful, too; you'll love it."

Siyabonga sat to applause and Barry called on Rahmatullah Khan, who had been Jamison's number two and had built the drums. "There is no question that in 2 years, we'll need more space," he said. "But there is no obvious reason to put it here. We already have space for 200 people on Triton, but it is only partially complete. I'm very grateful to the crew that has returned there and is completing both drums and the pressure bulkhead. That represents a clear commitment to building up Columbia Outpost and, by implication, Triton. Because there is no doubt that we need a substantial portion of our population on Triton. If we want to build Seron-2, we should build it in Columbia cavern."

Rahmatullah sat to applause, a bit more applause than Siyabonga, too. "He's right," said one of the geologists sitting near Fred. "Siyabonga should see this place."

Fred nodded and pulled out his communicator. He pressed the app that would connect him to the Future Forum, hundreds of thousands of kilometers away on Proteus. He got an immediate acknowledgement from Barry: *I'll add you to the short list.*

Dr. Daisy Chandra, their chief medical officer, rose to speak. "I fear Neptunia may always be split between two identities: Proteus and Triton. I have been pondering Filip's words about unity and wonder how we can maintain them. One way is to remember that Seron put down here, not on Triton, and that we can have only one central outpost where our university is located, where our main hospital is located, and where the seat of government is based. And the way to guarantee that we remember is to build Seron-2 here. I am not opposed to building up Triton; there's no doubt in my mind that it is a worthy object of study and will require a

continuous presence of scientists to study its eobiology and geology. Consequently, there will be a school there for elementary and high school students and a clinic to take care of medical needs. It will grow its own food; people will rotate through as they study Triton, then return here to write up the results. That's the future I see."

Barry nodded in thanks as Daisy sat. "Jamison."

Jamison Rideout rose from his seat next to Mercedes. The camera focused on him and everyone in the drum on Triton leaned forward toward the big screen. "I think everyone knows where I fall on this issue, so let me remind everyone about some facts regarding Triton. The Chinese are planning to send an expedition of a thousand people to Pluto in a few years, but Triton is thirty percent bigger than Pluto in diameter, and has a surface area slightly larger than Pluto and Charon combined. It is a Kuiper Belt object—one of the largest ones we know of—and is the closest one to the sun, and it has an intriguing history because it was captured by Neptune, and we are still not sure how. If we had a thousand people on Triton studying it for a century, we still wouldn't have unraveled all its mysteries.

"So it is important all by itself; indeed, if it hadn't been captured by Neptune, we'd call it a planet. But it isn't by itself; it is accompanied by over a dozen moons of Neptune, half primordial and half captured later. Neso is as far from Neptune as Mars is from the Earth at opposition and because it is retrograde, like Triton and several other moons, it is easier to reach from Triton than from Proteus. We need an outpost on Proteus to reach the prograde moons, study the rings, and reach Neptune itself. We need an outpost on Triton to study Triton and a few other little retrograde moons as well.

"We aren't going to study Triton by rotating geologists and their families between Triton and Proteus every six months. Triton will grow on them, as it grew on us. Columbia cavern will grow on them as well; Columbia Rille and cavern are both places of great natural beauty. Neptunia is destined to be a two-world civilization. The two worlds will always need each other; neither can manage without the other. That's the way it's going to be, and building Seron-2 won't stop that. What we need to build is Columbia-3—because the two drums are already Columbia-1 and Columbia-2—and we need to make Columbia-3 200 meters in diameter and 300 meters high. Why? Because there's a perfect spot for it about 400 meters inside Columbia cavern where the ceiling is 300 meters above the floor. So Columbia-3 needs to go floor to ceiling, and have extra structural bracing built into it to help support the ceiling. That isn't as difficult as it sounds, because the 300 meters of ice overhead has a weight equal to 25 meters of ice on Earth. Columbia-3 will be one of the seven wonders of the solar system when it's finished, too, rivaling the largest enclosures on Mars and the Japan-Korea tunnel. It will be a great engineering accomplishment worthy of a great, new addition to human civilization, on a world worthy of its own creative community. That's what we need to start in the next two years."

Jamison sat to startled applause and a lot of murmurs. Barry looked at his list. "Fred Klaas, on Triton."

Fred was surprised it was now his turn, and he wasn't sure what to say to Jamison's suggestion. He stood and faced the camera on the big screen, and a few seconds later his face appeared on the screen. Remembering the time delay, he decided he had better not look at himself; it'd be confusing. "I favor building Seron-2 here on Triton; or Columbia-3, if you prefer. This is a huge and fascinating world, worthy of being called a planet. Last Sunday several of us

drove to the geyser erupting about twenty kilometers east of here and watched it continuously blast dust and nitrogen gas several kilometers up into space. Quite something to see. Columbia Rille is almost as amazing as the Grand Canyon on Earth; not as deep, but steeper. There's a spot about six kilometers from here where we'll be able to build a road up the escarpment, and it'll shorten the route to Kanaloa Patera and to our nickel-iron supply. Columbia Cavern is a huge sparkling expanse; it's almost like walking in a crystal chandelier. Of course, to use it, we'll have to cover up the sparkles, but we can always keep a part of it natural. The latest seismic study indicates that the 300-meter roof is solid and strong, and heating it up by heating the cavern underneath will soften it very gradually; there will be plenty of time to install a nickel-steel roof and pillars to support it. We just got a new report from Martech that the heat flow through Kanaloa Patera is sufficient to generate about 250 megawatts of energy, which is about a third of the total we need to heat and light Columbia cavern. That will be plenty for several decades, however, because we don't need to terraform all of it at once.

"We have also received a white paper from Martech where some students studied a geyser field about fifty kilometers from here, where three geysers are erupting from underneath slightly more than 1,000 square kilometers of nitrogen ice. If we can drill through the ice and divert the flow of escaping nitrogen gas through turbines, we can generate several hundred megawatts of electrical power, so it is possible for us to capture a significant amount of solar power. Of course, this is a seasonal source of power and we'd need to install turbines in other geyser fields much farther away, but it is possible for us to utilize solar energy, even way out here at the edge of the solar system! I suspect in the long run, it'll be easier and safer to rely on fission reactors. Columbia cavern would need six of them. It might even be possible to insulate

the cavern very well, expel the extra heat via a pipeline to a solidified nitrogen lake twenty kilometers away, use the heat to gasify the nitrogen under the ice sheet, and use the resulting gas pressure to turn turbines, so we could actually recapture and reuse some of our electrical energy!

"Anyway, I am rambling, but the possibilities here at Columbia are immense, and the engineering challenges are intriguing. By solving some of them, we'll make a significant contribution to humanity. So I agree with Jamison: we need to build our new carrier here, not on Proteus."

"The stadium is pretty full," Maryam observed, as she and Oskar entered.

Oskar looked around the stadium quickly. "Currently, it holds 30,000. They designed it so they could add rings of seats and make it 100,000, some day. But I'd say it's two thirds full. Maybe less."

"Maybe. How many were here two years ago?"

"About this much, but Aurorae was 15,000 or 20,000 people smaller, so I'm disappointed."

"I suppose a lot of people watch the Future of Mars forum on tv at home. That's what my mom is planning to do."

"My parents can't; they're sitting in the front row."

Maryam chuckled. "I'm sure." She pointed, Oskar nodded, and they headed up a set of stairs to some free seats half way up. As they went, they saw Ted and Changying waving, so they diverted over.

"Good sol!" said Ted. "So, your first Future of Mars forum?"

Maryam nodded. “Yes, I wanted the excitement of coming here and watching the process unfold.”

“It is exciting,” agreed Changying. “I attended last annum even though I had decided not to claim Marsian citizenship and therefore not to vote, because I wanted to watch. But this time is different because we are both citizens now.”

“Congratulations,” said Oskar. “I have probably attended every Future of Mars Forum since ’62 when I was born. Even when we were on Ceres, we attended, but we watched from the galley on t.v.”

“This is my first one, too,” said Ted. “I didn’t go, two years ago.” He pointed to four seats nearby. “Let’s sit there.”

“Sure,” said Maryam. They all moved to the seats. Maryam looked at Ted. “So, what do you think about the stock market crash?”

“I’m not a bit surprised. President Peters managed to pull the United States out of the world dollar in just a month—a mere month! His team had been preparing the legislation since November and they feared that if they waited, the Supreme Court might nullify the election. So they rushed, everyone panicked, and now the United States Federal Reserve has to create trillions of dollars overnight and they have no experience, because they have been closed for eight years. Why should anyone have any confidence in them, or in him? If the United States is lucky, the Grand Union will let them come crawling back.”

“Well, not if they pass all this legislation banning robotization of factories and banning imports made robotically,” said Changying. “No one even knows how to define ‘robotic manufacturing.’ Machines have been integral to manufacturing for thousands of years.”

"What have you heard, through your contacts?" Ted asked Maryam.

Maryam shook her head. "The bureaucracy is furious and they're undermining Peters in every way they can. Everyone who can is suing the government; I suspect they'll get the anti-robotization stuff thrown out on technical grounds. But no one knows whether they'll get a paycheck in a meaningful currency, or what it'll be worth; that's the big uncertainty. The U.S. dollar was supposed to be equal to the world dollar, but it's already down to a quarter of that, and it's still falling."

"Yes, an economist I heard on t.v. said that a United States economy that can't use robots will be a third to a quarter as productive, so the only way it can compete is for workers to be paid a third to a quarter as much," said Ted. "No will be able to import anything because it will be ridiculously expensive, which will solve the rules about importing robotically manufactured goods."

"But U.S. goods will be too expensive to export, so the country will be forced into self sufficiency, which will disrupt supply chains, cause huge shortages of goods, and disrupt manufacturing," said Oskar.

"And there is already capital flight," added Maryam. "America is impoverishing itself overnight."

Just then, Will Elliott walked onto the stage in the middle of the stadium and the four gigantic screens all came on with his image, so the crowd immediately quieted. He walked quickly and confidently; he did not look 84 years old. When he spoke, his voice was strong.

"Welcome, everyone, to this Future of Mars Forum. Last Satursol, we were able to watch the forums in Cassini, Uzboi, and Meridiani; last Sunsol, the ones in Dawes, Thymiamata, and

Kalgoorlie. Morrowsol there will be a second Aurorae forum, plus forums in Thaumasia, Tithonis, and Phobos. Last weekend we were also able to watch the very interesting forums on Uranus and Neptune, and I followed them closely.

"Traditionally, the chair of these gatherings is someone who is ineligible to be elected, and we usually consider former Chief Ministers to fall in that category. Morrowsol, your chair will be Jacquie Collins. I have the privilege of chairing this sol, and it brings me great pleasure to do so. Five months from now, it will be the fiftieth anniversary of Columbus 1's departure for Mars. Almost exactly a year from now, we celebrate the fiftieth anniversary of the first human landing on Mars. Think what we have accomplished in 49 years! I can look back at that event as if it occurred yestersol, and I pinch myself to think that almost 150,000 human beings now live on Dusty Red. How many millions will be here in another fifty years? What civilization will be here? And how will we compare to the mother world, the old world, so torn with ancient rivalries and struggles? How will we help Earth to achieve its destiny, while we are sending expeditions to the nearest starts?

"These are matters of long-term perspective that we need to contemplate with great seriousness as we begin this Future of Mars Forum. Certain subjects have already dominated the forums elsewhere, notably immigration—an eternal issue for us—our efforts to help Earth, our efforts to foster exploration deeper into space, the relative sizes of our outposts and groups of outposts, the level of prosperity here, and intangibles such as culture, work hours, and leisure time. I look forward to hearing your thoughts. To speak, you need to message 44567; when you are granted the floor by me, I will call your name, and your communicator's camera and microphone will go live. To get us started, we will hear from Bishop Karol Miller."

There was a pause and Mars's Catholic bishop—bishop for the Diocese of the Outer Solar System, to be exact—walked to the stage from his seat nearby. "For those who wish to make this a prayer, please silently add your own words to mine. My heart goes out first to our school children, who are taught in school they should always ask themselves 'what are the ethical principles?' whenever they have to make a moral decision. We have many moral decisions to make this sol and at this gathering. First, how will we help out fellow human beings on Earth—our relatives, friends, colleagues, and the strangers to us there—who are now caught up in the biggest crisis since the great war? Many are losing everything because of economic uncertainty and instability; soon many will be hungry and in despair. We are a small and fairly weak nation, but that does not absolve us of responsibility to assist them. How can we at least give them hope? How can we be an example of another way to organize society?

"My heart turns to Mars. How can we be better neighbors to each other? How can we love each other and make everyone feel welcome and a part of this Commonwealth, especially the 40,000 new arrivals who have joined us in the last six months? How can we increase our prosperity, but also our striving to make ourselves better human beings? How can we make this world more humane and worthy of being called a 'civilization'?

"Finally, my heart turns outward to space, the blackness we all crossed to get here, and I ask: how can we help more people come here, and help more people to head out farther into the depths of the solar system? How can we foster the spirit of exploration?

"I contemplate all these matters as I stand before you, and I pray we can all dedicate the next two hours to a principled and wise deliberation about them. Thank you."

The bishop headed back to his seat. Will looked at the screen resting on his lectern and said, "Nathan Rubin." Martech's chief philosopher and Chair of the Department of Philosophy and Religion rose from his seat in the stadium and his face appeared on the screens. "Thank you, Dr. Will, and thank you Bishop for reminding us of our ethical responsibilities. I have been thinking a lot about my colleagues on Earth in the last few months, and the irresponsibility of the people in power—not just in the United States—to focus on their own position rather than protecting the populous from economic disaster. I suspect the world economy will avoid a depression, but the United States won't.

"A month ago, I heard that applications to immigrate to Mars had tripled. According to *Mars This Sol,* as of Thursol the applications are now up five fold. So I see for us an immense opportunity to diversify our population and our professional expertise. Martech has only three of us teaching philosophy, and our courses are always full; people here love philosophy. We have only one professor of religious studies. The Department of Languages, Literatures, and Cultures has only five professors, covering English, Spanish, Chinese, Indian, and French respectively, and they are all overburdened. We have only three people teaching art full time, and again the courses are full. We have only two sociologists, but eight people teaching psychology. And how many teach geological sciences? Two hundred? How many engineering faculty? Over a thousand? Admittedly, many have honorary faculty status and mostly do research; but shouldn't our people in the humanities and social sciences and arts have time to research and perform as well? Mars is by the far the largest off-Earth society, so we need to have expertise in terrestrial cultures. Our children don't understand Earth; they need at least to take courses about it! This is a very important issue for the development of our civilization."

Will looked at who was next. “Vanessa Smith.”

The Nobel Laureate rose from her seat. “I want to remind all of us about the native Martians. As you probably know, last year we drilled into a subglacial lake at the North Pole and discovered 25 species of native life-forms, raising the total known to 87. We are steadily rescuing Martian species from near extinction and we need to devote far more resources to the effort. We drilled into the lake because it was located under the proposed site of a 5-gigaton fusion explosion, an explosion that probably would have crushed and obliterated the lake. We have already ruled several large areas in the south off limits to fusion explosions, or least explosions larger than 50 megatons; personally, I’d prefer a total ban in those areas. Overall, Project Estival has been making pretty good progress, in spite of last year’s Category-5 global dust storm. It’ll be several decades before the atmosphere is appreciably thicker or the exterior temperatures significantly warmer. It does appear now that we can get the atmospheric pressure up to about 25 millibars and raise the average global temperature by 30 degrees Celsius, which will put us close to Antarctic thermal conditions. This is quite significant, because at that point Martian organisms can begin to survive on the surface. Furthermore. artificial Marsoforms, which are getting better adapted to the Martian climate every year, can do fairly well under those conditions. Finally, there appears to be no problem of competition between the two ecologies; they appear to be compatible. So all this is excellent news indeed. If we can double our budget for finding and preserving Martian life forms, we will have done this planet well. And we will have made life for ourselves easier as well; a some point, there will be enough moisture in the atmosphere to reduce the dust problem.”

"Thank you, Vanessa, that's a very important point," replied Will, relieved she hadn't attacked the nuclear program. In the last year, opposition to it had softened considerably. "Cecilia Hughes."

Cecilia rose. "I want to express gratitude that over the last year, we have offered some support to the Green World communities at Aram and on Themis. Both are struggling; Aram is poor and Themis is both poor and isolated. A corvet with 700 on board, en route from Earth to Mars, stops at Themis next week and then, two months later, resumes their trip here with the last of our immigrants for this columbiad. That stop is a Godsend for them; it is bringing them supplies, a few new settlers, and they are selling food and supplies to the passengers. I hope that Themis can be recognized as a borough of Mars, so that its residents will have the full benefits of citizenship and regular support from us. No nation on Earth has taken Themis under its wing. If they have a disaster, they could all die. They badly need support from someone." She sat to scattered applause, but mostly to disinterest.

"Cesar Alvarez," announced Will.

"I want to speak about immigration," he began, and some people rolled their eyes, because he, Lyle Quincy, and Johnny Lind had created an entire campaign against large-scale immigration two years earlier. "We have had minimal disruption to our lives this columbiad, partly because the administration bowed to pressure two years ago and cut back on the immigration wave this time. We added only 40,000 people this columbiad; relative to our population, a fairly small number, 35%. They propose to add 55,000 next columbiad, and I say let's make it even smaller; 50,000! We don't need to experience the disruption that rapid growth brings our businesses and offices, the shortages that inevitably result, and the confusion; and for

what? We can't relieve Earth of its overcrowding and we can't become a big nation any time soon. We have a long way to go and we might as well not rush breakneck and risk all sorts of mistakes, like the crash last columbiad, and other problems. If we slow it down, we'll have more resources for other items, like the arts and areobiology. It's quite simple."

Cesar sat and Will recognized a veteran biologist. He stood and elaborated on the importance of developing cactars; the Mars-adapted descendants of high-altitude terrestrial cacti had virtual space suits tinted with a dark chlorophyll and UV-protecting chemicals and hollow interiors that stored oxygen and hosted nitrogen-fixing bacteria. He pointed out the relevance of the work to the creation of crops that can thrive on Earth at high altitudes and latitudes and noted that Marsian geneticists have been making many breakthroughs to improve Marsian agriculture that are generating hundreds of millions of redbacks of licensing fees on Earth.

Next, a Martech software developer spoke, emphasizing the need for more artificial intelligence and further robotization. He advocated more spending on hyperloop-compatible metal highways--where passengers and cargo could be whizzed along at twice the speed of sound--to complete the connection of all the major outposts as soon as possible.

"Terese Antoine," announced Will, hoping the next speaker would stir things up, since the audience was looking bored. Maryam smiled and turned to Oskar. "She was on my flight from Earth. Haitian, very bright; an accountant and MBA."

"We could always use more MBAs," said Oskar, which was true; Mars had a lot scientists and engineers, but relatively few small businesses.

The 26 year old woman stood. "I have several topics I want to address, and I apologize if I ramble a bit. First, I want to thank the Commonwealth, for accepting my application and

bringing me here. Second, thank you for our educational policy, which allows me to take one Martech course per year, which is what keeps the arts and humanities alive here and diversifies our outlook. Third, thanks to our environmental management people, who maintain fresh air, incredibly good tasting fresh food, and really beautiful open-air spaces. Fourth, to our manufacturers, who produce an amazing variety of consumer goods. Occasionally I hear people complain about shortages or lack of variety, but back in Haiti we did not have anything like the choices here. Luxury and comfort are relative terms.

"I also want to praise and express appreciation for our approach to the Martian environment. We have a big, wide-open planet around us, and by and large we are approaching it wisely, rationally, and deliberatively. I followed the discussion from Earth about the use of nuclear explosions to free up the trapped volatiles at the poles. It was respectful and principled, and near as I can tell, it has led to a consensus.

"Finally, I want to stress the importance of immigration. I respectfully disagree with Mr. Alvarez. We should bring as many people here as is possible. We should grow as fast as we can. I did not see confusion or disruption as a result of this year's 35% population growth. If someone can't get a sofa for their living room for two months, so what? These are trivial sacrifices for a greater cause. People on Earth look to us as an example. They yearn for our stability and prosperity and opportunity. They want to come here, as we have just heard. I say, pack as many people into the carriers as possible and bring them. The carrier I was on was mostly empty; we were living on the corvets docked to one end, frolicking in the huge open space, and building high-density housing in one end of it. The faster you fly people here, the denser you can pack

them in. I think we could double last columbiad's immigration if we planned it carefully, and when will a better time come along? People are desperate to leave Earth, I say, let them!"

Terese sat to surprisingly strong applause. Alvarez looked rather upset. Will looked at the list of speakers and inwardly groaned, the next speaker was experienced and strongly against immigration. "Johnny Lind."

There was a noticeable reaction to the audience when his name was called out. Johnny was sitting up front, close to the podium, where many of Mars's old veterans were sitting; at age 67, he had been on Mars 35 years. "I very much thank Terese for bring up immigration. She is quite right that where the Martian environment is concerned, we have had an excellent, principled discourse over the last few years. No so much, the topic of immigration, and it is something we should have a consensus on as well. I very much respect my old friend Dr. Cesar, but I no longer view the subject the same way I used to. Terese is right; an appeal to comfort and luxury, a warning against disruption, and a rejection of sacrifice asks us to look at immigration in a completely incorrect way. If we really want comfort and luxury, we should have stayed on Earth, where salaries buy a lot more and where we can roam through vast open spaces without a pressure suit. A certain level of sacrifice should be expected, because immigration is a positive good for this vast, uninhabited world. A warning against disruption is mostly an emotional appeal, a kind of fear mongering, and immigration is an easy subject to use if you want to stir up fear. As for arguments that we should spend less on immigration to spend more on something else, we all know that immigration in the long run guarantees larger spending on everything. You want to double the team investigating Marsoforms or genetically modifying cactars? Double the immigration and they naturally double! And so does the tax base and GDP to support them. So

with the greatest respect for some of my old friends like Lyle and Cesar, I say: let's drop the misleading rhetoric and foster a discussion that is rational, mature, and respectful. There is no reason to obfuscate or appeal to emotions. From what I hear, the carriers could indeed be expanded to accommodate a lot more people. I understand at the next columbiad there will be an entire C-100 carrier filled with Cererian water in Earth orbit, providing us cheap propellant. Let's take advantage of the equipment, the propellant, and the circumstances and plan a really big immigration wave in early 2087."

Johnny's wife, jumped up and kissed him as he finished, and they both sat to a shocked audience. Lyle Quincy and Cesar Alvarez were the exceptions; they were livid. Then after a few seconds of shocked silence, one of the loudest applauses ever generated on Mars followed. Even Will was surprised.

"I wonder what happened," said Oskar. "Johnny was our principal nemesis. He was against everything."

"Maybe someone talked to him."

"It's hard to believe anything would work! But that was Betty kissing him when he finished."

"Skip Carson," called out Will. When Skip had first arrived on Mars to make a movie in 2048--the same year as Johnny--he had been young and blond, but now his 74 year old head was silver. "Amen to my old friend Johnny! I remember many columbiads when we grew fifty percent and there were all sorts of shortages, even some food items! And we managed just fine. We are the hub for the settlement of the solar system. Saturn has over 2,000 people; they need to aim for 5,000. We just heard Uranus debate Avalon 2 and decided to put drums, C-50s, on five

moons. They need at least 2,000. So does Neptune. We're the main sending community, so we need more GDP! Phobos needs 10,000 people, to compete against Swiftville and the other manufacturers in LEO! Ceres needs several thousand so it can send cheap carriers full of water all over the solar system. We're at 150,000 now; Mars had about 200 when I arrived on Columbus 7, with 36 other people! We just hauled 40,000 here. Let's haul 80,000 next time." He sat to strong applause.

"It is hard to believe, but in 15 years--at the beginning of the twenty-second century--Mars really could have a million people," said Will. "I believe our time is up for this sol. The discussion was lively and quite surprising. Thank you for coming or watching. Please remember that the Mars.gov website has a very active discussion board where this conversation is continuing. I plan to post a comment there regularly and hope you will add a message or a video. Thank you, my fellow Marsians, and goodbye for now."

February 28, 2085: Will couldn't help but look at that date with a certain nostalgia. Exactly 49 years earlier, he and Ethel had been among the first six human beings to land on the Red Planet. Then, they speculated, mostly joked, about the future civilization that would eventually follow them. Now, as Will poured his morning coffee, he opened the main page of *Mars This Sol* to see the results of that civilization's latest election.

"I'm glad we didn't stay up for the entire vote counting and the endless speculation about its meaning," said Ethel, who was seated next to him sipping her morning tea.

"Well, we can figure out the meaning ourselves, pretty much," Will replied, pouring over the figures. He scanned down the Aurorae results, which showed the top ten vote getters in each

district, even though only the top 2 or 3 were elected. “Helmut came in sixth for Mars Assembly in his district, which is good.”

“Most people want him to be Chief Minister, then,” agreed Ethel, since the Chief Minister could not serve in the Assembly as well.

“In my second term, I came in fourth,” said Will.

“You faced a lot of jealousy.”

“Helmut has generally done a pretty good job. He handled the crash very well. The upset about the nukes has passed and the immigration debate is dead for now.” said Will. He skimmed and nodded. “Basically, good people were elected. No angry folks.” Will switched to the results for Cassini and Dawes. “The Central Highlands have more representatives now, but they’re generally responsible people. I think Helmut has managed to make them happy by stimulating development up there.”

“Personally, I hate the term ‘Central Highlands,’ since it’s neither central nor all that high, and an area with five outposts scattered across an area the size of North America really has no unity. I suppose their commonality is mining, though.”

“And the fact that they now have a common name. Aurorae will always be the biggest city, though, no one can catch up. But once the hyperloop is completed, we’ll have rapid and cheap transportation tying everyone together and size will matter less.”

Ethel pointed to election results on her screen. “Johnny Lind came in fourth in District 7, so maybe he has rehabilitated himself somewhat.”

“I think so. Did you see that the Sabetans were sitting with him and Betty? I think the two of them and Betty have been working on him. I’ll have to visit and see how he’s doing.”

"Now they need to work on Quincy and Alvarez. They're still disaffected."

"They are. I wonder what happened with Tad up on Uranus? He seems to have calmed down lately as well."

Just then there was a beep, indicating an incoming message from Saturn. "It's Marshall," said Ethel. "I wonder how things went up there." She reached over and pushed the play button.

Marshall's face filled the wall screen. "Good morning, mom and dad. I was just looking at the results of the Marsian elections and overall, they look pretty good and calm. Of course, turnout has declined somewhat since the Cinnamon Revolution, but it's still better than some terrestrial democracies!

"The Future of Saturn Forum two sols ago had a really good discussion about sending two engineers down to the aerostat to effect repairs. Everyone was in favor. They were also intrigued by discussions in the Uranus Future Forum about setting up 50-meter drums on a variety of moons. It appears we will plan to do exactly that on the remaining five large moons--Mimas, Tethys, Dione, Rhea, and Iapetus--which will allow us to visit them regularly and eventually set up outposts on them. The C-100 on Enceladus will be complete later this year and they can manufacture the C-50s for deployment on the larger moons once we are ready to undertake systematic, semi-permanent study of them.

"The election proceeded quite well and everyone was reelected to the Saturn Council. Presumably I'll be reelected First Minister next week, but of course we'll have to wait and see. But this is the dilemma I feel: I've been on the Council for over eleven years and I've been Chief Minister for four terms or almost eight years. The Council has had very little turnover, too, but our population has gone from less than 600 to 1800 in eleven years. If I'm not Chief Minister,

it's not clear what I would do instead, and I really can't leave now; the kids are growing, Amy has a great job, and I can't go back to being the local Chancellor of Martech. I think I have to leave in another few years; Willie's 15 and will be going to Martech for an education soon. So I suppose I'll remain available to be elected at least two years more. What do you think I should do? I hope you can give me some good advice! Bye."

Marshall's face disappeared from the screen. Will looked at Ethel. "That's a dilemma, for sure. I was in charge of Mars for some thirty years, but I did it under a series of titles, and rarely kept the same one for more than ten years or so."

"With a Chief Minister or Governor serving with you sometimes, too." Ethel thought. "I'm not sure there's a lot of difference between eight years and ten, and the outer solar system's settlements are not growing as fast as Mars did, nor are people leaving quickly to return here or Earth. So with slower turnover, maybe longer terms make sense."

"Perhaps." Will considered. "I think their best bet is to leave once Millie is old enough and make a complete break. Maybe we'll live long enough to see our grandchildren!"

Ethel laughed. "That would be nice!"

Across town in another house, a similar interplanetary conversation was going on. Johnny and Betty Lind were having breakfast when Tad's video message arrived. "Good morning! Did you see that I was elected to the Urania Council last night? I was amazed! Gandimohan retired from service; he felt it was time for there to be new blood. They also raised the Council's size from 8 to 9, so there were two guaranteed vacancies. I was elected and so was the commander of Uranus 3, Firuz Moulin; a very nice man, a Baha'i, which means the Council has two Baha'is on it. Anyway, I am very excited! The plan to build and put 50-meter drums on the major moons,

and on Portia to mine ataxite for its PGMs, was very well received by the future forum, and the Council will discuss it in two weeks after we elect the Chief Minister and review our basic policies. I suspect it will be approved; everyone is in favor. The big problem is that we don't have enough people to put on all the moons, so we will have to roll out the plan gradually over the next decade as our population increases. We'll have to postpone the further expansion of Avalon, which will be able to accommodate 6,000 people when the current phase is finished. It's really bigger than anything we actually need.

"Anyway, I'm still giddy! I see your vote came way up, too, and I was impressed by your comments in favor of immigration; they were really honest. I think we've turned over a new leaf, dad! Maybe people will think we really do have some good things to offer, rather than just negative comments. Gandhimohan has really helped me a lot to see that. Bye."

The screen faded. Betty smiled and put her arm around Johnny's shoulder. He smiled. "Tad's right; maybe we have finally figured out the right way to serve the public. Let me record a response." Johnny reached over and pushed the reply icon and waited while the recording counted down. "Good morning, Tad, and congratulations! I'm proud of you, not just for being elected, but for becoming worthy of being elected. I haven't been reelected to the Mars Assembly, but perhaps I will be some time, and if that happens, I want to be prepared to take a different approach. Over the last three months--since Peters was elected President in the U.S.--I've been thinking a lot about the role of the ego in driving people to seek election, and the results of the power orientation they acquire. Gandimohan is right when he told you that the correct orientation toward politics is public service, and that means you think of others first. That's impossible on Earth, with vicious campaigns dominated by lies about each side, by each

side. I hate to admit it--well, maybe I don't hate it any more--but Will Elliott is right. People need to vote based on character, not based on positions, and they need to vote in small districts or neighborhoods where they can get to know the people they might vote for, and that smaller group then gets to know each other and vote for the Chief Minister. It isn't a perfect system, either, but at least it restrains the ego. I think it is clear that Mars has a superior electoral system than the democratic nations on Earth, and considering we are dependent on each other for oxygen, that's a good thing. So my advice to you is, always ask yourself what is right for Uranus, and advocate that. If you do that, you will achieve a political goal. But if you start by seeking the political goal, you won't be worthy of achieving it."

8.

Thaumasia

Mar. 2085

A Martian hyperloop was an experience like nothing Maryam had ever experienced before.

She had been on a terrestrial hyperloop before; she often took it from Washington to New York City, completing the journey in less than half an hour. But that vehicle glided through an underground tunnel from which much of the Earth's air had been removed, so there was nothing to see; one got on, got on the internet, and then got off, as if one had gotten on a very long subway ride.

But the ride from Aurorae to Thaumasia--2,200 kilometers--was a two-hour blur of landscape, because the Martian atmosphere was thin enough to allow hyperloop transport without a tunnel. It was like supersonic transport, but 2 meters off the ground. Nothing within half a kilometer of the vehicle was recognizable; by the time one focused on it, it was passed. Even crater rims and hills several kilometers away were hard to look at when one was moving forward at a third of a kilometer per second. Behind them was a cloud of dust kicked up by their supersonic shock wave, but they never heard a sonic boom until they began to slow at the end.

Even then, the boom wasn't very loud; the atmosphere was too thin to transmit much sound. Maryam could see a crater rim coming up, then the skate glided up over it and into the bowl. It began to decelerate sharply as it approached a cluster of buried metal modules and an enclosure filled with thriving agriculture and a neat postage stamp of a public park. The hyperloop slowed almost to a stop, then entered an airlock, which it barely fit into. When it came out the other side, it rolled into a small, neat arrival station.

Maryam straightened her headscarf. She didn't usually wear one--Oskar had never seen her with one--but she had heard that her birth grandmother, Madhu Anderson, was an evangelical Protestant, and she wanted to make her Islamic identity clear. She could see a tall, blond, middle aged man waiting; her birth father Sam Anderson, who had just turned 44. His long, thin face and dark eyes looked strikingly like hers.

The door to the car opened. She picked up her bag and stepped out. "Ah--" she didn't know what to call him

"Maryam? Welcome to Thaumasia." He wasn't sure whether to shake her hand or hug her.

"Thank you . . . I don't know what to call you."

"Call me Sam, I think that's best. Shall I call you Maryam?"

"Yes, of course." She put down her bag and moved to hug him, so he hugged her back. It felt good.

"Like I said, welcome. Thaumasia isn't much, I'm afraid; a mining outpost against Mars's only true mountain range, exploiting its unique suite of minerals. I helped establish it twelve years ago and have been CEO ever since. We've now got 300 people, including about 40 kids. I hope you had a good trip?"

"It was . . . amazing! I was in Aurorae two hours ago. It's rather frightening."

"It is. We get one hyperloop per sol, mostly carrying supplies in and minerals out, but a few people a week are transported. I thought we could go to my office and have coffee, then I'll take you to meet mom, then maybe you can rest and have supper with my family. How does that sound?"

"Ah . . . fine."

"Good. This way." He picked up her bag and he headed for the door to the rest of the outpost, which was a warren of buried metal prefabs. Momentarily, he was ahead of her and she studied the body of this man who had fathered her, almost 25 years ago. He was familiar, yet different; she wasn't sure what to make of it all.

He opened the door for her and held it, then they walked down a corridor side by side. In 25 meters they turned into a prefab and then entered his office. His desk was one gigantic horizontal screen and it had several screens standing up on it as well. "Coffee, or tea?"

"Ah, tea please, black with sugar."

"Good, and I'll have my usual coffee, Jen, and please bring us some pastries from the cafeteria," Sam said to his AI. He pointed to two chairs and they sat. "So, you're back on Mars. I heard Ruhullah passed away last spring. He was a good man; I respected him very much. I'm sorry, Maryam. My condolences to you and your mom."

"Thank you. It was a rough time, but we decided to make a break. Mom is a space oncologist and has always wanted to return here; and I want to be here, live here, and learn more about this place that I left when I was seven. I wanted to meet you and my birth mom, too."

"Have you met Corrie yet?"

Maryam shook her head. "No, not yet. She's way down in Cassini with her parents, husband, and children. They said they'd come up to Aurorae to meet me, but they haven't yet."

"Alberto's a physician and very busy. It's probably hard for him to get away. A nice guy. I'm really not in touch with Corrie much."

Just then, a cart entered the room with their coffee and tea, all prepared, and before the cart had left another one rolled in with the pastries. They took their choices and that cart left as well.

"I'm really not sure what to say to you," said Sam, after sipping his coffee. "I was 19 when you were born. Corrie was still 17. I was at Martech, but she was a senior in high school. It wasn't practical for us to get married or to raise you. Nadia and Ruhullah wanted a child very badly and hadn't been able to have one, so they adopted you. It was the best thing to do for everyone."

"Yes, I understand that, and I am grateful. They were great parents. I'm . . . not trying to worm my way into your life. But I do want to get to know you. It's a piece of my past."

"Of course. A piece of my past, too. I'd like to get to know you, too." Sam sighed. "I was a rather wild teenager. Marshall was my close friend, was a year older, and was almost a big brother to me. I looked up to him but also wanted to be different. And he was the good boy. Remember, he was the first kid born on Mars. I was the second. Liz, Marshall's sister, was third, and Corrie came along just a week or so later, she was fourth. Corrie was also like the wild younger sister to Liz; they were very close and still are. So Corrie and I got very close and got experimental. And you were the result." He paused, looked at her, and sipped more coffee. "Our parents were absolutely furious. My parents and Corrie's came on Columbus 2, remember; three people from Columbus 1 had stayed, the Elliotts and Shinji Nakatani, and then there were my parents and Corrie's and two others who stayed. But when you were born, Mars had close to 2,000 people, so they were the veterans; among the first nine Marsians. My dad was commander

at one point and Corrie's dad was chief minister. So the pregnancy was potentially a huge embarrassment for them. An adoption was a good solution for everyone."

"That makes a lot of sense. But I am curious . . . I was here until I was seven, but I don't remember ever seeing you. Were you keeping away?"

"Yes, we were, because it was hard on Nadia if we were around and we didn't want to complicate her life or yours. Corrie moved to Cassini and Dawes at different times and never moved back to Aurorae. She made a complete break. I saw you from a distance a few times. You have my blond hair and my face, so it was hard for me to stay away completely. You were Nadia's and Ruhullah's, not mine." He shrugged, and there was some pain on his face. "So, you've lived in both Tunisia and Iran?"

She shook her head. "Not Tunisia, except a few visits. We lived in Bermuda when dad was Mars's foreign minister, then in New York City for a while. I went to Harvard early--age 17--graduated a bit early, and went to Georgetown for a Master's in International Relations. I've completed most of my courses for a doctorate and at some point when things settle down, I'll arrange for my doctoral exams through Martech. Ambassador Zhao has agreed to oversee the exams at this end and I'll probably ask him to be on my dissertation committee, eventually."

"Very impressive. I had Will Elliott on my committee! He and my father put together the definitive textbook on the geology of Mars some 20 years ago. Marshall and I helped. That was quite a project, and now it needs to be completely replaced because we know so much more. I really hadn't done much--I ran a few surface expeditions--when the Thaumasia outpost was proposed. I had been dispatched here to study the area because of its mineral potential. I asked Chief Minister Will to be appointed first Commander, until the residents could hold an election,

and he agreed. I was just reelected last month." He shrugged. "We're pretty far off the beaten path, though with the hyperloop it really doesn't matter. I get to Aurorae on business every month or two, and I'll be sure to let you know." He finished his coffee. "Let me take you to see my mother. She's very anxious to meet you. She's 88 years old--third oldest person on Mars--she can still get around with a cane, though I think she'll have to switch to a walker soon. She's still mentally sharp, though. She goes to kindergarten every day after lunch for an hour to tell the children a story. She's basically everyone's grandmother up here."

"That's quite a role."

"She stays as active as she can, but it's getting difficult. She has her own apartment and a robot named Roge, which is a little strange because my father was named Roger. She has a spare bedroom and we thought you could stay there, if you'd like. The outpost also has several spare rooms if you'd rather not."

"No, I'd like that."

"Good, I know she would." Sam rose and headed straight to the door, Maryam's bag in hand. Maryam hurried after him.

Thaumasia wasn't a very large outpost; in two minutes of winding through a maze of halls, they were there. Sam opened the door and Madhu was inside sitting at her dining table, talking to another woman. "Oh, let you introduce me to my wife, Mindy,"said Sam. "Mindy, this is Maryam."

"Pleased to meet you," replied Mindy, with a smile. She extended her hand and Maryam shook. They looked at each other; the smile struck Maryam as forced.She smiled back, embarrassed.

"I'm pleased to meet you as well," said Maryam.

"You're joining us for dinner, right? If so, I'll see you then, and meanwhile, I'll leave you to visit was Madhu." Mindy nodded a goodbye and rose from her chair. Sam nodded to her and kissed her on the cheek, as if to mollify her a bit.

Madhu rose slowly from her chair and extended her ams. "So, you are Maryam! I have been looking forward to this meeting so much! I can't tell you how much!"

"Oh, thank you so much." Maryam's voice cracked a bit in response to Madhu's love. They embraced, then Madhu kissed her on both cheeks. "That's a very nice European custom that we have adopted up here. Please, sit down and have tea with me. *Another* tea. I am sure Sam offered you something."

"He did."

Madhu turned to Sam. 'Thank you, dear, for bringing Maryam here. We'll see you at supper."

"Okay, mom." He kissed her. "You're well?"

"I'm *very* well, thank you."

"Good." Sam turned and walked out of the apartment. Maryam sat opposite Madhu as she poured a cup of tea; the pot was on the table and there was already an extra cup.

"Milk? Sugar?"

"A little milk, please."

Madhu added a bit of milk, Maryam nodded, and she passed the cup to her, along with a plate of pastries. "Have one. So I suppose you flew low to get here?"

"Flew low?"

"The hyperloop. Amazing and frightening at the same time."

Maryam laughed. "Yes, it is!"

"I think I prefer airplanes, but Thaumasia was never big enough to have hypersonic transport service, except an occasional medical emergency. I flew low on the hyperloop a few months ago; a very interesting experience."

"Just two hours, to get to Aurorae."

"I know, but at my age, two hours is still a long time. I don't have the energy to go and visit friends anymore, I'm afraid. Though I might go in, one of the times Sam goes there for business. Tell me about you! Two years ago when you met Ethel Elliott in Washington, she was thrilled and she videomailed me. I was so thrilled to hear you were doing very well; but now you're here, and I am even more thrilled! I . . . I have missed you, Maryam. I hope you don't mind me saying so."

"No, not at all! You are very kind to say so. I really didn't know what sort of reception to expect here. I . . . want to fill in a big gap in my life, but I also know my arrival may not be completely welcome."

"Well, you are completely welcome with me." She smiled. "I can see Sam all over your face, and Sam's face was like Roger's, so I can see Roger in you. It's . . . very emotional for me, also."

Maryam smiled and tears welled up in her eyes. "Thank you, Madhu."

"Of course. Now, let me tell you that your arrival was a bit of a shock to Mindy. Sam never told her about you. Of course, I did, and years ago, so she really did know. But I don't think she ever expected you to appear in her life. She's a good person and she'll adjust. Now,

Vic--he's almost 15--he didn't know about you and this is a freak out situation for him, if you know what I mean. So he'll take some time. By the way, Corrie never told Alberto about you; I just found that out the other sol when I talked to Carmen, her mother."

"Corrie told me she and her parents would come to Aurorae to see me."

"Good. Give Alberto some space and time. Let them come to you. So, are you back on Mars permanently, or is this a long visit?"

"My intention is to stay permanently. I had a job in the Marsian Foreign Ministry in Washington and I have a job with them in Aurorae now, providing research and analysis."

"Married?"

"No, not yet, though I think I have a boyfriend. He's a bit younger than me, but he's a good guy."

"Good, I'm glad to hear it. But I would definitely advise you to not get pregnant until after you are ready!"

Maryam smiled. "No, that's not going to happen."

"I suppose not." Madhu eyed her headscarf. "So, you've cut ties with Earth. That can be quite frightening."

Maryam shrugged. "No, not for me; I've returned home. I've always felt like a Marsian, not like a terrestrial. I still have contact with college friends, of course, but I've been encouraging them to come here. Much more stable."

"And safer. No metal detectors, no strange problems crossing international borders, no financial uncertainty. We're not as prosperous, but that's partly because we're devoting a lot of resources to a 30-50% immigration every columbiad. Even here at Thaumasia, we've grown

steadily over 12 years; we have three times the population as when I arrived. And we're going to double in the next two years, when perfluoromethane production is scheduled to increase five fold."

"On the way here, I noticed wind turbines and a big solar farm going up."

"That's right; this little place is going to need 100 megawatts of power pretty soon, but we'll be increasing production of greenhouse gasses four fold. We've already raised the global mean temperature a tenth of a degree Celsius, and even more in this area. It's exciting for me to think I arrived here 47 years ago, a food scientist turned cook, and then artist! There are few stories in the history of mankind as amazing and dramatic as the settling of Dusty Red."

"That's very true, and I am amazed to be back here. There's an energy, an optimism, a trust in the future that's utterly lacking on Earth."

"Of course! I still feel it, too." Madhu reached around behind her and took a tablet from the table there. "Let me show you some photos. Would you like that?"

"Oh, yes, I would!"

"Good. And . . . I take it, you have no grandparents on Earth?"

"No, I never knew dad's parents, and mom's passed a few years ago."

"I suspected. I am sorry about your father's death, by the way. He was a good man and a good friend to us. I grieved over his death and said a lot of prayers for all of you."

"Thank you."

"I ask because . . . if you want a grandmother, dear, you now have one."

Maryam smiled and her voice cracked. "Oh, thank you so much! That really means a lot to me."

"It means a lot to me, too. I know Sam and Corrie's love is stretched thin, right now, but mine isn't. I have plenty for everyone, and I have plenty for you, too."

When Maryam left Thaumasia two sols later, she pulled out her communicator to call her mother, then changed her mind and texted Oskar: *My hyperloop from Thaumasia gets in at 12:15. Shall we do lunch?* He texted back right away: *Sure.*

She was glad to see him when her hyperloop pulled into Cochabamba Station. "Hi," she said as she stepped off the car.

"Hi. How did it go?"

"It was . . . mostly good. Let's sit over there at the Indian buffet." Oskar nodded and picked up her bag. They walked into the Indian buffet and got cups of steaming tea with milk. "Madhu was incredible. She wants to be my grandmother, and I want her to be my grandmother. I stayed in her apartment--which adjoins the apartment of Sam's family--so we spent a lot of time together. She showed me all sorts of pictures when I was a baby that my mom didn't have. She even sent them to me. She comes here twice a year for doctors' appointments and we'll get together then. She wants to be with me.

"Now, Sam: It's complicated for him because he has a wife and family. I ate with them the first and last nights, but not breakfasts or lunches. He . . .kind of wants to be my father, but it makes his family life difficult, and of course he and I really don't know each other. I call him Sam and he calls me Maryam. Yesterday afternoon he took me out on his inspection trip to the mines, which was fascinating and we had a lot of time together. It was a good chance to get to

know his personality, even though we didn't talk too much. He never told anyone who I was, either, which hurt a little bit."

"I bet."

"Mindy--Sam's wife--was outwardly friendly and polite, but completely distant. She doesn't know what this will do to her universe. Victor--my half brother--barely acknowledged me. He wasn't hostile, he was just confused and uncertain. That was unpleasant."

"So, are you going back? Will counseling help them?"

"I'm sure it would, but Madhu said the therapist at Thaumasia was the wrong person. Someone comes once a week on Monsols and might be better, but right now, I don't think anyone's ready. I'm not even sure I'm ready! It's not like they're a ready made family and want to add me. I don't think I expected that, but maybe I was hoping for some of that."

"There's still your birth mom."

"I gather her situation is even worse. Her husband didn't know about me until after I landed on Mars! Corrie and her parents plan to come here to see me in a month or so. Sam will be here for the Mars Assembly, starting next month, and he's bringing Madhu along, so I'll see them then."

Oskar nodded, uncertain what to say. "So . . . you still have your mom, so you haven't lost anything. You haven't gained as much as you hoped, but maybe you've gained something."

"I have. But my mom just turned 60; she's not young."

"Are you . . . afraid of being alone in this world?"

Maryam thought, then nodded. "I guess I am."

"I can understand that, because I felt very alone when I was sick. It isolated me from other kids, and Charlie went away just then, which was hard, too. But you're tough, you're smart, and you're attractive, Maryam. I wouldn't worry too much. You're only 24."

She laughed. "Wisdom about age from a 23 year old! But you're right. I . . . really have appreciated the time we've spent together."

"You've been able to see all the best cultural and sports events on Mars, and have even given me a few suggestions about my reviews! I've enjoyed it, too."

"Thanks." She smiled shyly.

"Well . . . then let's continue to go, shall we?"

Maryam nodded. "Yes, definitely."

"Well, my friends, welcome to our second term," said Helmut with a smile, looking at his cabinet ministers. "Our first two annums were rocky, with the crash and now with the economic crisis on Earth. But we accomplished a lot, and the Marsian public seems to be pleased, overall; the poll released this morning shows a 65% approval rating. We were riding pretty high when the Mars Assembly confirmed me as Chief Minister, too; I don't think a re-election has ever gone that smoothly. So, now we have to take that approval and the ideas expressed at the Future Forums--and a few others we've been considering--and put together a plan and budget for the next annum through the twenty-fifth columbiad. Lily, can you start with the immigration plans?"

Lily Estella, Minister of Immigration, nodded. "Sure, Helmut, but first let me thank you on behalf of all of us for being our Chief Minister. I am sure I speak for everyone when I say that

it is a real privilege to serve under you. Your leadership is inspiring and inspired, and you've led Mars from strength to strength. We are grateful for your sacrificial service to Mars."

The entire cabinet applauded. "Thank you, you're very kind," he replied. "Now, on to immigration."

"Alright. It's quite remarkable that everyone feels that the upcoming columbiad needs to see a large immigration wave, and people have said they are willing to sacrifice to make it possible. A larger wave means more resources for construction and therefore less to consumer goods, and less diverse food sources in order to feed a larger population.

"Currently, it appears we can transport up to 75,000 people here in late 2086 and early 2087." She paused; several people gasped in surprise. "Last columbiad we had 12 corvets. Four transported a thousand each and made two trips. The remaining eight were docked to two carriers--four each--transporting 2,000 each, with 8,000 more living on the carriers themselves. The quarters were rather tight at first, but by the end of the trip they had constructed enough additional housing so that everyone was pretty comfortable. We now have a third C-100 docked to Phobos, and we can expand the quarters on all three over the next year, especially if we send some construction workers on each one to complete them enroute to Earth. The result will completely fill half of the carrier, leaving the other half open for sports, including flying. Each C-100, accompanied by four corvets that can also serve as lifeboats in an emergency, can transport 24,000 people. Furthermore, because we have 200,000 tonnes of water from Ceres in low Earth orbit, we are best off using chemical propulsion to move the carriers here on a 5 or 6 month trajectory; a bit slow, but they'll have ample open space. We now have a variety of

galleons, caravels, and two more corvets available for moving additional migrants on faster trajectories if we desire; up to 3,000 more people, raising the total to 75,000."

There was stunned silence in the cabinet. "I had no idea we could transport so many," said Mi Sanda. "What's the cost? What are the safety margins?"

"The 200,000 tonnes of water, converted into propellant, will cost 1.1 billion redbacks, or 15,000 redbacks per passenger.. Each passenger needs about a tonne of supplies from Earth, which cost 75,000 per passenger, including the cost of transporting the passenger to orbit. Transporting the passenger from Phobos to the Martian surface cost about 5,000 each, and miscellaneous costs running the carriers and corvets cost another 5,000 each, so the total is 100,000 each. Altogether, the immigration wave will cost us 7.5 billion. That doesn't include the cost of manufacturing the vehicles because they're already manufactured; we're using 15 billion redbacks of transport infrastructure. In 2088, we should be able to halve the consumables brought up from the Earth's surface, which will halve that very large cost."

"And safety?"

"Each carrier will have twelve built in engines; four pods of three engines each. So trans-Mars injection and Mars orbit insertion won't be an issue. The four corvets docked to each carrier will give them robust lifeboat capacity. There will be ample oxygen and water on board and 50% redundant spare capacity for life support. The carriers will be set up to grow most of the food needed on the flight over the two-year period between flights. The transport phase should be very comfortable and safe."

"What about the twenty-sixth columbiad?" asked Crystal Kern.

"You mean, how big could it be? We're aiming to complete a C-200, which can transport at least 32,000 all by itself, even without corvets. We'd fly a C-100 to Mars with it, so that either carrier could rescue the other. That will raise our immigration capacity to over 100,000 in 2088. If we added a C-200 every columbiad, by 2099 we'd be flying 250,000 here every columbiad, at a cost of 10 to 12 billion redbacks. If you add 75% more for children born here one to four years later, the population of Mars will be close to two million in 2100. That's where we're going, and that's a fairly low estimate of our immigration capability."

"If we manufactured two C-200s every columbiad, we could increase by 64,000," said Crystal.

"In a few years, and after that we could create a third one. We could even move up to C-300s, which could carry 128,000. Transport to Earth orbit should decline somewhat over time, as will transport to the Martian surface. If we use Ceres to grow food as well as produce propellant, and use Phobos to produce food and more spare parts, we could lower costs further. Ticket prices have not reached their low point. An immigration of a million people per columbiad is not impossible."

"Which raises the eternal question of how many we should bring in, ultimately," said Helmut. "And there's no answer to that question. Any objection to our setting a goal of 75,000?"

"We have the budget for it," said Rolando Guzman, the Minister of the Treasury.

"Good." He looked around the room; no one shook their head. "Alright, 75,000 it is. Mi Sanda, what's the word from Uranus?"

"They want Uranus 4 to bring 500 people, not 300, and they want 500 from now on," she replied. "The increased number will allow them to establish outposts on Oberon, Titania, Umbriel, and Ariel in the next six years and exploit the ataxite on Portia."

"Not 450?" asked Helmut. "Three galleons can transport 450."

"No, with three of them the capacity can be pushed to 500," to Mi Sanda. "They also want at least one reactor every two years, and they need extra uranium because of heavy use. And they want loans to cover the extra costs, because they anticipate being able to pay us back."

"That'll help; an extra galleon and a reactor costs 250 million," said Rolando. "But what about Saturn and Neptune? They'll hear about this and want an increase as well."

"They will," confirmed Mi Santa. "I suspect they've already heard, too. Neptune wants to build a big outpost on Triton and Saturn is moving to start outposts on at least two more moons in the next few years. The idea of manufacturing a C-50 has given everyone ideas."

"Do we know whether the Saturn Commonwealth's budget can pay for a heavier immigration?" asked Helmut.

"They are exporting two tonnes of Helium-3 every year, now, but demand has not caught up, so the price has dropped," said Rolando. "They don't need reactors because they can concentrate solar power pretty inexpensively, so that saves money. With 40,000 more adults on Mars, our budget has increased fifty percent, so we can afford to add a third galleon to Saturn and a third galleon to Neptune. That's also assuming we can recruit the people. It has proved difficult to fill the more recent Uranus and Saturn missions."

"We can do it," replied Helmut. "Especially if we advertise on Earth. People will come to Mars in order to continue on out. Any other solar system news?'

"Fusion engine development is coming along slowly," replied Crystal. "The latest gaseous core engine prototype can now give 3,500 seconds of specific impulse, which is of great help for future missions to Uranus and Neptune."

"Bao-zhi, industrialization plans?"

"Phobos has completed plans to expand to 10,000 in the next columbiad, based on an immigration of 75,000, and Ceres is aiming for another thousand in the next four years, raising its population to 3,000. Ceres is expanding its capacity to two C-200s per year and it's expanding its electrical production to 150 megawatts so it can fill one C-200 with liquid hydrogen every year. That's 250,000 tonnes, and a gaseous core engine can get over 80% of it to low Earth orbit. If we choose to switch to gaseous core propulsion for all flights between Earth and Mars, that's enough for our entire current immigration wave. Ceres is also looking at using C-200s to move 200,000 tonnes of ataxite or other high-PGM ores from other asteroids in the belt to Ceres for processing, in order to maintain their ore supply."

"They have some very impressive plans," agreed Helmut. "They now have two flights per year to other asteroids. They're even looking at moving entire small asteroids into Ceres orbit in the future. Irit, how are plans for the polar caps?"

"A two-gigaton will go off under the North Polar cap next month and it will mostly create a liquid water lake that will radiate heat as it cools off over twenty years. It should suppress formation of the carbon dioxide cap every winter and accelerate its sublimation every summer. The data will help us plan larger underground explosions next annum. Plans are finalizing for the South Polar cap to have up to five explosions next year. We're on track to thicken the atmosphere by 1 millibar--14%--in the next decade."

"One more report; Joe?"

"We've increased the construction team, especially the robotic tunnelers and the bridge construction team, on the highway through western Aurorae, Aram Chaos, and the chaotic terrain to the east of Aram," replied Joe Abdullah. "The average hyperloop speed through that thousand-kilometer stretch should reach 400 kilometers per hour by the end of this year and 500 kmph by the end of next year. That means Aurorae to Dawes should take seven hours via hyperloop by the end of the year. It'll eventually come down to five hours, but that'll be in four years; the chaotic terrain is not easy to build through. This should stimulate development of the Central Highlands and should end the criticism that we aren't developing the hyperloop system fast enough. Dawes to Cassini is now down to three hours and should be down to two in three years."

"It's already revolutionary," said Irit. "I went from Uzboi to Cassini last week in fourteen hours; over 10,000 kilometers! The speed was a bit uncomfortable. I think I'd prefer closed cars with no windows; I'd prefer a screen that freezes an image of the countryside as you go, so you can actually see what you're passing."

"It really is hard to sightsee," agreed Fred. "We may switch many passenger trips to nighttime."

"Alright, folks, anything else?" asked Helmut. "No? Thank you for participating, this will help shape the annumal plan and budget for the Mars Assembly's consideration in two weeks."

9.

The Gathering Storm

April/early May 2085

"So, welcome back from your honeymoon," said Will to Ted Bukowski and Li Changying, as they entered his office in the Space Exploration Initiative building. "How many places did you finally get to?"

"We have now visited every single borough on Mars!" said Changying. "Eliot was difficult because there's no place to stay, but we managed to get to its store using an autotaxi and talked to the families there, then drove away. Elysium had pretty poor accommodations, but it was interesting."

"Not many people can say they've visited every borough," said Will. "A lot has happened in the last month since your wedding. I suppose you've heard that the U.S. has pulled out of the Space Exploration Initiative."

"We heard," said Ted. "I was very saddened by the news. What have the other partners said?"

"They have expressed regret, of course."

"But with the recession—the depression—I am sure China will have to cut back on its commitment," said Changying.

"Everyone is cutting back," replied Will. "Project Sedna is moving forward by the US only, or so they say."

"You can't trust any official statements," said Ted. "I was emailing some of my NASA contacts just this morning. They told me they are telling President Peters what he wants to hear.

He asked whether Project Sedna can continue without robotization and they said ‘sure, we can do that,’ and they’re ignoring that request.”

“That explains some of the things I’ve heard,” said Will. “Peters wants America to be a great space power, of course, but he has also pledged to protect workers’ jobs against robots.”

“Have you heard that some NASA workers didn’t get their pay last Friday?” asked Ted. “The government can’t pay all its workers! It’s crazy! That’s never happened before.”

“I heard.”

“And things haven’t hit bottom yet,” said Changying. “What are we going to do up here to maintain the Space Exploration Initiative?”

“That’s the question,” said Will. “We have a meeting with the Mars Commonwealth Cabinet on Frisol. I hope you can make it; I never heard back from you when I sent you the invitation. The huge increase in immigration next columbiad changes Mars’s budget drastically. They probably will slow down the various outer solar system projects for two or three years, but then they’ll be able to expand the budgets and catch up, because of the larger GDP.”

“So, Mars will go it alone?” said Changying.

“No, we’ll increase our portion of the projects. No matter how much Earth falls apart, there will always be some money for space; it’s too thoroughly established as part of the economy. Luxury space tourism to low Earth orbit has seen almost no hit from the economic disruptions. The number of wealthy people wanting to move to Swiftville and Marius has increased, not decreased.”

“That’s crazy,” said Ted. “And now there’s this rumor about Mars using its gigaton bombs to put Earth out of their misery.’”

"Yes, that stupid comment last week by a Martech political scientist about nuking Earth has gone viral and there are probably half a billion people on Earth who take it seriously," replied Will. "Conspiracy theories are flourishing, right now. It's crazy to think Helmut had to give a press conference to deny the rumor and admonish Marsians to be more careful when they express their frustrations."

"What about Helium 3?" asked Changying. "The Indians canceled their order from Uranus."

"I suspect Neptune and Saturn will lose their contracts, too," said Will. "Fusion reactor construction is being put on hold everywhere. All construction is being put on hold. PGM prices have collapsed. Gold prices have skyrocketed. I don't know how Helmut will balance all that."

"Self sufficiency," replied Changying. "Mars is big enough. It really doesn't need to import much any more."

"But can Mars afford to support the outer solar system as well?" asked Ted.

"I think we'll have to," said Will. "Saturn doesn't need to import much. We can make most computer chips and some vaccines, so we're in pretty good shape. The outer solar system mostly needs uranium, and they are developing clever ways to reduce their need for it."

"Still, they'll never eliminate the need for fission power; not until fusion reactors become smaller," said Changying.

"Meanwhile, Mars will have to subsidize them," said Ted.

"And I am sure we will," agreed Will. "The decision to push up immigration will prove providential, but it will also require a lot of sacrifice here. We won't be able to manufacture 200 square meters of polder for 70,000 people in the next two years, so the enclosures are going to

get crowded and there will be all sorts of shortages. Helmut's legacy could be a brilliant time of accomplishment or a time of disasters and struggles."

"But at least we have a stable political system!" said Ted.

"Yes, that's the key to our success. I am amazed that the population of the United States has forgotten all the lessons of the Great War. It was just over twenty years ago! The suffering brought them around to accepting a surrender of national sovereignty in order to achieve peace and economic stability."

"But they didn't get economic stability," said Changying. "The rich did, and they used it to get richer than they had ever been before, while the average person's income stagnated and even dropped somewhat, and unemployment became permanent for people with lesser skills. They were willing to destroy the world order because they did not get what they were promised."

Will nodded. "You are completely right about that, Changying. That explains the resurgence of nationalism in China and several other nations, too."

"But how will they ever get beyond it?" said Changying. "Mars never established a wealthy class and it never developed mechanisms for that class to manipulate politics. But the wealthy class is thoroughly ensconced in power on Earth."

"It'll take some pretty terrible suffering," said Ted. "Maybe the suffering will force through new laws about income distribution."

"Let's hope so. The United States needs, at minimum, to pay for four years of college for everyone, because the robots have taken all the lower skilled jobs. It could do that with a much steeper progressive income tax. The problems are solvable, as Mars has mostly demonstrated."

"Mostly, Will?" asked Changying.

"Mostly, because we aren't perfect either, nor are we guaranteed political stability. We have some residents worth a hundred million redbacks, so we have wealth up here, too. Give people enough time, and someone will figure out how to disguise their ambitions sufficiently to assume political power here. We've already had some close brushes with that."

"Well, I still prefer our imperfect system to any of the political systems on Earth!" said Ted. "It's beginning to look like the entire federal government will go on strike over pay. The government will be fabricating electronic money out of cyberspace at an unprecedented rate, so inflation will just get worse."

"That's one power Peters has that no other President has had for a century," agreed Will. "Because he had to reestablish the Federal Reserve Bank, he got to set up the rules and choose all the members of the Board of Governors. That's very dangerous."

"And now all the lawsuits are stalled, with the death of Chief Justice White," said Ted. "And with Peters' popularity collapsing, his party, which has only a three-seat majority in the Senate, will have a hard time agreeing on who to confirm as the next Chief Justice."

All three branches of government have serious troubles, now," agreed Will. "But enough about terrestrial politics! You can make it next Frisol, 10 to 12?"

"Yes, of course; we're back to work," said Changying. "Do you want us to prepare a report about everything the SEI has been encouraging and funding, with recommendations?"

"Yes, exactly; by Thursol morning if possible, because it'll take time for everyone to digest it."

"We won't have time to call or email people and ask whether their pledges still stand," noted Ted.

"Don't worry about that, because most people you talk to will have no idea whether a commitment last year will be any good in six months. I think we'll have to propose an assumption that only 50% of the funding comes through, and develop contingencies based on that."

"Even that's very difficult," said Changying. "Because we won't know whose 50% is available."

"True, but we can also develop a list of projects we would drop and which we would slow, based on the big picture. Each project has its own partners and they have to make the funding decision themselves, but we'll know how project A would affect project B. I can make myself available all of Tuesol and Wednesol to brainstorm with you."

"Good, we can do that," agreed Ted.

Enceladus 1 was a bare-bones thing, but very impressive. The moment Marshall entered the 100 meter in diameter, 100-meter high space, he was impressed. He had entered along the axis at the Enceladus end of the cylinder in 1 percent terrestrial gees—the most the moon could manage—and followed a spiral ramp until it emerged into 0.75 terrestrial gravities at the outer edge of the rotating cylinder. It made him feel like lead, but he'd only have to spend a few hours in it, and mostly sitting down.

The 315 arrivals of Saturn 7 were already in the cylinder, and they were often frolicking, enjoying a huge open space for the first time in 12 months. Other than the banquet tables and chairs, the huge space was shiny silver metal illumined by banks of lights at each end and from

pods around the middle. Voices echoed in the empty space. “We just pressurized it last week; just barely in time for their arrival,” said Oscar Pereira to Marshall. “Isn’t it beautiful?”

“Very impressive. You did an incredible job, Oscar.”

“Didn’t he?” added Iris Geyer, the chief executive officer of Enceladus Borough. “We are very grateful we were able to arrange for the postponement of some of the projects on Titan to get this built. We’ve still got a long way to go to set up life support and build all the facilities we need in here, but just having the open space is revolutionary.”

“I’ll have to come back when the interior is ready for dedication. I can’t imagine this space with buildings and trees in it.”

“Take the virtual reality tour; it’ll blow your mind,” said Iris.

Just then Seiji Takada, who was in charge of Enceladus spaceport, hurried over. “Welcome to Enceladus, Marshall! How was the Nike?”

“The flight was perfect, Seiji. It was just 48 hours from Titan. Acceleration out of Titan’s atmosphere was quick and smooth, the flight was comfortable, and the landing was without a bump.”

“I’m glad to hear it. The software has been working very well. Yours was the first official passenger flight, the other two being test runs only. We do have to plan a flight down to the aerostat, though.”

“So, the deterioration of the balloons is continuing?”

“Yes, and the aft balloon now has a significant leak, requiring the nuclear reactor to run at a higher level to maintain lift. We’re afraid there will be a big tear in the next storm and we’ll lose the aerostat entirely. We may have less than 6 months to act.”

"Well, the Future of Saturn Forum supported a human mission to the aerostat to repair the damage. Last I heard, the plans were fairly well advanced."

"Yes, we still have some details to fill out, and we'll need to run a simulation in the Titanian atmosphere to see how we do it. First, the Nike has to transport our 315 arrivals to Titan, though."

"That'll take a month or so." Marshall looked around. The food had just come out. "We should probably get started."

"I'll call everyone together," said Iris. "Do you want to speak first or after eating?"

"First. I don't have much to say and I'll go to every table during the meal."

"Alright." Iris walked to the podium and rang a bell, which prompted everyone to head to a table. Enceladus 1 had almost 500 people in it; the entire population of the moon plus Saturn 7's passengers, who had arrived just six hours earlier. Marshall was particularly pleased to see a dozen babies, most of which had been born on the flight out.

Once everyone settled down, Iris introduced him. Marshall walked to the podium. "Good evening everyone, and for the Saturn 7 passengers and crew, welcome to Enceladus and to the Saturn Commonwealth. I want to acknowledge the 52 veterans who are arriving from Mars aiming for a four-year stay, to contribute to our science, engineering, and ecology. I hope you agree to stay longer than four years! So far, about half of our veteran Mariners do stay longer. I especially welcome the 263 settlers, those who have come with no specified departure date. I see many of you were busy on the flight out, and now have babies, or soon will. Welcome! The Saturn Commonwealth needs settlers.

"You arrive at an historic time for humanity and for Saturn. For humanity, this is a time of disintegration, of collapsing governmental and economic systems—again—and huge uncertainty for the home world. I am sure you all heard today that the Attorney General of the state of Ohio has indicted members of the Peters Presidential Campaign for participation in a conspiracy to commit election fraud. Those indicted in Ohio have fled south to Kentucky, where that state may refuse to extradite them. Statistical analysis suggests that Peters actually lost that state's electoral vote by a significant margin and that Senator Hanley was not elected to the Senate after all. Similar investigations are underway in several other states, in spite of the administration's daily attempts to stop them. Already, a Constitutional crisis has been provoked, the US dollar has plunged further, and the stock markets worldwide are falling. This is just one specific incident in a chain of nearly unbelievable events. The situation on Earth is the worst it has been since the Great War, and it seems less easily resolved.

"We all need to hope and pray for our relatives on Earth, but one thing we can be sure of: even if we lose our Helium-3 contracts, as increasingly looks possible, Saturn will not go away. We will be fine out here. We can say that because Mars will be fine. We're talking about a world with 145,000 people—a very significant number—that have agreed to a remarkably sacrificial increase in their population by 75,000 immigrants in the twenty-fifth columbiad. That's based on their own resources; they don't have to borrow from collapsing terrestrial banks to do it. They can import the expertise and equipment to make vaccines, miniaturized parts of all sorts, and refine rare elements and complete their leap to self sufficiency *if necessary.* And it might not prove to be necessary. Meanwhile, we have put in for Saturn 8, in 2087, to bring us 500 settlers,

not just 300. And by then, Mars can afford to be generous. So we will be fine, regardless of what happens on Earth.

"This is a historic time for us as well. With your arrival, the Saturn Commonwealth now has more than 2,000 people; even when your vehicles depart, our population will remain over 2,000. Because of necessity, we are fairly self sufficient, with our two boroughs both powered by nearly inexhaustible geothermal energy. The construction of Enceladus 1, within which we are right now, is a historic turning point in its own right; the borough of Enceladus now has a significant sized gravitied enclosure and is in the position to grow to at least 500 people. They are already dreaming of an Enceladus 2. Meanwhile, the Commonwealth now has a sophisticated spaceport for interplanetary and intrasystem arrivals and departures. Once this enclosure is complete, the construction crew will turn to building C-50s, one per year. Rhea will get the first one because it, too, has geothermal energy to exploit, and a small subsurface ocean to study. But Mimas, Tethys, Dione, and Iapetus will follow, roughly one per year, and each will be gradually developed with facilities and an ecology able to support 100 people. We don't know when each will become a borough of its own, but consider this; if we receive 500 in 2087, 2089, 2091, and 2093, we will have 4,000 people, and that's without accounting for births and departures. With 4,000 people, we could easily have 500 on Enceladus, 100 each on the other five moons, and 3,000 on Titan. That's eight years from now. That's where we may be going.

"So thank you for coming and joining our adventure to settle and study this system. Raise a family here with us; this is a great place for children. Don't worry about college; we're already bigger than Mars was when I started at Martech! We are trying to learn about living as well as

about the worlds around us. We welcome your contributions to our civilization as well as to our science."

Maryam was nervous, as she approached the Parthenon restaurant in City Square. Oskar had invited his brother and sister-in-law to have lunch with them. She didn't want to make a bad impression.

She saw the three of them seated together near a potted palm, close to the edge of the area of tables and close to the square itself. It was a quiet, private spot, which made her even more nervous.

"Ah, there she is," said Oskar, as she approached. He smiled excitedly; he wanted to introduce her. "Charlie, Sirikit, this is Maryam Islami. Maryam, my brother and sister in law, Charlie and Sirikit Langlais."

"Very pleased to meet both of you."

"It's mutual; we're delighted," replied Charlie, who was closest to her. He rose and shook hands.

"Very good to meet you as well," added Sirikit, shaking hands and pointing to a chair. "So, you were the Mars Consular official in Washington?"

"Exactly," said Maryam, as she sat. "Ambassador Veronica Szulc was in town three or four days a month; otherwise, everything fell on me and a staff of three US citizens. I talked to her just about every day!"

"It must have been quite a responsible position! I'm impressed. What sort of contacts did you have?"

"NASA people, mostly, but a few Senators and Congressmen interested in science and technology, and other space people of course."

"People who know about the financial health of Swiftville?" asked Sirikit. "Because I've been trying to get some information. Swift wants our help, but we can't verify his statements."

Maryam nodded. "Everything is completely confused and chaotic, right now. I can ask some of my contacts, if you want."

"Yes, that would be of great help. The new United States dollar has lost three quarters of its value against the world dollar in just two months, and it's still falling. The irony is that its collapse may make some of President Peters' schemes work; for example, derobotization of factories. With the dollar falling, American wages are dropping to third world levels, which means they can produce things without robots and compete. Of course, there are huge quality issues--robots are much more precise--and Americans can't buy anything made outside the U.S., and since just about everything made in the U.S. still has non-US parts in it that are now four times more expensive, everything is incredibly expensive."

"Strikes and unrest," said Maryam. "They're everywhere, disrupting the economy even more."

"And the social fabric," added Charlie. "Because Peters' party has used their media to blame the problems on the other party, and their base believes them, so the country is tearing itself apart."

"And there's enough truth to that, for the claim to stick," added Maryam. "Both sides bear some responsibility."

"I find the whole thing unbelievable," said Oskar. "The greatest, wealthiest, most powerful nation on Earth is destroying its economy, pulling down the rest of the world, and seems on the verge of a revolution."

"It is unbelievable," agreed Maryam. "I lived there for much of the last seventeen years and I still find it hard to believe. Sirikit, if you are trying to get information, I'd pursue European sources. They have far more experts on the ground than we have, they have experience, and their economy is embedded in the American one."

"The Economics Institute has great contacts; the Canadians are great sources, too. We pay out a lot of consulting fees. Ironically, that's easier to do than ever, because the redback has doubled in value against the world dollar, which means we have 8 times as much purchasing power against the U.S. dollar! The rise in gold prices has done it. But what I don't have is contacts in the space establishment. The Foreign Ministry has those, and the Mars Space Agency, but they haven't been so helpful in passing economic information to us. Swiftville can't export anything to the U.S. right now because of its highly automated systems. But I suspect Washington will have to make an exception for Swiftville's pharmaceuticals, which really can't be replaced by another source, and possibly for some of the alloys they can make in zero-gee. If we had a sense of the likelihood of those exceptions, we'd have a better idea whether Swiftville will go bankrupt. That's the danger."

"It is," agreed Maryam. "I can help with that. I have contacts in the NASA office that deals with space products."

"That would be really helpful. American space tourism has dropped ninety percent since Peters was inaugurated, and the rest of the world's has dropped twenty-five percent. Orbiting

hotels, especially Swiftville's now have vacancies, except in the really expensive rooms and services. Lunar tourism is off by half. The mass driver has shut down because it can't cover its monthly expenses. Ceres isn't sure how much water to send to Earth orbit next year. All these details affect the plans to expand Phobos and Ceres; there are big ripple effects. The Economic Institute is issuing economic forecasts in an environment of great uncertainty."

"I can imagine."

"It looks like the two of you can collaborate, then," said Oskar. "That's great. Both of you report to dad periodically, too, which is ironic."

"Let's order our food before lunch hour is over," suggested Charlie. "I'll pay; everyone dictate into my communicator." He handed it to Maryam, who order a Greek salad and passed it to Oskar, who ordered souvlaki. As Sirikit was ordering, Oskar turned to Charlie. "So, what's the latest about the 3-gigaton explosion?"

"We were looking at the seismic data this morning; the explosion went exactly as predicted. It was set off 3,500 meters below the top of the ice cap in Noachian permafrost deposits, generated a cavity of superheated steam a kilometer in diameter, which then blasted through the overburden, vaporizing some of it, melting some of it, and tossing some of it dozens of kilometers. Just about all the heat went into vaporizing water, which was the goal. Over the next few sols it'll all fall as snow, and that will vaporize a lot of dry ice. The cavity will be emitting heat for several years. The computer model will need some small modifications, but it appears the supercomputer guys did a good job."

"They are good," said Sirikit. "We use them to model economic trends all the time." She turned back to Maryam. "Oskar said you were working on a Ph.D."

"Yes, in political science, from Georgetown. "I'm taking off this semester to get settled into Mars, but this summer I'll get back to defining my thesis topic. I don't know a lot about your work, but I have admired your brilliance. I am also intrigued that you and Charlie went to Callisto for a year."

"Yes, that was a fascinating trip. I'm still in contact with members of the Jovian Council. The place has changed radically, though; Callisto now has 1,500 people, a C-200, there are robotic stations on Io, Europa, and Ganymede, and there are two aerostats in Jupiter's atmosphere."

"But no recovery of Helium-3?"

Sirikit shook her head. "Jupiter's gravity is too strong to retrieve it, and now they wouldn't be able to sell it, anyway. The Callisto outpost is totally dependent on Chinese subsidies. As a result, it is much less independent than the other outer solar system settlements."

"Of course, that may prove to their advantage, now that no one seems to want Helium 3," said Charlie.

"And it may tie up China's space resources," added Sirikit. "What's your judgment about the situation in the US, Maryam?"

Maryam was flattered Sirikit asked. "It's extremely complicated because Peters has a fairly small group of loyal men and women around him, and they can't run everything, so they have to rely on new appointees whose loyalty is less certain, or the existing bureaucracy, which is largely hostile to them. As a result, they can't be sure of anything. They are being fed misinformation or partial truths. They're firing long-time directors and they can't replace them, so many agencies are poorly led or are in chaos. NASA is one of them; it has no Administrator or

Assistant Administrator at the moment and the various projects, offices, and research centers are largely on their own, their budgets protected by local Congressmen."

"That's crazy; a huge waste of money," said Sirikit.

"That's why I'm here, and why millions want to come," said Maryam.

"And you're hanging out with this guy?" asked Charlie, patting his brother on his back.

"Yes, I am. I had no idea I'd enjoy poetry so much!"

"It's just the poetry she enjoys," said Oskar, smiling.

"And he's a good listener," added Maryam.

"So is she," added Oskar.

"That's very important," said Sirikit. "It's a good foundation."

10.

Civil Collapse

June 2085

Helmut's immediate impression of the videomail was that Pauline Augustine looked nervous, even anxious. It wasn't a good sign. "Good sol, Chief Minister Helmut," began the First Minister of the Venus Commonwealth. "The last twenty-four hours here have been absolute hell. I fear you can say the same, I apologize for making your burdens even greater, but you know the circumstances.

"I received a call last evening from the European Space Agency that because of the riots in France, the French government is reallocating twenty billion world dollars to unemployment and social services, so they are cutting their support for ESA by twenty percent starting immediately. This hit the news, of course, and triggered a domino effect; by this morning, five other governments had done the same, some by twenty-five or even thirty percent. ESA has to continue paying European workers whenever possible, so the off-world projects are the ones that will be hit first. In anticipation, several weeks ago they sould a three billion world dollar line of credit, but they were turned down. Three hours ago they called to tell me that their support for the Venus Commonwealth's projects, if they involved workers outside the European Union, would have to be eliminated. That means that Lakshmi, our half finished, $2 billion, 200-meter carrier, which had received a half billion in installment payments so far, no longer has a source of revenue to be completed.

"Needless to say, we are devastated by the news. Ishtar was revolutionary for us and allowed us to triple the population of the Venus Commonwealth. Lakshmi would allow at least a

doubling again, to 2,000 people, and would provide crucial redundancy that our aging galleons and corvets cannot continue to offer us. We are also aware of the fact that ESA's construction grant was providing Ceres with a revenue source for the work, so this hits Ceres as well as Venus. Tomorrow--morrowsol for you--our Director of Construction will inform Ceresworks of the development. We all will look to the Marsian Commonwealth for advice about this common disaster.

"I know your resources are seriously strained by the falling dominos of civil disorder on Earth. Venus has no exports, except scientific knowledge of the Second Rock orbiting the sun, and no one wants to pay us for that. Yet we do not want to abandon Venus and seek refuge on Phobos, as we did during the Great War. The best I can hope for is a half billion redback loan from Marsian sources to allow the completion of Lakshmi's outer hull, and its shipment here with water, nitrogen gas, and sufficient metals and plastic for us to complete the work ourselves, which we are quite capable of doing, even though it would require us to halve our human resources devoted to the study of Venus.

"Please let me know what you think. Ciao."

Helmut watched her picture fade and stared at the screen. There went another 1.5 billion over two years. It was the ongoing story of his hell, over the last week. He had no immediate response, so he sent a quick, noncommittal acknowledgement and promised to study the situation.

"So, how did it go with your birth mom, Corrie?" Oskar asked Maryam, as they walked across North America enclosure.

"That part of the visit went quite well," replied Maryam. "We went to the Parthenon for a long lunch. It turns out I have her laugh! Who would have thought that was genetic? She's a delightful person and apologized profusely and repeatedly for giving me up for adoption, so I had to assure her again and again that it was fine and everything worked out well. She's very smart and has a great job in AI. Her parents then joined us--Erico and Carmen. They were warm and friendly, but a bit distant."

"Why?"

"I don't know. Maybe they didn't want to get too close if the relationship with Corazon didn't work out."

"What about her husband, Alberto?"

"He stayed in Cassini with the kids. I guess I'll go down there to meet them, eventually. It's a big shock for them, obviously, so this is the preliminary exploration."

"I suppose that makes sense."

"Yes. Corrie gets here once every year or two for conferences and meetings and when she does she'd like to get together, so that's great. I'd like to get to know her." Maryam stuck her hand out. "Is it raining in here?'

Oskar looked up; the dome, 750 meters over their head, was obscured by clouds. "It might be, a little bit. It's early summer, so the daytime temperature is highest and the air absorbs a lot of water. It'll just be a few drops. Did your mom come along?"

"I offered, but she said she didn't want to interfere. She seems worried about the whole thing. No matter how much I assure her she's my mom and that'll never change, she seems worried our relationship will change. I'm all she has up here."

"Sure, and your dad's passing is still fresh."

"She said she would meet Sam, though, now that I have established a good contact with him. He'll be here next week for the emergency meeting of the Mars Council."

"Yeah, the Council has to meet." Oskar shook his head. "Has the entire Earth gone crazy? I just don't get it!"

"Well, you were raised here and you've never been there. Basically, people feel the politicians have been lying to them for over a century and they've had enough of it. That's a situation that breeds all sorts of conspiracy theories, and once you are into them, you can spend your entire day watching videos and participating in online discussions that reinforce your beliefs. There's little that neutral journalism can do about that. The facts on the ground reinforce the conspiracy theories, too; wealthy people all live like billionaires, not just millionaires, because of the wealth disparity, the basic living wage that most advanced societies guarantee looks paltry and feels inadequate by comparison, and there's no work if you have no education or the wrong training. No wonder a quarter of the population is high on drugs all the time! Their lives are meaningless."

"And now they're rioting and performing acts of terrorism against the rich."

"And attacking rich neighborhoods, or firebombing expensive cars, or shooting people who look wealthy, especially if there's a racial issue.So politicians are desperate and doing things that look good for now, but are really stupid long term." Maryam shook her head in disgust.

"I like the idea of the Swedes, to hire ten percent of their population to be artists and craftsmen."

"Yes, that gives people a creative outlet, and with training opportunities so great art will result, as well as a society interested in purchasing hand-made items. But in the US, with its idea that everyone needs to be self-made and not take handouts, disaster is looming."

"Yes, you can't make it on your own in the twenty-first century when you have no money for an education or expensive equipment. And now there's even the possibility of civil war. Who could have imagined that?"

"I couldn't have, and I lived in the U.S. over a decade. What's your dad doing?"

"We haven't seen him practically at all for three sols; he's in his office, sometimes overnight. Every hour, a new contract is canceled or a new videomail comes in asking for assistance. I know that from *Mars This Sol.* It's made my job harder, if anything, because people don't attend arts events, and then they don't read about them afterwards!"

"I think you should write poetry about the crisis, then."

"Oh, I have a great start on one, and a lot of time on my hands. I'm surprised you've been able to get away from the office."

"My job has changed, but it doesn't take more time. When governments cancel contracts, there's not a lot of negotiating or paperwork."

"No, I suppose not."

Maryam saw a bench nearby, so she diverted them over to it. "Let's not talk about events or about my family, of even about your family. Where are we going, Oskar?"

They sat together. "I don't know. I really like you, Maryam. I . . . could see this relationship developing into something beautiful."

"Thank you, because I feel the same." She took his hand and he smiled, then leaned over and gave her a kiss.

She beamed. "Thank you."

Helmut hurred to the cabinet meeting from his office. There had been no time that sol to shave or change clothes. "Did the Texas Attorney General's report finally come in?" he asked, as he sat.

"Fifteen minutes ago," replied Rory Mayerovitch, his chief of staff. "He found that the 2084 presidential and senatorial elections in Texas to be compromised by extensive electronic tampering of the vote, to the extent that the results 'were not credible.' He also found evidence the Peters campaign was aware of the plans to tamper with the results and thus were a conspirator in the effort. Consequently, the results of the election were 'illegitimate.'"

"So three states: Ohio, Florida, and now Texas." Helmut shook his head.

"With three more states investing," added Rory. "Though the results in those states probably won't change."

"But what does 'illegitimate' mean?" asked Mi Sanda. "I am unfamiliar with American laws!"

"Well, no one knows what it means," replied Helmut. "That's three Senators of the President's party whose elections are now considered illegitimate, and they had only a three-deat majority in the Senate. There are lawsuits submitted to the federal district courts calling for the election to be thrown out and rerun. In one district court, the lawsuit won; in another, it lost. The verdicts have been appealed to the Supreme Court. But it has only eight members right now and they are split four-four, so they can't render a verdict. Normally when that happens, the district

court decision is upheld, but the two decisions are contradictory. If the vacancy in the Supreme Court is filled, the Supreme Court can render a verdict, but that means the three Senators whose elections have been declared illegitimate get to vote on the nomination to fill the vacancy."

"That would be seen as illegitimate, wouldn't it?" asked Mi Sanda.

"Yes, exactly," replied Helmut. "But if they recuse themselves, the Senate has a tie and the Vice President gets to render the tie-breaking vote, and that may not seem any more legitimate."

"Of course, some of the Senators or Supreme Court justices who are members of the President's party might break away and vote against him," noted Rory.

"Maybe," said Helmut. "But I asked Foreign Minister Indira about that this morning and she said they are under such intense partisan pressure, that's unlikely."

"This makes even stronger the threats by the Governors of New York and Pennsylvania to declare the world dollar legal tender in their states," noted Yuki Tajima, the Minister of Finance. "A few hours ago the FBI went to arrest the Governor of California for her declaration and the state police turned them back."

"And the president ordered the national guard mobilized against the state police and they refused, on the grounds the governor had already mobilized them to control the riots," said Rory. "It really is looking like a creeping civil war."

"Especially since no one can sue the other side in the Supreme Court; it's deadlocked." Helmut shook his head very sadly. "And the situations in Britain, China, India, Brazil, and a half down other countries, though different, are just about equally bad."

"In Myanmar it's worse," added Mi Sanda. "There are serious food shortages."

"So clearly, we need to implement the self sufficiency protocols," exclaimed Henry Smith, Minister of Development.

"I guess the question is, how far to go with it," said Helmut. "We are self sufficient, or can quickly become self sufficient, on category 1 and 2 items. Category 3, however, has a lot more on it than computer chips, vaccines, and rare medicines. There are several hundred nanoproducts and other very rare items, and there are still a few raw materials as well."

"They are all still available on Earth," replied Henry. "We can order a four-year supply morrowsol and have them in orbit in a month."

"How much will that cost?" asked Yuki.

Henry shook his head. "We have started to figure out quantities needed, available sources, and negotiate the prices, but we don't have the final tally yet."

"We'll need a breakdown of cost by item and quantity, because we may not be able to get everything. The redback has pretty good buying power right now, with the price of gold going through the roof, but we can't get credit easily because of that theft of our gold shipment last month, after it landed in the Australian outback. That event has undermined our credit. We have no way to guarantee the security of a large gold shipment, with all the insecurity on Earth."

"Hum." Helmut thought about that. "Can you give Henry an estimate of how much we can afford to spend?"

"Yes, give me two sols."

"I'd call purchase of category 3 items our highest priority," said Zhang Bao-Zhi.

"What about the priority needs of the outer solar system settlements, Mercury, and Venus?" asked Mi Sanda. "They've been calling and asking us about our surplus."

"Find out what their category 3 needs are and we'll accommodate them as well as we can," said Helmut.

"They are all losing Helium-3 contacts," said Zhang. "Uranus has no contracts now, Titan has only one commitment for a tenth of its production, and Neptune, because it has been begging, has lost a quarter of its commitments. Ceres and Uzboi have lost half their 2086 PGM contracts and Parenago has lost a third of its. Mercury and Venus are wholly dependent on terrestrial subsidies and Callisto may even lose some Chinese backing."

"How much are we talking about?" asked Helmut.

Zhang added it up in his head. "Probably ten billion total, 2086-87. They still have 2085 payments in the bank. They'll need to use those fast."

"Tell them to bundle their purchases with ours. The bigger problem is loss of industrial contracts for Phobos and Ceres. Can you get a total of those?"

"I've been keeping a count," said Zhang. "So far it's half a billion a year for two or three years for Ceres and 1.5 billion per year for Phobos."

"What about Project Pluto and Project Sedna?" asked Lily Estrella, Minister of Immigration. "Those carriers are half built and are scheduled to be launched from Mars to Earth in thirteen months."

"We haven't been able to get a straight answer from NASA about Sedna because there is no acting Administrator," replied Crystal Kern, Minister of Space Exploration. "The Chinese say they're committed to Project Pluto, but they're in turmoil also and Callisto is their priority. The Indians want to postpone their mission to Makemake two years. In the last month three space agencies have canceled or postponed asteroidal missions based at Ceres."

"Are they sending their crews home, or are we paying for them to stay?" asked Helmut, startled.

"I asked but I haven't heard. Probably the latter, because some of the crew members have been on Ceres for several years and are settled there with families."

"More expenses for our budget," said Helmut, shaking his head. "What about the Thai and Swedish crews based at Phobos?"

"We haven't heard, but I'll inquire."

"The budget will require vast revisions," said Yuki.

"Even so, under Helmut's emergency powers, we don't have to go to the Mars Council," noted Irit Goldberg, Minister for the Martian Environment. "So why have we called them into town?"

"Two reasons, really," said Helmut. "Changes this extensive will require sacrifice and discomfort, so it's important to have the Council behind it. But the other reason is immigration."

"We are being begged by people to allow them to come here," said Lily. "The public email box actually filled up so fast, it began to reject messages. The public website hasn't gone down, but the staff can't get to the messages and applications fast enough. The volume is double our capacity. Something like a million people want to come here next columbiad."

"People struggling to get on lifeboats and off a sinking ship," added Mi Sanda.

"But the ship isn't actually sinking," said Lily. "It's going through a really bad storm, but it won't sink."

"True, but that argument doesn't impress most people," said Lily. "They are smart, talented, experienced, unemployed, fearful of bankruptcy, fearful of crime and violence, and

feeling hopeless. That's no exaggeration. College graduations were last month and it feels like half the Bachelors, Masters, and PhDs in STEM fields have written us. They want their spouses to come, their babies, even their parents! Even three passes through the applications won't weed out enough. We'll need a lottery! My poor staff on Earth is working eighty hours a week."

"Are you hiring more?" asked Helmut.

"Yes, but they all want to come here, too!"

Everyone laughed at that. "No, seriously," continued Lily. "This is a very grave situation. Our office in Atlanta, remember, was caught up in the rioting there and was trashed. Our Middle East office in Damascus has had to close completely. Some staff report difficulties buying basic necessities, so they have to miss work. You watch it on tv, but I have 500 staff who are reporting very difficult conditions, and they are making the ordinary workload difficult, let alone the expansion."

"What are you proposing, Lily?' asked Helmut. He knew, but he wanted her to say.

She took a deep breath. "Increasing immigration considerably above 75,000."

There was silence for a moment. "That's impossible," said Bao-zhi. "We've never attempted an increase larger than 50% before, and the bigger the immigration wave, the more complex the logistics get."

"Hear me out," replied Lily. "There are a series of possible bottlenecks to immigration that need to be considered. First, getting people and necessities from the Earth to orbit: right now, middle class tourism is way down, so there's lots of spare launch capacity. Second, getting them from Earth orbit to Mars: we have three carriers, each accompanied by 4 corvets to provide some lifeboat capacity, transporting 25,000 each. Three such carriers can transport 75,000. If we

also contracted to use the Sedna and Pluto carriers without corvets, they could raise the number even higher; to 100,000. I think we can obtain the propellant for them, too, though we need further research to be sure.

"Third: Keep them at Phobos until they can be landed. We might have to delay the return of some of the carriers to Earth, but we have the propellant to get them there if we are late, and we can raise the transport capacity to the surface to about 1,200 people per sol. That would get 100,000 to the surface in 80 sols.

Fourth: accommodating them, feeding them, and giving them work. Right now, Mars has 28,000,000 square meters of polder, or 200 square meters per inhabitant, a number that will decline slightly as 10,000 babies are born over the next year. Aurorae just got North America enclosure, with its 4.5 million square meters of polder, and Africa will be barely finished by then with 6 million more. Cassini and Dawes are getting 3 million each, so we will have 16 million more square meters of polder, for a total of 44.5 million; enough to support 220,500 at our current standards, or an immigration wave of 75,000. But if we brought 100,000 instead--to use a round number--we'd end up with 178 square meters per person on Mars. With planning, that's plenty. Our old standard was 100 square meters, after all."

"But you are also condemning us to certain shortages; coffee production can't increase that fast, for example," exclaimed Irit.

"True, but let me finish. There's one more bottleneck. Fifth: Political and social will. People have to understand this involves a sacrifice, especially the people who are arriving. We'd have to house two people in some efficiency apartments for up to six months. We could make enough beds, but at the cost of manufacturing fewer sofas and other furniture. Restaurants would

be crowded for a few months until things evened out. And some of the arrivals would be unemployed for a few months until jobs settled down. We'd all be inconvenienced. But the result of the sacrifice would be a Mars with close to a quarter million people and with as much as a 60% larger GDP, after a year or so."

"And we could borrow against the increase in taxes in order to settle them," said Yuki. "That's what we always do. That's the easiest part to finance."

"We have a shortage of coffee now," observed Mi Sanda. "They planted in anticipation of a twenty-five percent population increase and we had a thirty-three perent increase this columbiad. If they plant in anticipation of a fifty percent increase, it'll be four years before the trees start to bear."

Lily scowled. "The price of coffee went up as a result and some people switched to chicory or tea. That happens on Earth, too, when there's unexpected bad weather in the coffee growing areas. Marjeeling tea can be harvested after two years. Fruit trees take at least three or four years to bear, but we can substitute strawberries and pineapples and melons and other things that can be planted based on demand."

"We can also export less marabica," said Yuki. "Demand for it on Earth is growing, so the price may go up even more and we may earn just as much exporting less of it."

"Have you checked with Agmar about food production?" asked Iris, skeptically. "I doubt they'd appreciate their plans being ripped up and redone, especially when you can't tell them how big the immigration wave will be."

"How many are you proposing, anyway?" asked Helmut.

"I haven't proposed a specific number; that's not my point. My point is that we need to examine every bottleneck and determine which one limits immigration. Then we set the number based on that bottleneck."

Helmut nodded, understanding. "And since one of the bottlenecks is popular opinion, we need to have all the numbers before the Mars Council meets next week."

"Isn't it beautiful?" said Ramesh Prathan to Helmut and Lily. He had brought them to the tenth floor penthouse of the tallest building on Mars, now the headquarters of Mardome, and pointed out the sweeping views through the north and east facing windows.

"It is impressive," agreed Lily, a bit awestruck. The building was in New York Square in the center of the North America enclosure, which extended 1,500 meters to the north and 750 to the west of them.

"I'm amazed the dome doesn't look any closer," said Helmut.

"Well, we're under the center where it's highest; 750 meters. This building is just sixty meters high. But it's designed so we can add 20 more stories and raise it to 120 meters."

"We really don't need tall buildings," said Lily.

Ramesh shook his head. "No, I disagree. Polder is as expensive to make, per square meter, as land is valued in many large cities. We'll also have a shortage." He pointed northward. "As you can see, ninety percent of this enclosure is agricultural, but all of it is available for gradual development when needed."

"If we raise the immigration quota this columbiad, we'll focus on developing the land closer to the center."

"Of course; that'll decrease the strain on the public transportation system. You're looking at 90,000 or 100,000 instead of 75,000? Where will you put them?"

"Making basic apartments isn't a problem," replied Lily. "With 75,000, we figured we'd need 60,000 units, as some people arrive as couples or with family members. Uzboi is making plenty of metal carbonyls and the new automated three-d printers can literally print a four story apartment complex with twelve units of 200 square meters each in 3 ½ days. We have two years, so we need to increase the number of systems from 30 to 40 and build ten more robot teams to install insulation and wiring and finish the interiors."

"So, they are switching from three stories to four," confirmed Ramesh, because he hadn't heard.

"Yes, because of the increase in immigration," replied Lily. "The streets will be twenty percent wider, too, to accommodate more pedestrian traffic, and they will be one floor above the bottom level, which will be reserved for vehicles."

"That'll be a great improvement. We should have done that with the initial construction in Australia and Europe." Ramesh pointed north. "It's hard to believe that this area will look almost as agricultural as it does now, once the housing is put underneath! The streets will be barely visible." He pointed east. "As you can see, Africa is already under construction; 2 kilometers wide and 3 kilometers long, though the dome will go up only 500 meters, partly to save on air and partly because the dome can be stabilized better. North America will remain our enclosure with the most headroom."

"It'll have 5 meters of water overhead, right?" asked Lily.

"Correct, which will provide all the radiation protection anyone will ever need. The water weight will equal half the upward push of the air pressure, which means the dome and cables can be lighter in weight. The chemicals in the water will be a new mix that will absorb excessive ultraviolet better and give the sky a blue tint. The cooling system for the enclosure will be more efficient, too, it can pump heat up into the water overhead or down into the ground, because the ice table will be fifty meters below the surface under most of the enclosure. If the innovations work well, we'll improve them for Asia and retrofit the earlier domes. As you can see, the ground for Africa has been cleared of rocks and coarse gravel and we have laid out the dome material. We're in the process of installing the cables and mesh on top. It'll be followed by the empty water bags and their plumbing, then a second dome and the final cabling system. That'll take over a year to set up, then we will begin a slow inflation. As soon as the dome is inflated enough to be off the ground we'll start dumping heat from North America into the enclosure, spraying steam on the ground and injecting it into the ground to thaw the subsurface, and we'll start to add eolian dust to the surface to begin the process of creating topsoil. Because you need the space sooner than originally projected, we'll start agriculture in there about 12 months from now, before the dome is completely inflated. Air pressure will be about half Mars standard; workers will need oxygen masks. Africa won't be raised to standard pressure until mid 2087."

"So, no construction in it?"

"No, it'll be purely agricultural for the next two years. So will Asia, beyond it. As you can see, we've already started clearing Asia of rocks, the excavation for the fifteen-meter metal pressure curtain is proceeding, and the pile drivers have started emplacing anchors for the

dome's cabling. It'll be ready to pressurize in 2088 and will add 8 square kilometers, or 8 million square meters, to our total polder."

"I see Africa and Asia aren't flat, like the earlier domes," said Helmut.

"Correct; both enclosures surround existing craters that we are incorporating into the ground plan. That should make for a more interesting and varied surface layout."

"If we import 100,000 people in 2088, we'll need two and half times more space than Asia," said Lily.

"I know, and you'll have it," replied Ramesh insistently. "We're already designing Demeter, which will be a series of purely agricultural enclosures south of Europe, North and South America, Africa, and Asia. They will be eleven kilometers long and two wide. Half the immigration wave will go to the Central Highlands. Helmut, we'll need more Mardome teams up there, because right now we can build big enclosures only at Cassini and Dawes. Kalgoorlie and Meridiani want them as well and will need them in the next year."

"I know."

"So, to sum up," said Lily. "You can handle an immigration wave of 90,000? What about 100,000?"

"One hundred thousand would be difficult. We hadn't even planned for 75,000, two years ago; we were expecting 50,000 or maybe 60,000. These are not the sorts of changes we can accommodate quickly. Africa wasn't scheduled to be ready for this coming wave, but the next, and Asia for the one after that. That's why we're rearranging the construction schedule so that agriculture can begin before the dome is fully pressurized and before the water bags are completely filled. The Cassini and Dawes domes will be ready in plenty of time, though, and

Agmar can rearrange its crops. Remember, we're not a struggling little community living under little domes." He pointed. "We really have a vast reservoir of breathable air and water, now, and an extensive, robust ecology. I'd ask Agmar how they would reallocate *their* resources. I can provide the polder you need."

"Okay, thanks, Ramesh," said Helmut, trying not to sound too skeptical. Ramesh was right; they really did have big reserves to draw on in an emergency. But Ramesh often underestimated the problems.

"I appreciate your time, Ramesh," said Lily. "We're meeting with Agmar morrowsol."

"Excellent, good luck with that meeting." Ramesh extended his hand and they shook once again, exchanged goodbyes, and Lily and Helmut headed down the elevator.

"He runs an impressive operation," observed Lily.

"He does, but he can't always deliver on his promises. I'll have to ask for regular reports. At least with North America already inflated, Agmar can plant high-productivity crops and stockpile food, but it sounds like they won't have the surplus farmland for the 2088 immigration wave."

"So, the immigration bottleneck might be lower."

"Exactly."

They exited the elevator on the first floor, headed out of the building, and went in different directions. Helmut decided to check with his brother Kristof about Agmar, but on his way he got a phone call from Will Elliott. "Good morning, Helmut," Will began. "I thought I should let you know that I have drafted a statement about the political condition of Earth for release to the public. Jacquie has agreed to sign it as well, and I think I can get a few more Nobel

Peace Prize winners to sign as well. To summarize, it calls for the abandonment of partisan elections and the adoption of a nonpartisan election system, such as the one used by some cities in the United States and used by Nunavut and Northwest Territories in Canada. It points out that the United States Constitution never envisioned the existence of parties and in fact the 'evil of party' was specifically condemned in the Federalist Papers."

"But you aren't calling for the abolition of nominations and campaigning?"

"No. We are making it clear that we are proposing a transition state and we are condemning the damage partisanship has done in no uncertain terms. The goal is a transition to elections without nominations and campaigning as well, but meanwhile there's a lot of experience with nonpartisan elections to draw on."

"That sounds like a tough sell to me. Are you getting much support for the statement?"

"It is a tough sell; more than I expected. But I think I can get 2 or 3 more Peace Prize winners to sign on with me."

"Well, I wish you luck with the effort. Partisanship has gotten so poisonous, it'll be difficult to have much impact."

"Correct, but we need to think long term and develop ways to nudge the process forward. Politicians will sneer, but Mars is a pretty powerful example, and millions are following us closely. Millions are disgusted about the situation on Earth. It's been brought on by partisan paralysis. We have a moral imperative to do anything we can do to prevent a complete collapse and the loss of life that will follow."

"I quite agree. You can count on me to issue a statement of support citing Mars as a viable example."

"That's what I hoped you would do. Thank you, Helmut. I'll let you know when it appears."

"Thank you, and best wishes with the effort. You are right, we do have to do something."

"Exactly. Ciao."

"Ciao." Helmut closed the circuit. He was almost at his brother's anyway. Kristoff didn't have an office as much as a control room built into his house, with two full time employees. Screens showed robotic equipment doing plowing, picking, and thinning plants. Other screens showed the progress of watering and feeding fields.

"Hey," said Kristof. "Come sit. This is a good time. Jeb can watch things while I talk."

"Can we talk in private?"

Kristof was surprised. "Sure." He pointed to the hallway. They stepped out and walked to the living room. "What's up?"

"This is confidential. So . . . if we had 90,000 or even 100,000 immigrants, this coming columbiad, could we feed them?"

Kristof's eyebrows went up. He shrugged. "Sure. I guess it depends on whether you want real ice cream with real chocolate sauce on it, or soy ice cream with artificial chocolate sauce on it."

"Huh. Elaborate."

"Well, everyone off Earth except us grows most of their food hydroponically. We don't for several reasons. We had a lot of sunlight and it was expensive to replace it with solar panels, electric lines, and LED lights. Nuclear power was expensive as well. And everyone here wanted open space, so we have a lot of agricultural spaces where people can walk or jog but not too

many parks. But now we have something like 15,000 kilometers of metal roads, all equipped with electric lines and methane and oxygen pipelines, so we can install wind turbines and solar panels in the very best locations. Power is much cheaper than it was and the supply is reasonably good even during dust storm season."

"But people have also gotten used to organic food."

"It's still organic; we don't have to spray them, after all! But not everything needs to be grown in open air. Who cares if cotton is grown hydroponically? Soybeans, sorghum, and other crops that are used to produce processed foods--like artificial meat, which is popular!--could easily be grown in trays one meter apart underground. For that matter, if you add a level underneath all the condos, you could grow the food right there, and leave the ground surface open for parks."

"That's interesting. It'd generate a lot of heat to get rid of, but that can be handled."

"Of course! It might even be better because the heat and oxygen produced could be routed elsewhere and used. This isn't a new idea, but there was no reason to implement it."

"Now that we may have a crisis, perhaps the time has come."

11.

Let Them Come

Late June 2085

Oskar was nervous as he arrived at Maryam's house, but his nose was immediately overwhelmed by the smell of cooking. "Wow, what is your mother making?" he asked Maryam as he entered.

"Tunisian couscous; you'll like it."

"I'm sure, I like couscous." Oscar entered the house's living room; the dining room formed an l-shaped addition onto it and the table was already set.. The wall screens displayed images of beautiful paintings of the sea.

"These are by my aunt," said Maryam, pointing. "We left the originals on Earth because we had reached our mass quota."

"But you have beautiful copies." Oskar leaned in close; he could see the brush strokes. "The Mediterranean?"

"Yes, by Sous, where she lives."

Just then Nadia, Maryam's mother, entered from the kitchen. "How are you, Oskar? It's nice to meet you as a man."

"He chuckled. "Yes, I suppose you saw me around Mars, before we left for Ceres. I was 4 then."

"That sounds about right. We left for Earth in 2067, right after independence."

"I was five by then, and on Ceres."

"Well, I'm pleased to meet you. Maryam has said a lot about you, all positive. Please sit down and I'll bring the dinner."

"Can I help carry something?"

Nadia smiled. "Of course! Come." She led Oskar and Maryam into the condo's small kitchenette where a great bowl of couscous with vegetables and chicken--artificial chicken, Oskar guessed--awaited. She gestured and he picked it up and carried it to the table, where he put it in the center. "What restaurant made this?" he asked as they sat.

"Restaurant? No, I made it!"

"You did?"

"Of course! Some of us still cook at home, you know! I even made the couscous. It's quite labor intensive, but great exercise for the hands!"

"She's a great cook," added Maryam. "While we were in Iran, she picked up quite a few Iranian dishes as well. I'm afraid my repertoire is much more limited."

"Well, as she noted, not many people cook up here."

"Come on, help yourself and pass it around," urged Nadia. "So, you are the culture reporter of *Mars This Sol* and a poet as well."

"I am indeed," said Oskar as he ladled out food on his plate. "I love my job and *Mars This Sol* likes my work enough to employ me full time, now."

"Really? Congratulations!" said Maryam.

"They didn't realize there were so many arts and sports activities going on and my articles are read by a lot of people, so I start full time on July 1. My poetry writing grant ends then, so the timing is important!"

"I guess so," said Nadia. "I am so glad to be back here and working full time on radiation oncology. I figure I have a good ten years of research left, before I retire at age 70.*Mars This Sol* has an excellent medical reporter, too."

"Yes, Sandra is quite well respected. We're lucky to have a strong journalism sector up here. And now with Earth melting down, there's a lot to cover."

"Yes, it's shocking! President Peters orders the arrest of six governors of states and he can't get any of them because of lack of cooperation of state police and even the local national guard units, and now the number of states recognizing the world dollar as legal tender is up to ten!"

"And the Chairman of the Federal Reserve is refusing to insist that regional federal reserve banks use just the world dollar, so parts of the old federal reserve system are cooperating," agreed Oskar. "Meanwhile, pro-Peters and anti-Peters demonstrations are clashing and everyone blames the other side for shortages of food and commodities that no one can pay for."

"I referred one of the *Mars This Sol* journalists--Julia Rippin--to some of my old friends in Washington, D.C.," said Maryam. "And part of my old neighborhood was looted the other sol."

"That was quite a dramatic article," said Oskar. "There are some good ones coming out in the next few hours, too. I was talking to Julia briefly over lunch and she was working on an article about the big riot in Moscow. Her sources are usually relatives of Marsians."

"What articles are coming about immigration here?" asked Maryam. "Apparently both the *Sedna* and the *Pluto* are going to be available."

"They are, but they can't be set up to accommodate a lot of people quickly, so they won't have a huge impact, and everything hinges on the decision of the Mars Council to reallocate or borrow several billion redbacks."

"For settling them, as well as transporting them," noted Maryam.

"That's the big issue; comfort and safety," agreed Oskar. "But we have so much infrastructure now, and so much redundancy, we can accommodate an extra fifty thousand people pretty well. It's hard to believe, but it seems to be true. There's reporting about that ongoing. Agmar doesn't want Marfab to get into fabricating food--Agmar wants to grow it all--but Marfab has long had a division, Nutrimar, that produces artificial meat, food coloring and flavors, and similar items, and they can expand their production into items like coffee substitute. So shortages shouldn't be that serious. We have enough polder and Marbuild can provide the housing. We have a *lot* of robots, after all."

"We have to let as many people come as we can accommodate," said Maryam.

"Yes, let them come," agreed Nadia. "So, are you planning to stay in journalism, Oskar? Have you thought of moving into political reporting?"

"Political reporting? No, not now when my father is Chief Minister! That would be an impossible situation. Maybe some sol, but right now I really enjoy the assignments for the arts, culture, and sports. I'm learning a lot about all sorts of things I have never studied before. And I want to write poetry, of course. If I could earn a living that way, I would."

"You write very well," said Maryam, admiringly.

"You do; I'm impressed," agreed Nadia.

"When I was sick from cancer half my teenhood, I did a lot of reading, and a lot of it was classical literature. For some reason, I was really attracted to it. Now I can be thankful for it!"

"I think so," agreed Nadia. "And you're cured now?"

"I've passed the five year point, so yes, I seem to be."

"That's good," said Nadia, looking at Maryam.

They ate in silence for a moment. "Oh, did I tell you?" said Nadia. "Corazon is coming to Aurorae in Satursol. She'll be by herself and we're planning to get together for lunch."

"Excellent. And I guess Sam will be here too, for the Mars Council session."

"Yes, a nice coincidence. I'm looking forward to meeting her. I hope I can meet Albert and their kids some time, too."

"It's a matter of time," replied Oskar.

"They need the time to digest the situation," agreed Nadia. "You can't blame them. And you have family."

"I do," said Maryam, reaching out to touch her mother's arm. But she cast a glance at Oskar as well.

Helmut walked to the front of the Mars Council briskly, looking confident, but careful not to betray the nervousness he actually felt. The "Chief Minister's Questions" was a Marsian tradition patterned after the similar weekly institution in the British Parliament. He had primarily answered questions when the Mars Council was debating something major, like the budget or a major revision of a law. This sol it was his chance to explain and defend the plans to raise the number of immigrants next year to 100,000.

He turned to look at David Hamm, the Speaker of the Mars Council and a very good, impartial chair of the meeting. “Thank you, David, for your introduction, and I do hope it doesn’t count against my ten minutes!” He paused for laughter, but not for very long. He pressed a button and his first slide appeared on the screen. “I do hope all of you will read as much of the 350 page report as possible. All I am don’t is reviewing the 15-page executive summary this sol. The details are important: we are proposing to move up to 100,000 people here next year, starting in a matter of months!

“First, getting them to Earth orbit: there are two passenger shuttles each capable of transporting 150 passengers and a third one comes into service in order to help our transport needs. They normally make one run a week but are able to make one run a day, especially when we need to get people into orbit. They can easily get 100,000 people into orbit, plus supplies. We are already stockpiling supplies in Earth orbit and can start launching people any time because the hotels are mostly empty and Swiftville has space. The carriers and corvets start to arrive in four months and they will provide housing. We plan to send geologists and other Mars scientists to Mariusville on the moon where they can do lunar research while awaiting their flight to Mars.

“The 3 passenger carriers, the carriers *Sedna* and *Pluto*, and the 12 corvets can transport 100,000 safely. The three passenger carriers will be set up for 15,000, which sounds like a lot, but remember a C-100 has 780,000 cubic meters of interior volume. Each will come with four corvets attached, set up for 2,500 each, so the carrier-corvet combination will transport 25,000. Two of the carriers will arrive quickly enough for their eight corvets to make fast trips back to Earth to bring a second load to Mars 2,000 each--bringing us 16,000 immigrants. The *Sedna* and the *Pluto,* will come together, for safety, bringing 13,000 more. If you add all of that up, we have

a transport capacity of 104,000. Because of the arrival of Cererian water in low Earth orbit and the decline in demand for propellant because of Earth's economic crisis, there's plenty of propellant for trans-Mars injection.

"The passengers will arrive here spread out over a six month period and the carriers will be able to linger as much as three months, and we are able to transport everyone to the surface over 9 months. Thus we have two years to house everyone. Africa, Cassini-3000, and Dawes-3000 will be finished, raising our polder to 44,500,000 square meters; for a population of 250,000 people, that's 178 square meters per person, which everyone assures me is plenty to provide us with food and other necessities, because we now have access to plenty of electrical power to run hydroponics, and they need about 65 square meters per person to provide all necessities. If we add a level below the housing, split to provide two 1.5 meter high agricultural spaces, we can feed everyone easily. Before the next columbiad in 2089, Asia enclosure will be finished, plus Demeter-1 and 3-million square meter enclosures at Cassini, Dawes, Thymiamata, and Meridiani, providing 28 million square meters more polder, and we will complete five million square meters of intense hydroponic agriculture. These should raise our polder to over 190 square meters per person, assuming our population again grows through immigration by 100,000, plus 40,000 children, and the total hits 400,000.

"As for housing, we can build basic units to accommodate everyone, but we will concentrate them in Australia, Europe, and South America, and we will not develop housing in Africa or Asia at all before 2088. By leaving them agricultural, we can optimize their climate for crops, and we will save some money on construction of public transportation lines, sewer, water, electrical, and communications services. Housing and work facilities will be four stories instead

of three, with the lowermost level for non-residential space; public schools, offices, stores, etc. When development is expanded in North America, we will use five levels, with the lowermost dedicated to agriculture. Housing units will have fairly minimalist furnishings for the first year. We will ask people to sell or loan spare beds and other furniture to ease the shortages.

"That's it! The details are in the longer document, and no doubt many will come up in the question session. Thank you."

Helmut nodded to the applause, which was strong--that seemed like a good sign--and turned to the Speaker. "Thank you, Chief Minister Helmut. We will now take questions, and the first one we have is from Marshall Elliott, representative of the Marsian citizens in the Saturn system. Please play Marshall's comments."

There was a pause and Marshall's face replaced Helmut's slides. "I am very grateful that Chief Minister Helmut has come to us to seek our assent to this increase in immigration," he began. "My comments are based on the report and summary and not on the presentation the Chief Minister just made, because of the communications limits imposed by the speed of light. I am obviously in favor of the proposal, and I think all of you can imagine why. As the first child born on Mars, I saw changes far greater than anything we now envisage; Aurorae went from three residents to several thousand during my time there!

"But more important to me, and to everyone else in the outer solar system, is the fact that a larger Mars can provide better support for us. Three quarters of the Helium-3 contracts for Saturn, Uranus, and Neptune have been canceled. We need you, and the bigger you are, the less of a burden we will be. You have the luxury of thinking in terms of Categories 1, 2, and 3 necessities. All three of these categories in fact have three subcategories, A, B, and C. Saturn can

handle Category 2A and 2B, but not 2C, and we can't handle any of the Category 3 items. Uranus and Neptune are even more limited. It is the goal of Project Helia to make all Category 3 items produceable by a community of 1,000 adults, but we aren't there yet.

"Earth needs a larger Mars, too. As its politics sinks into farce, deceit, hostility, and an unrelenting quest for power, Mars must be an example of government for the purpose of building community. What we have is unique. Just as the United States was a compelling example to the world that democracy is better than dictatorship, we must be a compelling example that a society can be created based on a government of selfless service."

Marshall's face faded from the screen and was followed by scattered applause. "Mr. Anker Christofferson," said David Hamm.

Anker rose. "As a horticulturist, I am very concerned about the decrease in polder per person and the impossibility of Agmar or anyone else to meet the demand of 100,000 additional people. Yes, we can feed everyone, but every square meter per person we lose represents a decrease in ecological diversity per person. Many common items will become expensive. Furthermore, while the additional 28 million square meters of polder will raise the amount of polder per person *almost* to the ideal 200 square meters, that's assuming the twenty-sixth columbiad will also have 100,000 immigrants, just like the twenty-fifth. Since when has that ever happened? If we aimed for 150,000 people instead--which would not be an unusual increase--we'd be back down to about 175 square meters per person."

"Thank you, Anker, for the question. You are correct that demand for coffee and oranges--to take two random examples--will increase about fifty percent, while production, which has to be planned four years in advance, will increase about thirty percent. Prices will

probably increase or there will be shortages. But there are some solutions. Coffee substitutes exist, such as chicory, which can grow to harvest in a matter of months, and artificial coffee can be produced chemically. Most food crops have substitutes; mint for tea, strawberries for oranges. Yes, we will have more substitutes.

"Longer term, we can adjust our polder per person downward if we develop more hydroponics and aquaculture. The pipelines and electrical lines built into our metal highways can bring us very large quantities of power and the amount of food and fiber we can produce intensively in a very small volume is remarkably high."

Anker nodded and sat. "Cesar Alvarez," called out David Hamm.

The arch critic of Helmut rose. "Once again, we have this promise of a golden age if we allow a huge immigration wave to roll over us. Why are we in such a hurry to grow, really? Do we really need it to support the outer solar system? Will we really be able to draw off a significant number of desperate professionals? I understand over a million people have applied to immigrate! If we raise the quota, more will apply, not fewer, so we will never satisfy the demand. And do we become a better example to Earth if we have 250,000 people instead of 220,000? No. Does this really help Earth at all? No. So why, Chief Minister Helmut? Why?"

Cesar sat to scattered applause. "Thank you for the excellent question, Cesar. I have not predicted any kind of golden age, and I thank you for not predicting an apocalypse." He paused for the laughs. "Mars has 145 million square kilometers and the current estimate is that if we can terraform one percent of it, we can draw all the power and resources we need from the rest. At our current population density of 5,000 per square kilometer, 1.45 million square kilometers of polder could accommodate about 7 billion people. So we have a long way to go to populate this

world. I will turn your question around: Why shouldn't we raise the total this columbiad to 100,000? Will it cause terrible shortages and difficulties? No. Will it help bring us additional resources for partial terraformation, for our expansion into the solar system, for a more vibrant culture, a stronger economy, a larger Mars? Obviously. Is it an important symbol of our capacities? Yes. Is it an appropriate response to the crisis on Earth? Yes, and a reasonably priced one, because terrestrial resources will be cheaper and more available than ever. So I say to you, Cesar: Let them come. Let them come, join us, transform this world, and strengthen our example."

Stronger applause followed. David waited for it to die down, then announced "Anika Matadeen." The Dawes Borough's development officer rose. "I have several concerns," she began. "An obvious one is that Africa and Asia are being left agricultural, instead of becoming culturally appropriate residential areas in their own right. But that's fairly minor. A bigger concern is that Aurorae is gaining 16 million square meters of polder while the Central Highlands are gaining only 12 million. The goal of parity is not being maintained. And there's the question of the Syrtis Major gold deposits that we are becoming more and more aware of. Right now, gold is our biggest income earner, and the economic distress on Earth is pushing the price of gold higher and higher. We need more gold exports, rather than PGMs, which are dropping in price. Syrtis has the potential of becoming a major new borough, but the budget cuts the funds for its development."

"Excellent questions, Anika. Africa and Asia are the largest enclosures in a series that extended Aurorae eastward by 8.5 kilometers, each enclosure larger than the previous one so we can progressively learn how to make them. So Africa and Asia will be the most impressive, the

most sophisticated technologically, and they will have the largest populations. The delay in populating them is purely practical: we need to accelerate their completion, so we are shifting resources that would complete the transportation and service tunnels to completing the domes themselves. Our existing infrastructure in the other enclosures is adequate to handle the population increase.

"As for parity between Aurorae and the Central Highlands, that parity does not include the populations of Uzboi, Tithonium, and Thaumasia, who need to be fed, even though none of those boroughs are getting new enclosures. Aurorae's larger area is for feeding them.

"Finally, the Syrtis Major borough: the budget cut delays the extension of the metal road to the site by one year because we need the human resources to expand the ability of the Central Highlands to enclose more polder. Syrtis is 1,800 kilometers from the Dawes-Cassini metal road, which is a long way to build a metal road. If we can come up with the redbacks to fund both, I'd certainly be in favor. I should add that with four boroughs able to enclose 3 million square meters of polder every columbiad, it is not hard to increase that capacity to 4 million, then 5 million, etc., so the Highlands will soon have substantial growth capacity."

"Marci Carnegie."

Marci, who was in charge of Phobos's substantial agricultural capacity, rose. "I am encouraged to hear that our techniques--often developed on Mars--are now being extended to aquaponics and hydroponics on the surface. Ten thousand square meters--one hectare--of intense aquaponics can provide for 150 people. It needs about 5,000 kilowatts of electricity, so it is not a huge demand on power; indeed, if it were spread out across the surface of an enclosure, the sun would provide most of that for free. Africa alone, with its 6 million square meters of space, alone

could feed 100,000 people. So our old standard of 100 square meters of polder per person is excessively pessimistic, with our genetically modified low-light crops.

"So I am not worried about food on the surface, or even on Phobos, where we can build up supplies enough to accommodate 50,000 or so guests for six months if we had to. Most of the food to feed those 100,000 people on their flight to Mars is on the carriers right now, raised on Phobos previously and on its way to Earth on them.

"But I am concerned about issues of employment and social integration. You did not touch on them at all, and as we know, they are the most difficult issues of all. A certain fraction of the arrivals head back to Earth, also, discouraged, after two columbiads, and meanwhile some of them end up with alcohol and drug problems. How can we improve those issues?"

Helmut nodded to Marci. "Obviously, we can't make everyone's experience here ideal. People come here with their struggles, their dreams, and not all of the dreams are viable here. In the past the return rate has been as high as eight percent and we have reduced it to four percent through better psychological screening and better support after they arrive. We can anticipate some chaos this coming columbiad and that may cause the return rate to go up somewhat. The Ministry of Immigration is aware of this and is looking at ways to improve orientation and counseling services. Anyone with ideas, please offer them. As for employment, we have pressed everyone to think seriously about what a near doubling of our adult population will mean to their work. Some of that, unfortunately, won't become clear until after people arrive. No amount of artificial intelligence can solve that problem."

"Thanks," said Marci, and she sat. David looked at the list. "Johnny Lind."

Helmut sort of held his breath as Johnny rose, because he wasn't sure Johnny's "conversion" would hold. But Johnny smiled. "I think you put it very well, Mr. Chief Minister Helmut. Let them come. Clearly, we can do this. Let's plant the coffee and orange trees for half a million people, just in case this expansion rate continues. We have an army of robots to make everything ready for them. Let them come."

Johnny sat to applause. "Carter Levine."

Everyone turned to the screen to see the comments of the representative of Ceres, who was also the Chief Executive Officer of that borough. "Once I heard Marshall's comments, I felt I should add mine," he began. "And fortunately, there's now only a twenty minute communications delay each way. I speak on behalf of all 1,500 of us here on Ceres when I say that we want a bigger Mars and we want a bigger Ceres. We can send you all the metal and water that you want; indeed, all anyone could ever want in low Earth orbit. We can afford to export PGMs even if the price drops to a quarter of what it used to be because we can now export cobalt and nickel at a decent price. We want to see Phobos grow because between the two of us, we can serve the entire solar system. We also want to double our population so we can explore the asteroid belt better. So we are very much in favor of 100,000 immigrants in the twenty-fifth columbiad."

The screen faded to black. "Yuri Severin."

The veteran astronaut--who had been to Venus, Ceres, and Saturn for several years at a time--rose. "Let them come," he said, and he sat.

"Let them come!" echoed several more, than a dozen voices. People looked around the chamber at enthusiastic faces and a few doubting faces. But the doubters were in the minority.

12.

Resolutions

early July 2085

Sam hurried to the restaurant to see Maryam. He was a bit late, and he was squeezed for time; a hyperloop would depart for Thaumasia in two hours. He was pleased to see she was still waiting at the restaurant, and even more surprised to see who was with her.

"My goodness. Corrie." That's all he had to say. She was now 43 instead of 17 and he was now 45 instead of 18, but there was a timelessness to seeing her.

"Hello Sam." She rose and gave him a quick hug, a rather loose one, too.

"I didn't know you'd be here."

"I'm sorry I didn't tell you," said Maryam. "She called me just two hours ago because she was back in Aurorae."

"The immigration planning conference?" he asked, with a sigh.

Corrie nodded. "I'm on Cassini's planning committee, and needless to say, we want to get as many immigrants as possible."

"So does Thaumasia; we've requested a doubling of our chlorofluorcarbon production department, which will double the size of the outpost. We've got the power and the mineral supply, and Mars will soon have twice the GDP."

"Please join us," said Maryam. "Sit down." She pointed to a chair.

"Yes, of course I will."

"You haven't changed much, Sam," said Corrie.

"Well, I'm getting a bald spot. Older and wiser, I guess. You look good."

"Thanks. Life is good and has been good to me. Mom and dad are getting old; they're in their late 70s. But they're enjoying their status as Cassini's veteran Marsians. They're always busy going to the school to talk about the early sols, or chairing various events around the outpost."

"My mom's 88 and is grandmother to everyone at Thaumasia. She can't volunteer at the school any more and has a live-in robot, but she can still walk around pretty well. I'm sure she would ask me to say hello to you."

"She was always so kind to me. Please say hello to her as well."

"I will." Sam pulled out his communicator and said into it, "Please order me a coffee with milk and sugar and a raspberry danish."

"Is that all you're having?" asked Maryam, surprised.

"Yes. I'm having supper with mom and my family as soon as I get back home."

There was an awkward silence for a moment. "Tell us about the Mars Council," asked Corrie.

"Three sols proved to be enough for the special session. Helmut was very persuasive and the polls showed the public was behind the huge immigration wave, so the debate was mostly about how to reallocate the budget. In the end, like good politicians, we opted to go into deficit and borrow money, but there's no more reliable investment than in immigration because you know there will be increased taxes to pay off the loan over a very short time."

"And complete the metal highway to Syrtis," said Corrie. "We really wanted that."

"Well, the only thing that's more of a sure thing than immigration is gold, right now! Once the 100,000 people arrive, they'll need jobs, so the money supply has to almost double and

demand for goods almost doubles. The Redback Central Bank knows how to handle all that. What really seems unbelievable is that immigration could double again, and then again . . . there has to be a limit!"

"Even with 100,000 per year, Mars will exceed one million in 2100," said Maryam. "And we know there will be people wanting to come here, even if the current crisis on Earth ends soon."

"The political crisis in the U.S. will have to end soon, too," said Sam. "The entire northeastern United States and the west coast have declared Peters an illegitimate President, have recognized Omar as President, have reverted to the world dollar, and the national guard units are sticking with their governors, so Peters is threatening to launch air raids against the national guard bases. Omar is sitting in Boston or New York issuing orders. The governor of Colorado has been arrested but the Lieutenant Governor has taken his place, gone into hiding, and is equally defiant. Protesters have taken over the capitol building in Texas and are using force to remain. Every sol it's another unbelievable shocker." He shook his head.

"Even if it's resolved, the economic damage is immense and will last years," said Maryam. "But someone will blink."

"That's what everyone says," said Sam.

A robotic cart rolled up with his coffee and danish, which Sam took. He sipped. "Real marabica. They say there will be a shortage in a year and a half, so enjoy it now!"

"I bet the coffee growers will figure out a way to maintain supply," said Corrie, skeptically.

"The price has already gone up," observed Maryam. "They're stretching out the existing supply." She sipped her mint tea. "You know, this sounds strange, but just sitting with both of you, talking about silly, ordinary things, is very nice."

"This is strange, for us," said Corrie. "I haven't sat and talked to Sam for more than ten seconds for . . . I don't know how long."

"Twenty years or more," said Sam. "But we both have our spouses, our children, our families . . . I guess things are different, now."

"Yes, things are different," agreed Corrie. She turned to Maryam. "I'm sorry we can't be with you more, but I know you understand."

"Of course, and I have my family, too. My mother."

"And the time will come when you get married and start your own family," added Corrie. "That will be a special time and a remarkable development for you, too."

"I know, and now that I've met both of you, and your parents, and gotten to know you, have . . . reconciled with you, you might say . . .I feel that an important milestone in my life has been passed successfully. Even if we can't have a very active and close relationship right now, I'm grateful that we can get together like this, that we can see each other and be in touch. It has been immensely helpful for me." Maryam felt tears forming in her eyes.

Corrie reached over and wiped a tear away. "This brings closure to an important part of our lives, too. I'm so delighted to meet you, to be able to be with you, and I'm proud of what you've become, Maryam."

"Thank you," she said, choking up.

"I'm proud of you, too. I love you. You are always welcome in Thaumasia, too." Sam's voice broke a bit.

"And the time will come when you will be welcome in Cassini, too, believe me," said Corrie. "Alberto is feeling much better."

"I'm glad, because I don't want to make your family life more difficult," said Maryam, tearfully.

"We're working our way through this test, don't worry," said Corrie.

I appreciate that, and I will come some time; I look forward to it. But the three of us . . . never will be a family, obviously, and that's alright. My mom and dad were great and did a great job as parents, and I don't want to replace them. No one can, obviously, and you wouldn't want to, anyway. So I am happy to be with both of you when it works out."

"That's fine with me, too," said Sam. "I don't know when the three of us will ever be together again."

"At Maryam's wedding, whenever that is," said Corrie, with a smile.

"Yes, whenever that is," Maryam said, nodding.

Tad Lind hurried down the hallway to Anand's office. The Chief Minister of Urania had a spacious office so he could hold meetings and it opened straight onto a wide balcony overlooking the interior of Avalon 1A, so he always had a great view. When Tad entered, Anand rose from behind his desk. "Come in. Let's sit and be comfortable." Anand led Tad over to chairs on the balcony and poured him some ice water. "Thanks for coming. How's the write-up of the Six Moons expedition?"

"Good. All the papers are finished, peer reviewed, and edited for four moons out of six and they will appear in separate issues of *Urania Journal of Science* in September. Larissa and Portia are a lot more complicated to write up, so they won't be done until November, I think."

"Excellent. Firuz's expedition just found some excellent exposures of cryovolcanic ice with prebiotic chemicals. The eobiologists are swooning over it."

"I was talking to Firuz last night and he said they think they can date the ice based on the biochemical signatures to 4.37 billion, which would be right after the reformation of the satellite system, so it's very early."

"The earliest prebiotic samples known in the outer solar system," added Anand. "This is a major find, another big datapoint in the origin of life in this solar system. We're going to be drilling this cryovolcanic ice formation for years. We'll need to rearrange the berths on Uranus 3 to include more eobiologists and eobiochemists."

Tad nodded. "Absolutely."

"The reason I asked you to come in is because we need to respond to this opportunity flexibly. We'll need to send expeditions to Valeria on a permanent basis, so we need a base there. We are in the process of completing a fifty-meter drum intended for Portia. But this is a lousy time to go into the PGM extraction business, with the price down to a quarter of what it was a year ago. So I want to postpone the Portia expedition and the drum at least one year, possibly two, and send the drum to Titania."

"I see." Tad scowled.

"I'm sorry, Tad. You've earned that expedition and I won't give the job of setting up Portia outpost to anyone else. But it looks like yours will be Urania's third borough. Titania will be second."

"That makes sense, Anand. I . . . understand. Yes, it's disappointing, but the problem lies on Earth."

"Exactly, not with you. Firuz Moulin is already on Titania, so I can't take that away from him. He's a very experienced commander. We've put into Mars for a wave of 500 immigrants for Uranus 5 in 2087-89. The 300 we get in 2087 will raise our numbers to 1600 or 1700, depending on the birth rate, so Uranus 5 will push us over 2,000 in 2089. We'll easily be able to support three boroughs at that point, maybe four. We'll be closer to self sufficiency, too, except for uranium, plutonium, and other essential radioisotopes. But PGMs will play a role in Urania, believe me."

"I believe you, Anand. Can I propose another expedition for next year, then?"

"Yes, I think so, once we get the drum to Titania, because that will free up the ships."

"Okay, thanks." Tad rose from his seat and shook hands with Anand, then headed out of the office. He was furious that his plans had been blocked, but he did understand. He tried to focus on what was best for Urania, even if it hurt.

A series of clanks marked the successful arrival of the Peregrine-V spacecraft in Ishtar station's dry dock. The control room team burst into applause and they were accompanied by Pauline Augustine, the Chief Minister of the Venus Commonwealth; Elena Volkava, Director of Construction; Harold Laan, Director of Venus surface geology; and Lakshanya Chandresekar,

Director of Ecology. Pauline rose from her seat and moved up to congratulate and shake hands personally with all six control room personnel.

"Thank you for all your work and sacrifice that made this mission a success," she said, when she finished shaking hands, aware that the event was being live streamed. "We now have achieved two milestones in two months: we have deployed a new and more sophisticated aerostat, the *Daedalus,* in the atmosphere of Venus and have tested a new and better way to reach the *Daedalus* as well."

"Thank you, Chief Minister Pauline, for your encouragement and support," replied Patrice Beaudoin, Director of Venus Spaceflight. "We are thrilled to have this new capacity for our service to Venus science and exploration." She reached out and shook his hand. Then she turned to face the camera. "I am pleased to announce that if a post-mortem reveals that this flight went as smoothly as it appears to have, in three weeks we will send a crew of two to Daedalus for a one-year stay. Human beings will no longer simply orbit Venus; we will begin our journey to the planet itself. I cannot tell you how thrilling and historic this day is for all of us. It is our hope that, in the next century , there will be a city floating in the atmosphere of Venus."

The mission control staff and the department heads all began to applaud vigorously. They knew the announcement was coming, but this was the first public release of the information. Pauline waited for the applause to end, a smile on her face, because she had more. "I have also heard from Mars today about Lakshmi enclosure." She paused to be sure everyone was paying attention. "Currently, Lakshmi has been enclosed; she is 200 meters in diameter and 200 meters long, divided into four compartments of unequal size to transport water, nitrogen, and useful elements here. Her total cost will be 2 billion redbacks, about equally divided between work

done here and work done on Ceres. Of the billion redbacks we owe Mars for her, half has been paid by the European Space Agency on our behalf, but ESA has lost the funding to cover the remaining half of the construction costs. Today I heard from the Mars Commonwealth that they will loan us the remaining half billion redbacks to complete the enclosure, The loan will not come due for at least ten years and we are confident Europe can afford to pay off the loan gradually over that time. Lakshmi has been saved."

There was strong, surprised applause about that announcement, but she had saved the best for last. "Furthermore, our Venus Spaceflight Center has determined that Lakshmi can be brought here a bit more slowly than planned--so that its arrival will occur in 2090, rather than 2088--but *en route* it can stop at the asteroid 2061DXR, a mixed body of nickel-iron and stone 65 meters in diameter, dock to it, and push it here, thereby building up our orbiting base. The asteroid's mass of 2 million tonnes will require use of nearly every drop of the 3.15 million tonnes of water in Lakshmi, but she will have enough left over to provide for our needs here in Venus orbit. In 2090, the Venus Commonwealth will have all the metals and volatiles it needs and will have modest exports in deuterium and PGMs. These will ensure our future."

There was even stronger applause at that line. Several people came up to her to shake her hands, much to Pauline's surprise. It took over a minute for the crowd to calm, at which point the broadcast ended.

"So, what was the final result of discussions with ESA?" asked Patrice.

"We decided to agree to disagree. We have sovereignty here, after all; this is our world. Either way, ESA won't abandon us. They feel that with all the instability on Earth right now, this is not a good time to send a crew down to the Daedalus. It is potentially dangerous, after all; if

something goes wrong and the aerostat loses altitude, they'll be crushed and cooked. But I reminded them that for us, the instability on the Earth is a good reason for us to launch the mission because we need the sense of progress and development of our mission here. They dismiss the idea of a cloud city as an unnecessary luxury and risk; we can run things remotely from orbit just fine. We don't need to be 54 kilometers above the surface."

"Yes, sure, but this is our world," replied Patrice. "They don't understand that."

"No, they don't; to them it's just an unnecessary luxury and risk. I understand their point. But as I said, we have agreed to disagree."

"Good. Thank you, Pauline," said Harold. "It may even prove possible to get people to the surface, some day."

"Well, that won't happen any time soon," agreed Pauline. "But if we want to make that happen, it will. Once we have a permanent human base in the atmosphere, excursions to the surface will be possible. Mining of tellurium deposits on Mons Maxwell may be marginally economic. And future generations will argue whether it's an unnecessary risk and luxury as well."

"Oh, this is a fancy place!" said Maryam, as they entered the Palace restaurant. "Are you sure you can afford it?"

"I'm sure," replied Oskar. "But I just published a poem in *Mars This Sol* and you seem to have resolved some family stuff, so let's celebrate."

"Thank you!"

Oskar pulled out his communicator and found they already had a table, so he led her to it and they ordered some wine. “I loved your poem,” she said. “A lot of feel of angst toward our ‘mother world.’”

“It’s a lament to Earth, and I can’t tell you how many people have come up to me and said ‘you captured exactly how I feel.’ For weeks, people have been saying that someone in the U.S. is going to blink. But no one expected the federal government using cruise missiles against their own people.”

“President Peters has gone too far. You can’t target the electrical generating capacity of an entire state like California. People are dying because of the lack of power. And the government has accidentally brought down half the internet for the whole country, not to mention all the websites from around the world stored on California servers that are now unplugged! He’s going to deal with a big backlash.”

“He doesn’t seem to care.”

“That’s true, which means the backlash will be even more powerful. I think he has overplayed his hand.”

“Well, you have access to information I don’t have. But I get the impression the *Mars This Sol* political writers agree with you.”

“They have their sources, too. But never mind; let’s not worry about politics tonight.”

“Let’s order steaks; *real* steaks.”

“Too expensive!”

“No. Just this once.”

She smiled. “Okay.” She scanned down the menu on her communicator, then asked for the filet mignon. He ordered the same and refilled his glass of wine. “So, all the drama with your birth parents is resolved.”

“Yes, I think so. It was providential that Sam and Corrie were both available at the same time. Sitting with both of them--as three adults, but as birth parents anyway--was really powerful for me. For a moment, we were a family of sorts; as much of a family that we’ll ever be. I have a standing invitation to come to Thaumasia any time, especially to see Madhu, which I would like to do some time. I will eventually have an invitation to go to Cassini as well, but maybe it’ll be a year or so. And that’s all I’m going to get from that part of my background. But I’m fine with that because they have their lives and their families, and I have mine.”

“That’s the way fate has worked out.”

“Exactly. My past is now resolved. I can look to the future.”

“And what does that look like?”

She smiled. “It’s hard to see, isn’t it? But I have a direction for my education and for my career: foreign relations, especially with North America.”

“The most vexing and complex relationship of all.”

“Of course! It’s like the relationship of the United States to Great Britain, twenty years after the Revolutionary War, of a promising young power to its parent. America has to let go of parts of its past to be truly great as the exemplary great power, leading all of Earth to a just and democratic international order. Instead, it has to be dragged into that order, kicking and screaming, and every decade or two it tries to break free. Mars can’t do it: not only are we small,

but we'll never be part of terrestrial governance. Our future is outward, toward the solar system and the stars."

"You sound like Will Elliott!"

"He's right!"

Oskar chuckled and nodded. "Well, I guess my future is getting pretty well charted as well. I don't know whether it will require another degree; probably, if I want to be a really good writer. But poetry and journalism are so much fun; I really enjoy them." He looked at her. "I guess the open part of our future is each other."

She smiled, delighted he brought up the subject. "Yes, let's talk about that part."

"Maryam, I'd like to marry you."

She gazed into his eyes. ""I think I'd like to marry you, too."

"Really? Will you?"

She nodded. "I think I will."

"Think?" He sounded disappointed.

"Yes, I want to marry you, so let's explore that."

"Alright." He leaned over the table and kissed her. "How's that for exploring?"

She giggled. "Good." She leaned over the table and kissed him back.

He reached into his pocket and pulled out a box. He opened it to reveal a diamond engagement ring. "How about this?"

"Oh, Oskar, it's beautiful!" she said, shocked.

"Just like you."

"You must have spent a fortune! They have to be imported from Earth!"

"True: Mars has no diamonds, so far. But diamonds are so small and so expensive, import costs are actually pretty small! Try it on."

Maryam took the box, pulled the diamond ring out, and with shaking fingers put it on. "It fits pretty well! Just a bit big, I think."

"That can be adjusted. It looks beautiful on you."

"Thank you, Oskar!" She pulled her chair over to his and they exchanged a long, passionate kiss.

14.

Yellow Clouds

late July, 2085

Dr. Fahim Hijazi peered at the brilliant yellow clouds, searching for the Daedalus aerostat. It was a fat, white cylinder the shape of a tuna can with a comparatively small cabin attached to its bottom like a silver button.

"There!" said Dr. Mary O'Hare Hijazi, his wife, pointing to a white spot emerging from a sulfurous cloud straight in front of them.

Fahim nodded. "Nando, transmit a closeup image of Daedalus, please."

"Acknowledged, Fahim," replied his AI over his ear piece. Fahim glanced at the screen in front of him that showed what was being broadcast live back to the audience in Magellan Station, orbiting 40,000 kilometers above the surface of Venus, and from there to audiences all over the solar system. He turned on his microphone. "There you see it, folks; the new home for Mary and me for at least the next year. You can see the big balloon filled with nitrogen and oxygen, a lovely breathable atmosphere for us, which also gives us lift because the carbon dioxide atmosphere of Venus is 25% heavier per cubic meter. Our cabin is underneath and contains our quarters, life support, an extensive laboratory, and an area to set up various atmospheric and surface probes. It'll be pretty packed, but we have access to the floor of the balloon, which gives us a big open space."

"We'll also be able to operate a garden in the balloon. We should be pretty comfortable," added Mary. "Daedalus is a sight for sore eyes! It's a good thing we had that weather delay; the weather today is beautiful and as predicted, crosswinds are very quiet."

"We are now commencing the final approach," said Nando, which was in control of the Peregrine shuttle and the Daedalus aerostat at once. The shuttle headed for a landing platform suspended five meters below the cabin. It coasted in, slowed, and its methane and oxygen hover jets came on to keep it steady as it closed on the platform. Nando controlled the Daedalus and the Peregrine at once, compensating for wind gusts through a combination of jets on the Daedalus and the hover jets on the Peregrine. In less than ten seconds the shuttle settled onto the landing platform. Two arms descended from the cabin and settled under the shuttle's stubby wings to clamp the vehicle in place regardless of future gusts. The Daedalus opened several ports and began to jettison 17 tonnes of liquid carbon dioxide ballast while its stabilizing jets of heated carbon dioxide gave the aerostat additional lift to keep it from dropping. In another ten seconds the arrival procedure was finished; the carbon dioxide ballast was jettisoned and the stabilizing jets ceased to fire.

"Ladies and gentlemen, we have arrived at Daedalus," said Fahim.

"Congratulations, Daedalus 1 crew!" exclaimed Patrice Beaudoin, Director of Venus Spaceflight. "You have achieved a historic first!"

"Thank you, mission control, we are thrilled," replied Fahim.

"To explain what just happened to our audiences, the Daedalus aerostat has a mass of 13 tonnes, but it had stored 17 tonnes of carbon dioxide as compressed liquid in a ring of storage cylinders around the cabin," said Mary. "When the Peregrine docked, it added 17 tonnes to the system and the balloon can't hold up that much additional weight, so the carbon dioxide was dumped, thereby keeping the total weight at 30 tonnes. The Peregrine will remain attached to the Daedalus throughout our mission; it will serve as our emergency escape vehicle if the balloon

suffers a failure and will carry us back to orbit when our mission ends next year. As I think most of you already know, the Daedalus operates 54 kilometers above the surface where the air pressure is about half that at the surface of the earth and the temperature is generally 20 or 30 degrees Celsius; a lovely, inhabitable level. If we were to lose buoyancy, however, we would sink to the surface where the temperature is hotter than a household oven and the air pressure is equivalent to almost a kilometer under the ocean. We'd be crushed and burned up."

"Fortunately, we have decades of experience operating aerostats in the Venus atmosphere and we've never lost one," added Fahim. "The design lifetime of this one is five years and we think with repairs we can keep it operating much longer.. Nando, how is the shut down sequence going?"

"Fine, Fahim. The docking tunnel has clamped onto the shuttle's nose and I've replaced its air with oxygen. It is now safe for you to transfer to the Daedalus."

"Thank you." He looked at Mary. "Ready, my dear?"

"Yes, and quite excited!" she replied.

Fahim nodded. They were in a very small cockpit, smaller than a four-passenger car, and their duffle bags for the year's visit were strapped into the seats behind them. They both twisted around to unstrap the luggage behind the seat of the other--it was too difficult to unstrap their own--then Fahim crouched down and opened the docking tunnel hatch in front of his seat. He grabbed a cord for pulling the bags through and wiggled along the diagonal tunnel until he emerged from the floor of the cabin's lower level. "Do you have the luggage ready?"

"Yes, pull them through," replied Mary. He pulled on the cord and brought his duffle bags, then hers up the tunnel and set them on the floor. A moment later she followed. He helped

her stand. “Close the tunnel hatches, Nando, and activate the room camera.” He turned to it as the camera light turned green. “As you can see, we are now in the cabin of the Daedalus, which has two levels. This lower level is our living area, closest to the shuttle so we can make a quick emergency exit if necessary. This room is our living room, but it also has a kitchenette area on the left side with a microwave, two-burner stove, refrigerator, sink, counter, and cabinets that are already full of food for us. The door next to the kitchenette leads to the bathroom, with a toilet, sink, and shower.”

“The door on the right leads to our bedroom,” continued Mary. She opened the door and the camera in the room came on so the audience could see the queen sized bed, closets, dressers, and chairs. “All the furniture in here, plus the tables, couch, and chairs in the living room are all bolted down to the floor. Occasionally the Daedalus encounters turbulence, just like an airplane on Earth would.”

“Let’s take them upstairs,” said Fahim, and Mary nodded. They walked to the spiral staircase and went up one level. “We’re now in the main lab,” he continued. “We have a powerful but compact geochemical lab that allows us to measure the composition of surface samples to the parts per trillion range. One thing this expedition will allow is rapid geological research and analysis. I’ll be able to send a drone to the surface to grab samples and float them back up here in just a few hours and will be able to produce a detailed composition report a few hours later. This can be done robotically as well, but it is slower and more complicated.”

“The door to the right leads to the drone and sonde room; my favorite,” added Mary. “We have a dozen of each. We can pull a sonde or drone from its storage area, set it on a table and configure it the way we want, with the help of our AIs, Nando and Kat, and launch it out a port.

The sondes are balloons with propellers that float in the atmosphere, collecting samples and measuring variables like temperature and composition. Drones are designed to fly to the surface, remain up to sixty minutes there, then return to the Daedalus via an inflatable balloon. They can scout areas and pick up samples or can rendezvous with surface rovers or visit one of our automated stations to bring back samples. They can even fly down spare parts, which we can install remotely at one of the stations. They are our principal means for doing science here."

"On the other side of the science lab, on the left, is the mechanical room," said Fahim. "It has the life support equipment, water purification, fuel cells to store solar power, and everything else we need to live here safely. We will be in there several times a week to do maintenance."

"This place takes a lot of work," added Mary. "Now, let's go up to the deck." She headed to the spiral staircase and went up one more level.

They emerged inside the balloon itself. "Wow!" said Mary, awestruck and slightly blinded at the same time, because the sides of the balloon were transparent, revealing dazzling sunlight and brilliant yellowish clouds. "What an incredible view!" she said, walking toward the edge of the floor of the balloon. The floor was a tough, stiff plastic, suitable for walking on, bowing upward like a bowl as one walked away from the center, gray in color and opaque; they could not look down through miles of air below them. But when they reached the edge of the balloon, the wall was transparent and they could look down as well as out.

"Wow!" said Fahim, repeating Mary's response. "Nando, how can our audience see this?"

"I have a camera on, about ten meters above your head and to your right."

Fahim looked up and saw a camera where Nando had described, attached to one of the kevlar cords providing the balloon structure. He pulled out his communicator and clicked on the camera icon. “Can you transmit this?”

“Sure. Hold up your communicator so they can see the view.”

Fahim held up the communicator. “Here’s what we see; a vast expanse of yellow clouds and a yellowish-gray tint to the air, which is a mixture of sulfuric acid drops and dust. The Daedalus can suck in the air and capture both. The sulfuric acid can be broken down to extract water, which is broken down to obtain oxygen and hydrogen. The hydrogen in turn is processed to remove the deuterium, a rare isotope on Earth but a thousand times more common here because when most of Venus’s water escaped into space, the heavier deuterium largely stayed behind.The sale of deuterium is the Venus Commonwealth’s main export, besides scientific knowledge of this fascinating world, the second rock from the sun. The Daedalus has been storing water for us and we’ll use it once we start to set up our agriculture. The Daedalus has already captured a hundred kilos of dust particles as well, and we’ll use them when we start to manufacture soil.”

“Let’s pan around the inside, too,” said Mary, so Fahim began to scan the interior of the balloon. “This floor is almost 50 meters across and the top of the balloon is 20 meters over our heads. The top is covered by solar panels and provides us shade from the fierce sun. So we have a huge interior space to run around in, and we have some furniture we can put in here.”

“I’ll be jogging in here every day,” said Fahim. “We have one more thing to do before we end this broadcast. Where’s the script?”

Nando heard him and a moment later a script appeared on the screen of his communicator. He looked around and Mary held up her communicator to broadcast his image and voice.

"As duly appointed representatives of the Venus Commonwealth and citizens of that sovereign entity, we hereby claim the planet Venus, its interior, surface, and atmosphere as part of the sovereign territory of the Venus Commonwealth, now and forever. As such, the Commonwealth claims complete control over said planet and its resources and the exclusive right to assign the same to any entity for any purpose it deems fit."

"The Commonwealth has been making this claim since its establishment," added Mary, "but repeating our claim on an aerostat stationed in the Venusian atmosphere reinforces its legal power, especially since it is currently impossible for a human to set foot on the surface."

"I believe that ends our broadcast today," said Fahim. "But we will make others periodically during our mission. Its purpose, in essence, is this: to determine whether the benefits of a human presence in the atmosphere of Venus outweighs the possible dangers. We are convinced that our mission will make a difference and will demonstrate the importance of the human presence. So tune in and watch our progress, which we hope will erelong lead to the construction of a floating city here above Venus. Thank you for watching. Goodbye."

He paused and looked up at the camera on the balloon. The green light had gone out. "I'm glad that's done. I hate live broadcasts."

"You did a great job, Fahim and Mary," replied First Minister Pauline Augustine. "You're a good team. And welcome to Venus, on behalf of all of us!"

"Thanks, Pauline. We're thrilled," said Mary.

"Excellent. All of us in Venus Spaceflight Control were watching every detail and hanging on every word. We're thrilled, too."

"Congratulations!" echoed Patrice, followed by a chorus of other voices.

"We'll leave you now, so you can get settled in. Pauline out."

"Bye," replied Fahim. There was a click; the transmission was over.

Mary walked back to the edge of the balloon and looked down. "It's amazing; twenty kilometers of yellowish clouds blowing by, then an impenetrable haze between us and hell."

"Yes; amazing and rather frightening to think we're suspended 54 kilometers over hell."

Just then a gust of wind rocked the balloon a bit. Mary reached out to steady herself against the transparent wall. "We're going to have to get used to a lot of that, as we blow around Venus every four days at 360 kilometers per hour.."

"Let's go down to our quarters and unpack. Next time we come up here, we have to put on sunglasses, it's so bright!"

"And sunscreen."

They headed back to the spiral stair and descended two levels to the lower cabin. It was a relief to be back in a closed space, after exposure to Venus's dazzling yellowish sulfuric acid clouds. They grabbed their duffle bags--two each--put them on the bed, and began to unpack. As expected, the emails from their friends up on Magellan Station began to pour in, so they sat to reply to everyone. Then Theresa O'Hare, Mary's sister, sent congrats from Parenago on the moon, where she worked in PGM mining. "How long will it take for Patrick to email us from Neptune?" asked Fahim.

Mary laughed. “Hours!” Her communicator beeped. “It’s Bill Hollingworth from Themis! ‘Congrats, our High School class has gone far!’

Fahim laughed. “We’re all over the solar system, much to our parents’ distress!”

“And they were on Mars, to their parents’ distress!”

Fahim’s communicator beeped and he looked. “It’s Gianni DiPonte in Elliott borough. He just says ‘Congratulations to both of you!’”

“He was always closer to you than to me.” Her communicator beeped. “Oh, it’s dad.” She pushed the button and his videomail appeared on the screen. Eammon O’Hare was 74; the Irishman had been on Mars 43 years and was very proud of his five children, only two of whom still resided on Dusty Red. “Congratulations, Mary and Fahim, for an incredible opportunity and a successful beginning to your expedition. Please be very careful down there, in that hot, corrosive atmosphere! But I’m sure everything will go well, and Mary will have twenty new articles about Venusian aerosols, and Fahim will have twenty new articles about the chemistry of Venusian lavas. Remember, mama and I are still waiting for more grandchildren, and the clock is ticking! But don’t get started on that effort for at least another year, of course. All our love!”

Mary laughed. “I think that’s the first time he has ever even hinted that birth control is a good thing!”

“A loyal Catholic to the end.”

“But at least he had no objection to me marrying you. Your parents were the tough ones.” Mary pushed the reply icon. “Hi, dad, and thanks! We’re doing great here; still very excited about our arrival and the plans for the next year. Yes, we’ll both produce about twenty papers, and yes, when we get back to Magellan we’ll turn to family matters, don’t worry! It’s not too

late, *but as you hinted,* we're going to be careful here on Daedalus. Give mom a kiss for us! Bye." She sent the message and pulled her duffle bags off the bed. "Well, maybe dad brought up the right subject."

Fahim chuckled. "Yes, I agree. Let's test this bed out. Nando, we don't want to be disturbed."

Will Elliott looked at the long list of videomails in his inbox. He had waded most of the way down and was now receiving replies from Earth, some 12 light minutes away. But two stood out and he needed to continue the conversation. He clicked on the videomail from Bart Mennea Jr., son of the assassinated late President and former Majority Whip in the United States House of Representatives.

"Dr. Will, I very much respect your position and largely agree with it," he began. "But I don't think you appreciate the danger we are all in. Reflect a moment about early January when Congress was organizing itself in preparation for the President's legislation, which was expected right after the inauguration. I gave a speech on the floor of the House of Representatives where I said that the reinstatement of the United States dollar and the ban on robotization of the economy would not solve our problems; rather, a much higher tax rate on the wealthy was essential to raise the money to improve this country's educational system, so that everyone could get high-paying jobs. For that speech I was driven from my position as Majority Whip. Subsequently, whenever I raise the issue of extreme wealth I get death threats. I got two last week. I now have to have bodyguards with me twenty-four hours a day and my wife and kids have had to move to a safe location. Three days ago, Congressman Khan was actually killed. I

have no way to get home to Rhode Island because of the state of emergency and if I were to go back, it might not be safe. The National Guard there has defied the President, is loyal to the Governor, and two cruise missiles have fallen on their headquarters! It's crazy, it's mad, it's . . . unbelievable. But it is not safe for us to vote against the President, not when we are in the same party, because enough of his followers are absolute fanatics. I probably would survive the election, but I'd have to deal with a fanatic running against me in the primary because we don't have a nonpartisan primary system in Rhode Island. So there is really very little I can do. I am working quietly, of course; like most of us, we think Peters is a disaster. I do agree that a steep progressive income tax will help a lot, but let's face it, it can't bring retraining and education to fifty million unemployed workers fast enough. I think working on the Supreme Court justices is the best way to go because all of them have protection now because of death threats from crazies on the other side. How is Judge Don Nielsen's effort going? He's a really good man and a highly respected judge; I wish dad had appointed him to the Supreme Court! He's a Bahá'í, isn't he? He certainly stresses nonpartisanship and neutral, inclusive dialogue. Have you heard anything more from him? Bye."

Will watched the image of Congressman Mennea fade from the screen. He had been jotting one-word notes and now he looked them over and added a few more talking points. Then he hit reply. "Good afternoon, Congressman Bart. I so appreciate it that you like being addressed as we prefer to on Mars; it is formal, respectful of a person's position, yet familiar at the same time.

"I heard about the assassination of Congressman Khan. I remember meeting him when I addressed Congress; he struck me as a good man. I sent condolences to his family and issued a statement condemning the extreme fanatic partisanship that is destroying American democracy.

"It is not too late for the country to pull itself back from the brink. There are a lot more people who see partisanship as an evil, and I don't just mean Bahá'ís, of which the country has many more, compared to my childhood. Our principled stand against it, to the extent that Bahá'ís have been killed in some parts of the world for refusing to support political parties, has made a deep impression on many people, and more and more every day. So I would ask you to focus on the long term needs of the country and the world. The Earth needs unity. It needs a stable common currency and economic system. By virtue of its size, the United States can lead the world into this union, or it can fight the union and be left behind by the rest of the world. Your father understood that. He was a martyr for it. So it behooves you to hold steadfastly to your father's legacy and have the courage that it is the right thing to do. I know guards can't always protect you. But I've felt unsafe on Earth as well; I've gotten death threats there, too. If you let the fanatics dictate your behavior, they've won. Jesus Christ didn't give in, and his martyrdom caused his ideas to win! Stick to your principles, wisely of course. If that means working quietly behind the scenes, then do that. But inevitably it is the measure of a man when he has to choose between what is right and what is safe. The United States has too many leaders who are trying to do what is safe.

"I haven't heard anything more from Don Nielsen. I hope to videomail him today. He is a man of great integrity and principle, but no, he is not a Bahá'í, though his wife is, and so he has come to understand our peaceful, unifying approach to things. I may try emailing Justice

Hammond again; I met him briefly when I was in Washington. But my contacts are primarily with Congressmen. If you can talk to the Supreme Court Justices in your party, that may be our best hope to break the deadlock.

"Thank you. Bye." Will sent the message with a sigh. He sent a copy to Mars's Ministry of External Affairs, so they were aware of his communicatins and could reinforce them if appropriate.

He turned to the email from former President Marc Lee. During the man's two terms, Will had mostly been in touch with him through an intermediary, but over the last few months they had started to write directly. Lee, however, still preferred email, so Will opened his message.

Good to hear from you again, Will, as always. I agree in principle with your call to pull people back from the partisan brink, but in a way it is too late. Vice President Omar, by all accounts, was legitimately elected President, and his election was stolen. The investigations in four states, now--by governments held by Democrats as well as Republicans--all make it clear that the results were rigged and that the President's election committee knew it. So as important as nonpartisanship is, right now a big push by me would look like a sign of weakness and an admission that we were wrong. We clearly were not wrong and we can't let this injustice to stand. You support justice too, don't you? Then you will understand.

It was signed "Marc" so Will took that as a positive sign that he could respond. He hit reply and dictated his message:

Dear Marc: I have already said quite clearly in several public statements that the results of the four state investigations must be respected and allowed to run their course, without

interference by anyone, including President Peters. I would never ask you to equivocate about that. But what must be upheld are legal means for settling the dispute. Violence by both sides needs to be continually condemned. Peters has been stirring it up, no doubt; but you can't condemn his actions and do the same. You must occupy the high moral ground, and not just look like you occupy it, because people eventually will see through that, even with all the balkanization of the media that has occurred. An adherence to moral principle is the only thing that will save the country right now; otherwise people will pay lip service to principle and debase their behavior more and more for short-term gain and greed.

America's brightest moments in the past have been the times it did what was right; it freed the slaves, fought Naziism, rebuilt Europe, and founded both the League and the United Nations, to name a few. It tries to live by its principles; indeed, the entire history of the country can be seen as a struggle to live up to the ideals defined in the Constitution. And the Constitution does not mention political parties. The Federalist Papers decried partisanship. You know this, even without reading my dozen references to the subject. So please, Mr. President, adhere to the ideals of the Constitution and repeatedly and continually call on the American people to uphold it. Even the open defiance of the federal government by half the states can be framed in legal terms.

If the rule of law fails, there will be a civil war, but it won't be of one block of states against another because the states defying the federal government are scattered. It will be a civil war of one state against another, one city or county against another, one neighborhood against another. This has already started to happen and it is creating chaos and terrorism everywhere that no one can control. Congressman Khan was assassinated as one part of it. All congressmen

and judges face death threats. Hasn't this gone way too far? Martin Luther King did not call for violence to oppose violence; he called for nonviolence and love, and look at the change he produced. This is what a statesman can do, especially one who left office with a high approval rating.

--Will

He proofread one more time, hit send, and copied it to External Affairs. Almost immediately he heard a knock on the door. It was time for his meeting with Ted "Tadeusz" Bukowski and Lin Changying. "Come in!" he called, and they opened the door. "Good morning," said Ted. "We could hear you dictating, so we waited."

"Oh, that's alright. I guess I kept you waiting; I apologize for that. Come sit down. As you may have heard, I have been in communication with several people in Washington and I've been trying to moderate their approach." Will shook his head. "It's very difficult, though. It's almost too late."

"What do you think of the rumor that the Joint Chiefs of Staff discussed a coup; surrounding the White House and arresting Peters?" said Changying.

"I saw that on the *New York Times* earlier. It's absolutely crazy, but I suppose anything is possible now. Who would they turn him over to? Who would try him? And it would be considered an illegal arrest, so what would be the point? Could they actually overthrow the civilian government and suspend the Constitution? Terribly dangerous and absolutely unprecedented."

"The frightening thing is, a majority of Americans might approve of it because they'd be relieved," said Ted. "They're tired of the mess."

"They are. Sit down. I'm sorry these meetings of the Space Exploration Initiative leadership are so useless."

"There's not much we can do right now," agreed Changying. "We've connected Sri Lanka and Tanzania together; both wanted to do mission to a near-Earth asteroid. Now they're working together on a joint mission, which saves them both money. Nigeria's asteroid belt mission appears to be saved, mostly because their crew is already at Ceres and we were able to arrange some incentives for them to continue their mission."

"Free propellant and supplies," added Ted. "The Asteroid Studies Department at Martech-Ceres really didn't want to lose the mission."

"And we've managed to keep Helia going pretty well," continued Changying. "That has been our big effort. The U.S. has officially pulled out, but they are continuing to fund the fusion engine research at Los Alamos on the grounds that it'll lead to more compact and efficient fusion reactors, which it will. They've transferred funding to the life support systems research to Goddard Station because it's officially a U.S. station; the only one on the moon. So that research is continuing and is being coordinated with Martech."

"Chinese money is uninterrupted," added Ted. "That's to be expected; whenever the U.S. decreases their commitment to Mars, China sees an opportunity to increase its role. The Pluto carrier is the big beneficiary of their life support and materials research. Some of that has been transferred to the carrier *Sedna* and to carrier manufacture in general."

"That's important," said Will. "Any news from India about the Makemake expedition?"

Ted shook his head. “No, it’s still suspended. The Russian expedition to the Trojans at Jupiter L4 is postponed one year and is still supposed to leave from the Earth, but I suspect they’ll postpone it again. The world economy is still dropping.”

“Yes, sharply.” Will shrugged. “There’s only so much we can do. Helia, at least, is still chugging along.”

“Under Marsian leadership,” said Changying. “We want to talk to you about that. We met with Crystal yestersol to review Mars’s plans in the light of all these changes. She said she planned to recommend to Helmut that Helia be organized here with its own planning commission. The idea is to force everyone to make some sort of commitment. Ted and I said to her that we’d like to be considered as joint Commissioners.”

“Really?” Will thought about it and smiled. “I’d be really sorry to lose the two of you, but the Space Exploration Initiative is virtually dead anyway.”

“We could probably continue for a time because there’s no significant conflict of interest,” said Changying. “It’s a fourteen year job. We’d both be in our early forties when Helia is launched.”

“Would you go as Commanders?”

Ted nodded. “We think we would.”

“Any children you have would be young.”

“Thirteen, going on fourteen,” replied Changying. “We’re expecting in March. We’ll probably have just one child, so we can focus on the expedition.”

“Or a second one after launch,” said Ted. “That’d be possible, also.”

"Well, congratulations! I'm excited for you! Parenthood is a big step, an important one in adult life, and very fulfilling. I'm so pleased to see what my kids and grandkids are doing; it's very exciting, and I'm very proud of them. You will be amply rewarded, I'm sure!"

"Thank you," said Changying. "We're excited about it, too. We thought we should talk to you about this before applying formally for the position. We could continue serving as directors of the Space Exploration Initiative part time; if we both gave two mornings a week to it, that'd cover four sols out of five. Right now, that's all the work the job has, and I doubt it'll pick up any time, soon."

"I agree, the depression is too profound. There's still a lot of investment in space, but it's going to low Earth orbit manufacturing and materials research right now, not to deep space. I don't see that changing for two years or more."

"The depression hasn't hit bottom yet, and the Grand Union doesn't have the maneuverability to get out of it," said Changying. "I predict a lot of social unrest."

"No question; with rising sea level, severe floods and droughts and heat waves, chronic unemployment, and massive drug addiction, the situation on Earth is pretty hopeless," said Will. "But we can carry on four mornings a week. I'll do what I can, too, when I'm not writing people and pleading for sanity. I love the idea of the two of you leading Helia. You are perfectly positioned because of your experience and connections, and you're just the right age."

"Thank you; we're relieved you think so!" said Changying.

"We'll let you know what happens," added Ted, rising. "Thanks, Will."

"Thanks for stopping by. See you next week for another brief review of our limited progress." Will rose and shook their hands, then Ted and Changying left his office.

He turned back to his correspondence. Bart Mennea had responded. “You set high ethical standards, Dr. Will. I don’t know whether I can live up to them, but certainly I have my father’s example to remember. I’ll keep working on people. As a majority whip, I certainly have the skills! I still think about your speech before Congress. We have to do better; we have to be more courageous. Bye.”

Former President Lee had replied as well. *You make an excellent point about staying within legal bounds. The defiant states are indeed taking the Federal government to court and that needs to be emphasized more. It makes the scattered use of cruise missles a violation of all standards of decency, and polls show that the American people are coming around where that is concerned. I suspect the Supreme Court justices are feeling pressure to resolve their deadlock, too. They can end this deadock if they can break their tie. Pray that they do so before the violence gets worse! Marc.*

Will closed the email sadly, knowing that the Supreme Court could end the deadlock, but not persuade the public, because it had lost too much of its legitimacy. But it was the best solution. He hunted around for his email address for Justice Hammond, uncertain how he could say anything at all that would help. Perhaps Don Nielson could advise him.

”The pressure tunnel is now secure, *Dorado*,” reported Columbia’s Control Room. “You have permission for egress to Columbia 1.”

“Thank you, Columbia,” replied Jamison Rideout. His voice carried an eagerness that caused Fred Klass and Jeremy Wambleska to look at each other.

“Here he comes,” said Jeremy.

"Yes, here he comes.," replied Fred. "Remember, Mercedes stressed we need to be collegial and professional with him. And that shouldn't be too difficult. I'm still in charge here and he will be leading geological exploration of Kanaloa. And you're heading off to Nereid anyway."

"Yes I am; good luck with him!"

"I can handle Rideout." Fred looked at the wall screens. One showed the long pressure tunnel connecting the caravel's landing pad to Colombia 1 and they could see Jamison and two dozen others on their way to the Columbia 1 drum. "Let's go down and greet them."

Jeremy nodded and the two of them headed out of the control room and up a spiral ramp that took them to the bowl-shaped entrance area of the Columbia-1 drum. The parabolic curve of the bowl accommodated the growing centrifugal gravity as one moved away from the center, which was parallel to the surface of Triton, to the outer edge, which was tilted 75 degrees relative to Triton; it was a strange experience, even after six months, to feel the floor and the gravity tilt as one walked across the bowl. The very center of the bowl was open, allowing one to descend an elevator to the garage, the spacesuit donning area, and other egress spaces, which were not spinning and therefore had Tritonian gravity alone. Fred and Jeremy stood on the grass about five meters back from the opening, watching and waiting.

The arrival party stepped onto the elevator--which was just a big, circular floor with a railing around it--and the floor began to rise via a hydraulic pison underneath, and at the same time it began to spin until it matched the rotation of Columbia 1 when it reached the level of the bowl. They admired the grass, flowers, trees, and bushes as they opened the gate and stepped out

onto the bowl. Jamison walked over to Fred and extended his hand. “You’ve done a beautiful job finishing Columbia 1, Fred.”

“Thanks, Jamison. Welcome back to Triton.” They shook hands.

Jeremy extended his hand as well and said, “Welcome.” Jamison nodded and they also shook hands. Then Jamison stepped out of the way while the two greeted the two dozen other men and women who were rotating into Columbia 1.

“I don’t think any of you need a tour,” said Fred. “I’m sure you’ve seen the entire interior via virtual reality, and besides, as nice as it is, it’s a lot smaller than the *Seron!* That’s something we’re going to fix eventually, as I am sure you know. Supper is at 6, so you have 2 hours to settle in and explore. We’ll have the formal welcome then.”

“Thanks, Fred,” chorused the others, all of whom knew him from the flight from Mars.

Fred turned to Jamison and said, “Come to my office. Let’s talk.”

“Excellent, I’d welcome that.” Jamison turned to Jeremy and offered his hand again. “Best wishes with the expedition to Nereid. It’s a fascinating little world and will tell us a lot about the history of this system.”

“Thanks, Jamison. I’m excited by the opportunity to start our exploration of Neptunia’s second largest moon.”

“Andy Jordan’s an excellent geologist. I’m sure you will enjoy working with him. He’ll give you his all.”

“Thanks, I’m impressed by his work.” Jeremy nodded in thanks again, so Jamison turned and followed Fred across the bowl, to the spiral ramp. and to the Commander’s office next to the control room. They walked there in silence, then sat in comfortable chairs facing each other.

"I was looking at your proposed mission plan," said Fred. "It's heavily concentrated on this region. I'm surprised you don't have more expeditions proposed to other key areas of interest."

"The eruption of Kanaloa is the most important event on Triton right now. Jeremy's team has just gotten started with it, but it's time for them to rotate back to Proteus and prepare for the Nereid expedition. We need to carry on the work there, especially to drill the patera for geothermal energy. If we can divert the water flow and extract half its heat energy, we'll have 250 megawatts of electrical power. That's at least a third of the power we need to light the entire cavern."

"Yes, but we can't use that much power for a decade."

"Of course, but let's say we can obtain 25 megawatts for now. That'd be enough to build the first section of Columbia 3 and the spare heat would raise the interior temperature to the level of the Martian poles. That would gradually heat the cavern's walls, and they're going to suck up a lot of heat for decades."

"True. I'm sure you've been following our progress. The main bulkhead has worked out very well. We've been able to vaporize and pipe 1,000 tonnes of nitrogen into the cavern, so it now has a pressure close to half Martian normal. The little bit of ammonia and carbon dioxide frozen into the walls has been vaporizing and sometimes has been popping ice chunks free. So it's rather dangerous to walk around inside."

"Yes, I heard. I understand the slight air circulation is also keeping ice particles and CO2 snowflakes in the air, so it looks like a perpetual blizzard."

"Yes, exactly. We're not going into the main cavern right now, except inside a pressurized rover, because nothing is falling big enough to damage it."

"When will the second bulkhead be finished?"

"Another six months. At that point, the entrance tunnel to the cavern will be blocked off on both sides and we'll be able to pressurize it and heat it. The two drums will be in a terraformed space 250 meters by 250 meters, and 250 meters high. We'll have our own Cathedral Enclosure, essentially. That will make the two drums really useful because we can transfer the recreational space outside and put more housing and such in them."

"Raising Triton's capacity to what? Five hundred?"

Fred nodded. "About that. "

"That'll give us plenty of time for a Phase 2, involving a Columbia 3."

"Yes, that'll probably take five years. Columbia 3 will be 200 meters in diameter, but only 100 high initially, with pillars extending up to the roof to support its weight and support an insulated ceiling between Columbia 3 and the entrance tunnel By then, we'll have the cavern pressured to one third Earth normal with nitrogen and it'll be warmed up to about minus 100 Celsius. Heavy plastic curtains will be sufficient to oxygenate and heat sections of the cavern, one at a time."

"I know, I've been following the plans very closely, day by day, as they have developed. Twenty years to extend a ceiling over the entire cavern strikes me as unnecessarily pessimistic. I know you're commander here, Fred, and I'm just here in my capacity as Director of Surface Exploration. I've asked Mercedes to be here permanently. She has said no, and I respect that. She wants to dampen my enthusiasm, and I can understand that. But you can be sure that I will be

following all the plans for Columbia cavern very, very closely. I have the right to do that, and I know my place, as it were, in the governing structure. But be sure I wll be active in suggesting improvements, innovations, and ways to speed up our plans. We have a resource here that nothing anywhere else can compare to, on a world that is nearly unique; only Pluto can compare, and this place is bigger than Pluto. I want to see it succeed."

"Of course, and I appreciate that. Columbia cavern has really grown on me, too, so I understand. We just need to keep the plans in the context of the development of the entire system. If we heat and pressurize the cavern too quickly, we could cause a major roof collapse, so we have to be smart. I agree with you about installation of the ceiling; with robotic building techniques, we can cover it with supports and insulation in perhaps ten years. But oxygenating all of it? That requires 100,000 tonnes of oxygen. Triton research really can't absorb more than 100 scientists; add support personnel and we're talking about 800 to 1000 people tops. They can take their time to oxygenate and heat the cavern."

"I agree that Triton's entire need is for maybe 1,000 people at the most, and the entire Neptune Commonwealth, maybe double that. But you can say the same thing about Saturn, Uranus, Venus, and Mercury, and they're all dreaming about the day when they'll grow to 5,000, then 10,000. The issue isn't what the system can support with Helium 3; it's how many can we convince the Earth or Mars to send, because once they're here they'll be part of our economy, and that economy will be largely self sufficient. There's no reason for Neptunia not to grow to 10,000. But why should 1,000 be here and 9,000 on Proteus? Why can't both grow equally? Or for that matter, why can't Triton grow to be larger than Proteus? Mars has the same issue with the Central Highlands versus Aurorae. With fission engines and ample hydrogen--Triton can

make all we need, using geothermal energy--transportation between Triton and Proteus will be reasonably priced."

Fred shrugged. "Perhaps you're right, and I do appreciate your enthusiasm, Jamison. Triton needs a booster."

"Well, that's me."

"Just keep it in the overall context. Otherwise, the pressure will be counterproductive."

"I assure you, I'll try." Jamison nodded to emphasize his assent. Fred nodded too, but with more skepticism.

14.

Breakthrough

August 2085

"I'm glad you were able to join us, Will," said Helmut. "You know a lot of the principals down there."

"Well, not so much. In the last few months I've emailed and videomailed a lot of them, but they haven't always responded. But I also know about a few other efforts behind the scenes, such as Don Nielsen's quiet, patient lunches and coffees with seven of the eight Supreme Court justices. Since they lack a Chief Justice and the justice with the longest tenure was not able to fill the vacuum, he was working very quietly and kindly with all of them, listening and asking questions rather than arguing or pleading."

"And that broke the deadlock?" asked Rory Mayerovitch, Helmut's chief of staff.

Will nodded. "It seems to have flipped one of Peters's supporters and created the 5-3 Supreme Court decision to throw out the 2084 presidential and congressional election entirely, re-run the election this November, and declare both the position of President and Vice President vacant."

"It helped, though, that the Speaker of the House was from Peters' party," noted Helmut. "They got to keep the Presidency."

"That became a kind of compromise, too," said Will. "Because when you throw out three senatorial elections and declare them vacancies, the other party got a 49-48 majority in the Senate. The nullification of some congressional elections did not flip the House of Representatives, however. As a result, Peters' party keeps the presidency but loses the ability to

pass legislation without support from the minority party. And the public is so disgusted and disillusioned, Peters appears unable to win the second election, and the three Senators whose elections were thrown out may not be able to win the second election either. So most likely, Omar will be the next president of the United States, and he'll probably have a Senate majority, though not a majority in the House."

"Foreign Minister Indira does not particularly like him," said Helmut. He turned to the screeen, where they could see her in her office on Earth. "I hope Indira speaks up about that point in 25 minutes!"

"I agree," said Will. "I wrote him a very general, friendly email and got a canned response, like I was a constituent or something. He's a bureaucrat and a politician, not a statesman. But America no longer has statesmen available; the rigors of running for the presidency are too great, the honest ones won't put themselves through it."

Helmut glanced at the screen showing a live image of the White House. They could clearly see the damage to doors and windows caused by the assault of the Marine squad. "I'm afraid Peters is a good example."

"Yes. I was surprised acting President--or just President--Stratford would order in the troops to arrest Peters after just 12 hours. I have sent him messages as well. When he was elected Speaker of the House back in January, I congratulated him and commented about the difficult job he faced and he responded warmly. But when I wrote him a month ago he did not respond. Yestersol I congratulated him and wished him well as president and he hasn't responded yet, but he's probably overwhelmed by messages."

"He hasn't responded to me, yet, either," agreed Helmut. "Indira has a generally positive view of him."

"Yes, so do I, but it's shaped more by the media and by comments I've heard than anything else. I think he's making a big political gamble: he wants to argue that Peters' message was largely right, but he was incompetent, and he'd do a better job. Nearly half the American public supported Peters until his implementation of his campaign platform caused the economy to tank. The campaign promises were the direct cause, but Stratford wants to say the campaign promises were right and a different approach to implementation will work better, then he'll promise small efforts. He wants to be President."

Helmut nodded. "Now the judicial system will deal with Peters, rather than an impeachment process, and Peters probably can't run for President, so Stratford might be the logical pick. That's what everyone says."

"So, which would be best for Mars?" asked Rory. "Stratford or Omar?"

Will shook his head. "Omar will continue President Lee's policies of cooperation, which is good. Stratford probably would do so less. But either way, the economy is tanked and it won't recover for years. The U.S. has to rejoin the world dollar, and it isn't doing very well, either; the entire world economy is in a depression and there's unrest everywhere over the extremes of wealth and poverty."

"No government has money to devote to space travel," agreed Helmut, interrupting Will. "The wealthy are still wealthy and will invest some of it in low Earth orbit, but governments are being demanded by their people to solve social problems."

"Drug addiction in particular," agreed Lily Estrella. "We have to turn away nearly half the applicants to emigrate here because of past serious drug abuse. It has become so widespread in the last ten years, it is shocking."

"With all the problems that follow," said Will. "A lot of kids are being raised by robots because their parents are high. No one is fixing the problems, either; they continue to get worse. So Stratford versus Omar is a short-term question. Long term, Earth is not a reliable partner for space exploration."

"So: ignore them?" asked Rory.

Will shook his head. "Partner with them when we can and grow this place so we can manage without them if we have to."

"Immigration and greater self sufficiency," said Bao-zhi.

"I think so. In short, your current policy is right," said Will. "But we also need a policy of encouraging Earth to reform along our lines: elections without parties, campaigning, and nominations; priority given to education and health; better planning of economic development; laws to decrease the extremes of wealth and poverty; and an emphasis on the old-fashioned virtues of service and honesty. Without a focus on ethics, the rest won't work. And once the leaders are ethically tainted, it's hard to repair the damage, because that sets a standard of behavior. Most of the religious communities on Earth are tainted, too, so they can't be examples or set high standards."

"How are the Baha'is doing?" asked Helmut.

"Times of high social crisis tend to be times of rapid growth of the Baha'i community, but we're still too small to have much of an impact on Earth as a whole. Generally, the religious

communities up here are healthier; more open to dialogue, more focused on ethical behavior, and better led than the same communities on Earth. That may be a function of our high level of education and professionalism."

"I think it may be time for us to stress values more," said Helmut.

"And if we are more self sufficient economically and in space policy, we won't get as much pushback," said Rory.

"But we also have to be concerned about being consistent," said Will. "Any ethical lapse on our part will undermine the impact."

"And there will always be lapses," said Rory.

"But that's not a reason to ignore values," said Will. "On the contrary, they must be upheld and talked about consistently. The response to a lapse is the key; if it is detected and corrected quickly and clearly, the ethical position is reinforced, not undermined. A bad response to an ethical lapse is just a second ethical lapse."

"This doesn't strike me as a wise policy," said Bao-zhi. "I can't see that it will change the behavior of any politicians. It'll just make some of them angry. We'll come off as arrogant."

"I think the goal is to sway the populous," replied Lily. "And I can see this dovetailing perfectly with our immigration policy. We have been selling Mars to immigrants for almost fifty years based on the claim that our society is exciting, forward-looking, progressing, and fair."

"Exactly," said Will. "This is a long-term policy, and with our fiftieth anniversary coming up in six months, this is a perfect time for an emphasis on values."

"I agree," said Helmut. He glanced at the image of the White House. "That may be the best way, long-term, we can help Earth."

Fahim maneuvered his virtual reality body close to the rock outcrop and focused his virtual eyes on the rock. He zoomed in; it was crystaline rather like granite, with quartz, micas, and feldspars. He commanded a laser flash and the laser slowly built up power, then zapped the rock. The reflected light confirmed the mineral content; typical of Venus highlands and the two proto-continents that had started to form in Venus's oceans before they boiled away and Venus geology changed forever. It wasn't what he was looking for. He reached out with his robotic hand and snapped off a sample. In a few weeks he'd send down a flying probe to pick up several kilograms of samples and fly them to Daedalus.

He looked around for the next outcrop they had identified. It was 50 meters away; he zoomed in on it to verify it and gage the distance. Then he spread his rover's wings and flew over, an easy thing to do in the dense Venusian atmosphere. He landed three meters from it on all four little feet and walked over; he still didn't have four-legged walking down. But he had gotten better than everyone else, partly because the geologists at Magellan station had to deal with a quarter second delay, while his delay was mere milliseconds when the signal had to be relayed to a low-orbit communications satellite, and instantaneous when they were floating overhead. He had come to enjoy greatly virtual reality geology on Venus, and after a century of technological development, the mechanical, electrical, and electronic systems had been developed pretty well to operate at 460 Celsius.

The rock was unusual, as had been suspected. He had been hoping to find a rock like this one for weeks; it had broken off a steep slope nearby and rolled down to the lava plain where the rover was exploring. He zoomed close and saw that it was a mix of particles from sand and

gravel to boulders, all cemented together and then baked for several billion years in the oven that was the surface of Venus. But more important was the gradation of particle sizes, from coarsest on the bottom to finest on the top, all over 3 meters of distance. With the rover's sharp eyes he could see the distant top as easily as the bottom of the boulder. The rock fragments were angular, too, as expected.

Just then there was a beep. "Fahim, Pauline and Patrice want to have an important conversation with you and Mary in five minutes," said Nando.

"About what?"

"They didn't say; just that it was urgent."

"Okay, can you map this rock outcrop for particle size, zap it, and grab some samples of the angular rock fragments larger than 10 centimeters for me? Where's Mary?"

"Upstairs working on the garden."

"Thanks." Fahim pulled off his virtual reality helmet and gloves, stood up, and headed up the spiral staircase to the interior of the balloon. Mary had been filling a series of plastic trays on the sunny side of the balloon--they made sure it was oriented so that the area got a lot of sunlight--with simulated soil. It was a mix of one hundred kilos of Venus dust pulled from the atmosphere and cleaned of sulphuric acid, a dozen kilos of crushed basalt they had hauled up from the surface, activated charcoal they had made from carbon dioxide, and their own fecal material, "composted" via a special process so that it did not resemble or smell like the original. "How does the garden grow?" he asked her as he approached.

"It's coming along." She pointed. "The mint has transplanted pretty well, so we should have some for tea in a month."

"Good, because you are using up the coffee too fast."

"Well, you're using up the coca-cola syrup too fast, too!" She pointed. "The tomatoes and broccoli have come up, but they won't give us anything for a while. And the canteloupe; you'll like them." She pointed to tiny seedlings. "How's the geology?'

"Looks like I found another chunk of turbidite, but it rolled down from higher up, so I'll have to fly up there and look for the source."

"That'll be solid proof of deep water conditions, if your theory holds up. Pretty good for just two weeks of work!"

"I'm sure there will be other discoveries, too. We've explored so little of this planet! We have a lot to find. So, what do you think this is about?"

"I haven't the faintest idea. I got an email from Bill a little while ago; even if Elliottville is tiny, he is privy to all the emails that go out to borough councils. He said Helmut's planning a big announcement on Sunsol about Earth."

"I was surprised Pauline was so strong in her comments about partisanship and contentiousness. You'd think it'd jeopardize the funding for Daedalus 2."

"The Scandinavians and Swiss agree with her, though, and ESA wants to spend money on the Venus Commonwealth, even if they thought this mission was premaure. Daedalus 2 is keeping a lot of their engineers employed right now."

"That's true; they design, we build." He looked around, then up. "Looks like they've raised the top of the balloon."

"Yes, by an entire additional meter, which means they've added another 1 tonne of liquid carbon dioxide ballast. I guess we can schedule more flights to the surface to bring back more crushed basalt. We could cover a pretty big area in here with 'soil' eventually."

"The balloon has enough lift," agreed Fahim. "It'd be nice to have bushes or even small trees in here eventually."

"Oranges would be nice!"

Just then their communicators beeped. "Here we go. Let's sit and be comfortable." He pointed to some flimsy plastic chairs around a plastic table near the center of the balloon's floor, so they walked over and sat, then Fahim connected the call.

"Good afternoon," said Pauline. Patrice was sitting next to her, and that worried Fahim. The Chief Minister and the Director of Spaceflight were a powerful team, so the topic had to be urgent. "We felt we should contact you right away about something. The mission is going very smoothly; everyone is very pleased. But there is a potential problem." She turned to Patrice.

"Now that you have arrived and the liquid CO2 ballast has been replaced by the Perergine, we have run some simulations, and we have a new supercomputer with AI enhancement to do it," said Patrice. "It has detected a weakness in our escape protocols. If the balloon suffers catastrophic failure as a result of a severe storm and extensive lightning strikes, it is possible the Daedalus's stabilizing jets would be unable to give you the minimum of 90 seconds you need to evacuate to the Peregrine. The scenario involves a complex sequence of events that includes loss of ballast in an attempt to get above the storm, thereby decreasing the liquid CO2 available for the stabilizers. The estimated risk to the mission is one in 650."

Fahim stared at Patrice. “Alright. One in a thousand is the acceptable level of mission risk. Are you proposing to abort the mission?”

“No,” said Pauline. “Thast’s a joint decision, not a unilateral one. The risk is small. We’re still looking at mitigation strategies.”

“We can avoid stormy areas,” said Patrice. “That decreases your access to the surface, though, because you may not be able to fly over target areas when you want to, and it decreases the options for releasing driftsondes. Another alternative is to let out the balloon and fly higher.”

Mary shook her head. “It’ll be cold in here, and harder to breathe.”

“Well, we could replace some of the nitrogen with oxygen to maintain breathability, and if we heat the interior, you’ll have more buoyancy and it’ll be comfortable. That’ll get you out of some of the storms.”

“But not all of them,” said Mary. “The Daedalus can’t fly high enough to get out of all of them.”

“What are the mitigation strategies?” asked Fahim.

“Programming related,” replied Patrice. “Some storm avoidance if they are severe. Maintaining a larger margin of CO2 ballast for the stabilizing jets. Devoting more solar energy to them so the thermal canisters are hotter and have more power, especially toward the end of night span. Utilizing the hover jets of the Peregrine in an emergency to help stabilize the Daedalus. We haven’t explored all the combinations yet.”

“That sounds promising,” said Fahim.

“What does this do for the plans for Daedalus 2?” asked Mary.

Pauline sighed. “ESA said they’d spend two billion to the design, but support is weak. If we don’t announce this issue, we could be accused of a coverup and that will erode support. If we announce this problem, that could also erode support. Probably the best thing to do is to announce that we are concerned and are exploring options over the next four weeks, and if there is no progress, we will abort.”

Fahim nodded. “Presumably the risk over a month is a twelfth of the risk over a year; about one in 7500.”

One in 7800,” corrected Patrice. “Well within our safety protocols.”

Fahim looked at Mary. “I’m willing to accommodate that risk.”

“Me too,” agreed Mary immediately.

“Good,” said Pauline, relieved. “Daedalus 2 is looking very exciting, if we can build it. The balloon will be 75 meters across and at least fifty meters high, so it’ll have six times the lift and it can accommodate twelve to fifteen personnel. We can’t fly that many people up and down at once, so it’ll have balloon lifeboats in case of emergency. It should be able to accommodate an entire mini-fabrication facility, so materials can be flown up from the surface. It will have extensive self-repair capability. Paired with a second Daedalus 2, it might even have the capacity for construction of additional balloons.”

“So, it could grow autonomously?” said Fahim, surprised.

“Maybe. Almost,” said Patrice. “We’ll need a lot of technological investment first.”

“But we can’t be sure we’ll be able to build it,” continued Pauline. “Plan B is to send down more copies of Daedalus 1 and link them. We could dock a ring of six around your facility,

for example, and it would have the same capacity of Daedalus 2. It'd cost much less to develop, but more to deploy."

"Although it would be easier to add mass in smaller amounts," said Fahim. "Either option would be incredible," said Fahim.

"We'll certainly stay the month," said Mary. "But after that, we'll have to think carefully about what is best for the overall project."

"As you have all heard by now, we've lost our last Helium-3 contract," said Marshall gravely. looking at the other members of the Saturn Council. "That's on top of the decision of the Chinese energy ministry, two sols ago, to cancel their purchase of the Helium-3 we already have on the way to Earth. So we are 2.75 billion redbacks in the hole."

"And that's assuming we'll get paid for our share of the Saturn research we're contracted to conduct," said Shiyoko Takashima. "That's 40 million redbacks per year for our geologists and engineers."

"I am still hoping we can get some of the helium contracts back," said Iris Geyer. "Uranus has held onto one contract, but they're being paid half as much."

"That's the problem," said Sydney Kilgore. "If we get into a competition with Uranus and Neptune for sales, none of us will have enough money."

"We have no money at all, now," replied Marshall. "But the situation on Earth suggests to me that we won't be able to sell our Helium-3 for practically any price; not for five to ten years, anyway. The depression has halted all contruction of fusion power plants, so projected demand for Helium-3 is way down. Because of the supply that has already arrived, there's excess supply

over demand, so no one wants to tie up revenue stockpiling Helium-3 right now. Furthermore, some of the existing plants are shutting down or cutting back because demand for electricity is down, so many companies have switched to renewable sources. We won't be able to sell more Helium-3 for some time."

"What are our cash reserves?" asked Tomas Racan.

"One point five billion," replied Shiyoko. "That includes Helium-3 stockpiled on Mars, deposits for shipments on the way, forfitted deposits for canceled contracts, and the worth of the shipments en route."

"It's a year and a half of cash flow that will probably need to stretch for five or six years," said Marshall. "I've already talked to Rory Meyerovitch, Helmut's chief of staff. Mars will cover the cost of our existing flights between Mars and Saturn; the vehicle leases, propellant, and upgrades. We can get people and cargo here, essentially for free; that's a half billion redback annual subsidy right there. They will do the same for Uranus and Neptune. It's essential for making our settlements viable. His recommendation is that we devote the rest to raising our self sufficiency level, especially the production of electronics and vaccines. We'll have to continue importing uranium, americium, and other radioactive materials and some rare equipment and spare parts, but we can manage that on a thin budget."

"We can now make an amazing range of things," said Gwangya Kwok, their Director of Fabrication. "We could probably manufacture an entire caravel if we needed to."

"I'd rather avoid something like that," replied Marshall. "Certainly, though, we can repair and upgrade a caravel. The electronics we need to import for that task are light weight and relatively inexpensive."

"The design for the Rhea drum involves a lot of imports," noted Iris. "But we could substitute."

"Definitely," agreed Gwangya. "It's supposed to be outfitted with six rocket packs to fly it from Enceladus to Rhea. But once it has arrived there, we can dismantle the rocket packs and ship them back to Enceladus for use on the Mimas drum."

"We can look closely at other propulsion systems," added Tomas. "We've scattered them all over the Saturn system delivering probes, satellites, and rovers. But we could bring most of them back to Enceladus and refurbish them."

"Definitely look into that," agreed Marshall. "Especially the electronics. Our three-d printers can make tanks and engines pretty well."

"We have two missions scheduled for launch to Chariklo and Hidalgo in the next three years and we'll never recover their propulsion and power systems or electronics," said Tomas. "Those are ten-year missions, over a billion kilometers from here. Should we cancel them?"

Marshall considered, then shook his head. "No. We have contracts with several space agencies supporting those missions. But if they bail out, maybe we should."

"We could fly them on our own," added Christine Niehaus. "I'd favor us doing so."

"And we're continuing with the plans to plant 50-meter drums on a series of satellites?" asked Iris.

"Yes," said Marshall. "We're receiving the immigration to set up boroughs on all the major moons over the next decade or so. We might as well do it."

"What about continued Helium-3 extraction?" asked Iris.

"I'll talk to Uranus and Neptune. Certainly, we want to continue the annual flights down to the aerostat to drop off new probes and driftsondes. We might as well pick up the Helium-3. I suppose the question to consider is whether a cutback in Helium-3 extraction will allow the aerostat's reactor to work longer. We won't be able to replace the aerostat in three years, as we hoped."

"We've got to repair it before we lose it," noted Iris.

"That's scheduled for next month," replied Marshall. "How much reactor life is left?'

"Ten years," replied Iris.

"All of our current plans can and should go forward," said Marshall. "We can't get supplies to enhance self sufficiency for two years, anyway. The Enceladus C-100 has to be finished, the Rhea drum should move forward, the expansion of Cathedral should continue. We need to focus more on wind and geothermal energy because our uranium supply has to be imported, but for our current purposes, both Titan and Enceladus have inexhaustable energy sources, and Rhea can use giant solar collectors. We have satellites orbiting most of the major moons and robotic rovers on their surfaces. We can continue those efforts because we have the spare parts for them. What I do want is a review of our self sufficiency status. What can we make now that we are importing instead? I am sure we can increase our self sufficiency even with our current infrastructure. The second question that follows, then, is what equipment do we need to import to increase our self sufficiency? Gwangya, these are questions that fall in your area. Can you tackle them?"

"Sure, but I'd appreciate Shiyoko's assistance. We'll need to figure out how much to spend. There's also the problem that Mars may not have some things we need for self sufficiency

and they can't get the equipment from Earth before the next flight for Saturn leaves Phobos. There may be some items that we can't get for four years."

"I suspected that would be the case, so get everything you can. There's something else I need to tell all of you about." He paused and took a breath. "I'm publishing an op-ed in the *New York Times* in a few sols about the situation on Earth."

"Similar to your father's recent comments?" asked Tomas.

Marshall nodded. "Yes. There's a campaign that's about to start to educate Earth in Mariner values, specifically where elections are concerned. My father has been appearing on news shows lately and has written several commentaries. We'll start hearing from other Mariner League communities soon and from the Marsian Commonwealth as well. Maybe even from borough C.E.Os. I'll be speaking as Chief Minister of the Saturnian Commonwealth."

"Will this generate a backlash?" said Iris, worriedly.

Marshall shrugged. "We really don't know, but what backlash can it generate? We've lost our Helium 3 contracts already. I suspect it'll generate criticisms of us. That's why all the Mariner League members are going to speak up; safety in numbers."

"I can't imagine it'll sway politicians, though," said Tomas.

"I agree. Our goal is to make a slow, long-term impact on the culture. We're going after the masses, not the leaders."

"That's certainly needed," said Iris. "But I think there are limitations to applying our values to Earth. Even Mars is no bigger than a medium sized city, and its entire population is educated, employed, young, and has been screened for psychological and substance abuse problems. They are not representative."

"That's true, but we aren't expecting an immediate change in culture. The solution to automation is not banning robots, but providing everyone with education and training so they can contribute to an automated society. There are countries on Earth that are doing that. And there are political units that do not have political parties, such as Nunavut and Northwest Territories in Canada. We aren't the only models. I gather my father had been talking to them as well."

"It'll be interesting to see what results," said Tomas, skeptically.

15

The Langlais Doctrine

Sept.2085

"People are going to be watching this speech from Mercury to Neptune," noted Tad Lind to his friends Vahid and Tahirih, whom he and Susan had invited over.

"But the real question is, how many people will watch on Earth?" replied Vahid.

Tad shrugged. "Who knows. The speech is for the politicians and space agency bureaucrats, anyway. Helmut Langlais is redefining Mars's relationship to Earth based on its chronic and ongoing instability."

"Is that all he's doing? Or don't you think he's likely to comment on the conditions of terrestrial society?"

Tad was startled by that. "I don't know. What makes you think he might?"

"Because Will Elliott has been on a campaign to talk about the problems of terrestrial culture, lately, so they are front and center off-Earth. Helmut's almost certainly going to say something along those lines as well."

Tad considered. "I suppose he could."

Vahid nodded. “You can be sure of it.” He didn’t want to say that Helmut’s chief of staff had alerted the Councils of the Mariner Commonwealths last week and urged them and their Chief Ministers to issue similar statements as well, and Anand had prepared one.

Just then, the broadcast cut away from the *Mars This Sol* news anchors to Helmut’s office. Helmut Langlais sat at his desk, a huge live image of Mars from Phobos behind him. “Good evening, fellow citizens of the Marsian Commonwealth. Ever since human beings first walked on the Red Planet--fifty years ago, this February--Marsians have looked back at their home world with mixed feelings of love, sadness, confusion, and grief. The last half century has seen calamaties the like of which humanity has never seen before: two incidents of nuclear weapons terrorism and one intentional destruction of a nuclear power plant, the release of a biological weapon of terror that killed a hundred million people, a computer virus attack that wiped out most of the computers in North America and many on Mars, a nuclear war between China and the United States that killed tens of millions directly or indirectly, the collapse of a world currency twice, two major economic depressions, innumerable assassinations of prominent leaders, a major volcanic explosion and two-year nuclear winter that caused a hundred million or more deaths, and all the time sea level has been inching up for a total of two meters since the turn of the century. It has been a terrible time for humanity, a series of calamities that, by and large, we have brought on ourselves. Even sadder is recognition of the fact that humanity has not yet turned the corner. Terrorism is continuing, depressions will continue to occur cyclically, the threat of nuclear conflict is as great as ever, international mechanisms for stabilizing the mess are still weak and tentative, and billions are sinking into a hopeless state, unable to find meaningful work, often addicted to the latest recreational drug.

"Simply recognizing this reality is the first step in bringing about a change in conditions. For those of us living beyond the moon, it behooves us to take several measures for our own survival and to guarantee that we can be of service to the cradle planet of our species. First: To protect ourselves, we must move toward substantial self sufficiency. It is a fundamental characteristic of a stage 2 civilization--one that exists on more than one world--that the species can survive if one world totally collapses. Such a complete collapse is not impossible for Earth. The conditions there are that dire. Consequently, Mars must be prepared to provide the sustenance needed for itself and the Mariner outposts scattered across this solar system. Over the last few months we have examined our state of readiness and have prepared a plan that, within four years, will establish on Mars the ability to make machinery, electronics, vaccines, and other high-tech items. Martech is reviewing its capacities to remain a cutting-edge source of innovation even if its collaboration with terrestrial universities is greatly reduced or lost. We are prepared to maintain biennial flights to all the planets and possibly even to the moon if the latter world also needs our assistance.

Second, Mars will maintain its immigration at the highest level possible for the forseeable future. That means immigration waves surpassing 100,000 per columbiad and a planetary population that will exceed a million by the end of this century. With a million people in an advanced AI robotic economy, Mars will be in the position to maintain humanity's expansion into the solar system and beyond to Alpha Centauri, with or without terrestrial participation. We will also be able to assist the Commonwealths of Mercury, Venus, Saturn, Uranus, and Neptune--and even Jupiter, if it wishes--to grow to 5,000 or more each, by 2100. At that size, with their own AI robotic economies, they will be able to support most of their own needs even

if Helium 3 sales remain small. Phobos will grow to 10,000 or more if exports to low Earth orbit are able to continue. Ceres will also exceed 5,000 people, thereby putting it in the position to lead its own expansion into the Asteroid Belt and possibly the founding of other boroughs there.

Third, Mars will not forget Earth. Ours is not a perfect society; not by any means. We have divorce, a lot of personal psychic suffering, and a lot of threats to our continueed existence in a very hostile environment. But we do not have serious crime, terrorism, or political and economic instability. We like to say that this is because we can't afford these threats and thus we have eliminated them, but the reality is, *Earth can't afford them either.* The key, we think, is our election system, whereby no one has the right to influence the vote of anyone else.

"By abolishing nominations and campaigns, we have abolished the principal source of corruption and personal ambition in our election system. This breakthrough is as important as the United States democratic system was to a world of monarchs in the 1790s. At the time, America's founders had no idea whether their system would work, but 175 years later it had become the model for a wave of democratization that swept the Earth. We are confident that our electoral innovation is equally significant and as a change of culture occurs on Earth, our system will be a major solution to your problems. Mars and the Mariners are not alone in this belief. Two Canadian provinces--the ones dominated by First Nations Peoples in the far north--do not have partisan elections, either. Various cities in North America have eliminated partisanship as well in their elections. They have a ways to go--they still permit campaigning--but they are on the right road. We hope that cities, towns, provinces, and entire nations will look at our system and figure out ways to adopt it in stages.

"But our political system does not operate in isolation; it is also tied to our economic system, which funds education very generously, thereby creating a creative and informed electorate. It's a system that allows free movement of labor, so people can work three part-time jobs if they want. It's also a system that is fairly flat in its economic distribution so that we have no poor Marsians. Such a system will give meaning to billions of lives on Earth, thereby restoring human dignity. But it will not be easy to attain because of the extremes of wealth and poverty that have been allowed to form and become daily more extreme. Earth cannot grow itself out of the problem in less than 300 to 500 years, which is too long for most people today. The solution will require a much more progressive income tax system and other incentives that will make wealth available much more widely. This means the wealthy, inevitably, will become less wealthy. Any attenpt to make this change with violence will destabilize the entire system. The history of revolutions is clear: when an elite is crushed or forced from its position of wealth and power, it is replaced by a new elite. In some extreme cases, it was replaced by poverty by everyone. We Marsians and Mariners cannot help you much, except to point out that we are an example of a more equitable society that also grows, is innovative, generates wealth, and creates new companies and organizations. We are not the only example of a society that is economically more equitable and functions well; there are quite a few on Earth.

"To sum up, Mars is not proposing to isolate itself from Earth. We will continue to import and export and seek a greater flow of trade, not a lesser flow. Rather than isolate, we seek to insulate; to protect ourselves from the extreme fluctuations of terrestrial society while we grow and continue to innovate for the common good. We seek happiness, stability, and prosperity for

our home world and for all of humanity. We will contribute to those attainments any way we can while we pursue our own destiny to take humanity to the stars. Thank you."

The image cut from Helmut's office to the two news anchors, Jacaranda Chamberlin--*Mars This Sol's* expert in Marsian government--and Miranda Bytown. "Chief Minister Helmut has now completed his speech," said Jacaranda. "It was relatively short and focused on four major points."

"Or five, depending on how you count them," said Miranda. "I counted them this way: insulation of Mars from Earth's instability through self sufficiency; increasing immigration to Mars to the maximum achievable; solid support for the Mariner Commonwealths and continued space explorartion; assisting Earth's political stability through our example; and continued encouragement of reform of economic and social policies."

"That sounds good to me. I have heard this speech as described as outlining the 'Langlais Doctrine' rather like the way the Monroe Doctrine defined American foreign policy in the Western Hemisphere."

"Langlais Doctrine?" exclaimed Vahid, looking at the screen, and the other three turned towards him. "What an interesting idea."

"Except none of this is new," said Tad. "Relative self sufficiency was the goal during the last war on Earth, maximizing immigration has been a priority on and off, and Mars's commitment to the rest of the solar system has always been strong."

"But this strikes me as different," said Tahirih. "This speech had a 'last straw' feel to it and the self sufficiency goal strikes me as fairly ultimate. As for immigration, the dam has

broken and immigration is no longer controversial. And a commitment to the entire solar system is of a very different character when Mars has almost 150,000 people."

"True," agreed Tad. "But immigration may become controversial again. You never know."

"Tad, immigration was made controversial by a few people who were using scare tactics," reminded Susan.

Tad shrugged in acknowledgement. "At any rate, I am not sure the 'Langlais Doctrine' should include changing terrestrial political and social policy. That's a futile effort. We'll never succeed at that."

"Well, not very quickly," said Vahid. "I don't think anyone expects quick reform. If Helmut did, he wouldn't have had a policy of insulation. I think his point is that we need to stand for principle, confident that over time, others will come to agree with us."

"Perhaps," replied Tad skeptically.

"Helmut did mention political and economic systems on Earth that are more fair and just," noted Tahirih. "It isn't just the Bahá'ís."

"I know that," agreed Tad. "Our election system up here was initiated by Will Elliott based on his Bahá'í beliefs, but it worked and has become a part of our secular culture. I suppose it might be able to spread on Earth, but there's one difference: there was no power structure up here to oppose the new election system. On Earth, it threatens the existing power structures."

"It does," agreed Vahid. "And it will prevent reform. So will the economic structure. Until the conditions get truly awful and reform becomes unavoidable."

"That's pessimistic!" exclaimed Tad.

Vahid shrugged. “I’m a long-term optimist and a short-term pessimist. Reform is possible.”

“That’s very optimistic.”

Vahid smiled. “Well, I don’t know. You reformed, didn’t you?”

Rory Mayerovitch hurried to Helmut’s office door. “Sure enough, Mariella Fsadni just entered the Chinese embassy. They were definitely planning to gang up on me!”

“Sounds like they’re *very* mad. Like an intervention.” Helmut rose and walked to the sliding glass door that gave his office access to the balcony on top of the old Emporium building, the upper floors of which housed the executive branch of the Commonwealth government. He walked to the edge of the balcony and looked down on Andalus Square. The embassies were on the other side, facing the emporium building. As he watched, Ambassador Shiva Ramnath stepped out of the Indian Embassy, walked two doors, and entered the Chinese Embassy. “There goes Ambassador Shiva. It’s a good thing you were walking across the square and saw Danforth go in.”

“So, what am I supposed to do? This will be very difficult!”

Helmut thought. “Well, let’s both go over now and join their conversation.”

“But it isn’t protocol for the head of government to visit an embassy. That’s why the Chief of Staff--in the absence of the Minister of Foreign Affairs, who’s on Earth and unavailable--goes instead.”

“Well, we’re a bit more informal up here. Elliott was willing to go to embassies occasionally. Besides, when we’re done, they won’t want to talk about the event.” Helmut

walked to his door, where he grabbed a coat and tie; he rarely wore the latter, but he put it on, then added his formal coat. Rory made motions to straighten the tie, so Helmut pointed and the Chief of Staff fixed it.

"We'll be half an hour early."

Helmut smiled. "Good."

They headed down the spiral ramp to the emporium level--still full of restaurants and small stores--and onto Andalus Square. Once Mars's largest public space, it now looked a bit quaint and old, partly because the construction techniques had advanced a lot. They marched across the square and rang the doorbell of the Chinese Embassy.

The receptionist tried not to look startled. "Oh; Dr. Rory, you're a bit early."

"We saw that this was quite a large gathering and thought we should participate," replied Helmut, with a smile.

"I see. Please make yourself comfortable." She pointed to the alcove next to the entrance and headed up the stairs--the Chinese did not believe in ramps, they wanted the formality of a grand staircase, especially after the Americans had done the same. The sound of agitated conversation faintly drifted down from the ambassador's office. A few minutes later, the receptionist hurried back down. "The ambassador is ready for you."

"Thank you." Helmut and Rory rose and followed her up the stairs. The Ambassador's office was fairly crowded; Ambassadors Arthur Danforth of the United States, Mariella Fsadni of the European Union, Shiva Ramnath of India, and Zhao Tao of China were joined by Charge d'Affairs Ichiro Otsu of Japan and Elena Morales of Brazil. "The gang's all here," said Helmut,

as he sat. Everyone stared at him and Helmut couldn't tell whether they felt guilty at being caught, or angry.

"Welcome, Chief Minister Helmut and Chief of Staff Rory," said Zhao. "This is a most surprising little meeting."

"Perhaps next time we could arrange a neutral location, like the Aurorae Hilton or the Aurorae Interplanetary," suggested Helmut, the latter being the city's hotel in the Intercontinental chain. "How may I be of assistance to you?"

"Chief Minister Helmut, one major concern we have is that this so-called 'Langlais Doctrine' appears to set up Mars to dominate the solar system," continued Zhao. "You have no right to do so; it is the common heritage of humanity. Your speech mentioned all the extra-terrestrial settlements, including Callisto and even the moon. My government found this shocking and offensive."

"It was not intended to be either. You may recall that I mentioned Callisto and Luna separately from the others, because our relationship with them is different. At the end of the US-China War when your economy was prostrate, who helped keep Callisto functioning? We did. All I was saying in my speech was that if Callisto or any of the settlements--including the lunar bases--need emergency assistance, we will be there. That is the Langlais Doctrine. I welcome all of your nations to make a similar pledge." He looked around. "Ambassador Mariella, how is the European Union's support for the Venus and Mercury Commonwealths going?"

"We are struggling. India and Brazil have been instrumental in supporting Mercury. We are having trouble funding Daedalus 2 and may need to stretch out the development phase. But we cannot continue the funding of Lakshmi."

Helmut nodded. "But with an interest free loan from the Bank of Mars, Ceres will complete Lakshmi anyway, and it is our hope that someone--all of you are welcome--will pay us back over the next ten years."

"We certainly can't assist, because of the Makemake Project," noted Ambassador Shiva.

"But the Indian government still has not said whether it can provide the remaining funds to complete the project," said Helmut. "We're running out of time to complete the project in time for a 2089 launch."

"I know, and I have reminded the Prime Minister several times, but the political situation is difficult right now."

"Of course; I understand," replied Helmut. "But the project will employ 200 on Ceres and 800 on Phobos, and I can't send them home with unemployment checks, so Mars will build your C-200 carrier on time. I suggest we aim for a 2091 launch instead, and meanwhile we'll use the *Makemake* as a transport for immigrants. Depending on the configuration, it can transport 5,000 to 8,000 here. If you can't contribute to a 2091 launch, perhaps Mars will undertake the mission, and will encourage Indian-Marsians to apply. That way, with minimal funding from India, you'll still have a piece of the mission."

"But why not just wait?" asked Arthur. "Is Makemake all that important as a destination? Does it have to be explored in the 2090s? Why not wait until the next century?"

"Because we're going to Helia by then, and may be thinking about launching an automated probe to Alpha Centauri in the first decade of the twenty-second century. If the United States wants to wait, Ambassador Arthur, we have no objection. But you have no right to tell us to wait."

"And you have the right to tell us how to conduct our elections?"

"No, but we can make suggestions, just as you can make suggestions about our space policy. Ambassador Zhao, did the United States ever comment about China's election system?"

Zhao smiled. "I think we can all count a few hundred comments by Presidents, Secretaries of State, trade secretaries, and other government officials about the importance of democracy and human rights in China."

"And did it do any good?"

Zhao shrugged noncommittally.

"But that's different," said Ambassador Arthur. "Democracy and human rights are worldwide movements , and have been for over a century. What you called for is a basic violation of free speech and the right to property. As such, it is an outrageous and insulting attack on the American way of life!"

"I see. A way of life that lets a few people become extremely wealthy while the rest struggle to make ends meet, and gives the wealthy the ability to market candidates and political platforms while the masses are helpless to find their own voices. It doesn't sound much better than the royalty and aristocracy that was overthrown by the American Revolution 300 years ago. But don't worry; we won't lie or bribe, just educate. So you have nothing to worry about. We have freedom of speech, too, and we will use it responsibly."

"But what right do you have to do it?"

Helmut started at Arthur. "The right of human beings who fear for their fellow humans."

"But surely that isn't part of the Langlais Doctrine?" asked Ambassador Mariella. "Self sufficiency, rapid immigration, and a safety net for the other solar system settlements: all that makes sense. But elections without campaigns and a reduction of the extremes of wealth and poverty?"

"They are all part of the Langlais Doctrine. All five points. And the reduction of the extremes of wealth and poverty hardly is controversial; that has been a standard concern of terrestrial economists and governments since the mid twentieth century. Election reform, I concede, is controversial. But I think all of you, at one time or another, have commented to me how much easier my job is, compared to a politician's on Earth. Governing here is not easy, but it is not immensely complicated by lies, rumors, threats, bribes in the form of campaign 'donations,'and high pressure bargaining. Ours is 'scientific governance,' as we like to claim. The Swiss and the Scandinavians do pretty well, too. In a different way, the Canadian Arctic is governed withour political parties, though they still have campaigning. That's a change that will have to start in small communities. We will encourage it as an official government policy."

"And we will fight it," pledged Arthur.

"I welcome that, Ambassador Arthur, because you will bring our campaign far more exposure. We have a track record of accomplishment, after all, and knowledge about our governing system is already widespread on Earth."

"I assume you are aware of the fact that we can presure Mars in other ways, such as dropping cooperation agreements with you," said Zhao.

"That's very true, Ambassador Zhao, but the problem you have is that your people are hurting and they don't want money spent on space, so you never have enough to accomplish big space projects on your own. Meanwhile, space exploration isn't just in our blood; it is our life blood, and we don't have poor people or expensive social programs to compete with our space budget. If you adopted parts of our economic system, you wouldn't have the poverty and social problems you have now, anyway, and you'd have more money for space exploration. As long as we increase our population by 35 to 60% every columbiad with young people of child-bearing age, we will have nearly zero percent of our budget devoted to the health and comfort of our elderly, too. So if any of your countries decide to drop their joint programs with us, just remember that about three years from now our space exploration budget will have doubled anyway and we'll probably be able to continue without you. This is not to say we *want* to continue without cooperation with other nations; on the contrary. But we can. This gets back to the first point of the Langlais Doctrine: self sufficiency."

"You've thought of everything," growled Arthur.

Helmut shook his head. "No, I am sure I haven't. No one ever does. But for now, this is Mars's way forward. The best way to undo the Langlais Doctrine is render it obsolete. If Earth is a stable, reliable, and generous participant in space exploration, we will have to partner with you as junior partners, because all your economies are hundreds or thousands of times larger than ours. We will have no need for self sufficiency, we will have less motivation to encourage maximal immigration, and we will be incapable of competing with all of you in supporting the other solar system settlements. In that sense, the Langlais Doctrine includes its own sunset clauses; the last two points will obviate the need for the first three."

"I appreciate your explanations, Chief Minister Helmut," exclaimed Charge d'Affairs Ichiro. "I feel much more confident in your approach."

"I do, too," said Ambassdaor Mariella.

"I'll report back to my government that the Makemake Project may be able to proceed in other ways," said Ambassador Shiva.

"I'll make a report to my government, too, and it won't be so positive," replied Ambassador Arthur.

16.

Better Odds

Oct./Nov. 2085

Fahim came up the spiral stairs to the balloon level. “Here’s another 10 kilos of crushed basalt, all washed and cleaned.”

Mary looked at his heavy plastic bucket. “That was quick! Didn’t the drone deliver it just two hours ago?”

“No, three and a half hours ago. You were so immersed in your work, you lost track of time.”

She nodded. “Kat and I were able to retrive the driftsonde with Drone 2, replace the nitrogen filter, and release it.”

“I know, I was watching the feed. Congratulations, this will help us immensely with the study of wind patterns.”

“And our safety, and similar work in the atmospheres of the outer planets.” She pointed to an empty plastic tray, newly made from Venusian carbon dioxide and water. “Pour the ‘soil’ there.”

Fahim nodded and carried the big bucket over to the 1 meter by 1 meter tray. After he poured it, the finely ground grayish rock filled it to the depth of 4 centimeters. Mary had a bucket of artificial activated charcoal ready and she added it, then poured on composed waste, raising the depth to 6 centimeters or 2 1/2 inches.

“Good, I’ll mix this tomorrow, add water, and plant greenbeans. This tray can give us a generous handful of beans once a week, starting in about 2 months.”

"They'll be good for you; I really don't like greenbeans."

"I know, dear. I'll have to try out a recipe of my grandmother's, once we have all the herbs growing. I think you'll like it."

"Maybe."

"Did you get any geology done?"

"Sending Drone 1 down, loading it with 10 kilos of basalt fragments, and getting it safely back here consumed most of my time, but I did check out a rover on Maxwell Montes for half an hour. I'll be busy from 8 to 10 tonight with the rover in Demeter Corona, too. Is supper just about ready? I'm starved."

Mary raised her voice. "Kat, is supper ready?"

"Yes, Mary, and ready to put on the table." The AI's voice came out of a nearby speaker.

"Let's eat up here. It's just about sunset and very pretty."

"Alright," agreed Fahim. He walked to the plastic table they had set up near the edge of the balloon, where they had a view of the sulphurous clouds, rendered golden in the light of a slow Venus sunset. Venus's day lasted almost 117 Earth days, but the atmosphere circulated all the way around once every 4 days and east to west, so the sun was setting in the east. When they rose the next morning it would be dark in the balloon, except for the grow lights of their garden.

Mary sat with him and both AIs brought up supper, which was lasagna and frozen vegetables. They had carbonated water flavored with orange essence to drink. "This lasagna's great," said Fahim. "Any idea when we'll have eggplants?"

"Another month. They're coming along."

"You are really enjoying the gardening!"

"It's a nice break from the meteorology, especially with Kat doing the less pleasant tasks. Besides, we're just about at the critical mass of flowers where we can bring some of the butterflies out of deep freeze and let them mature, so they can pollinate for us."

"It'll be fun to have butterflies in here. How much more soil do you need?"

"We need 10 more trays and 100 kilos of soil. After that, I'd like to make 10 more trays and fill them as well. Can you get 200 kilos of crushed basalt?"

"We can make two runs every four days, whenever we're close to the stations at Aphrodite Terra and Lakshmi Terra, so twenty runs will take 40 days."

"The carbon dioxide reducer can't make activated charcoal that fast and we're not producing the solid wastes fast enough either, so I think we can stick to one drone trip to the surface every four days."

"You'd like to cover the entire floor of the balloon with plants, wouldn't you?"

Mary smiled. "I think that'd be really pretty! But it'd take 2,500 runs and the balloon wouldn't be able to handle 25 tonnes of artificial soil. In a year we can make almost 100 square meters of ground, massing one tonne, and that'll have to do!"

"It's cool that we can recover surface materials, treat them, and grow plants in them. There's hope for this hot, sterile world after all!"

"There is. Who would have thought that the Venus atmosphere was a high-resource zone for human life? The balloon has a vast supply a solar energy, it just needs to extract oxygen and nitrogen from the air to float, you can compress carbon dioxide and store it as a liquid for ballast or run it through a thermal canister for thrust, you can extract water for drinking and growing plants and deuterium production, you can make plastic out of CO2 and water, you can fly

silicates and metals up from the surface for agriculture and construction . . .now we just have to figure out how to make this place safe!"

Fahim laughed. "That's the hard part!"

Just then, as if in response, there was a beep. "Incoming call from Venus Spaceflight control," announced Nando.

"Damn, they're interrupting supper," said Mary.

"Maybe they finally have a solution to the safety issues. Nando, can you project the broadcast onto the screen?" They had set up a screen against the outer wall of the balloon, which was gray up to waist level near them.

"Will do."

A second later Patrice Beaudoin and Pauline Augustine appeared on the screen. "Good evening! I see you're eating an early supper. I apologize for interrupting."

"We wanted to catch the sunset," replied Mary. "What have you got?"

"We apologize it's been five weeks and we promised an answer in a month," said Pauline. "There were a lot of variables to analyze, and the data about the Venus atmosphere is improving constantly."

"And your rescue of the floatsonde today was significant for planning," added Patrice. "Because it means we can send out more floatsondes to study the atmosphere around you and issue early warnings of trouble, and if they get in trouble we can rescue them, rather than expend them."

"Remember we have only two drones," replied Fahim, who had not been in favor of using them to rescue sondes.

"I know," said Patrice. He sighed. "With more aggressive use of floatsondes, more active use of their propellers to stay 5 to 50 kilometers in front of you--which is tricky because we can't predict precisely where the Daedalus will drift--more active use of the CO2 jets on Daedalus to steer around up and down drafts, our simulations suggest that we can reduce the risk of balloon loss to 1 in 950." He paused to let the number sink in.

"Not one per thousand?" replied Fahim, noticably irritated.

"No. We're not quite there, yet."

"Have you factored in use of the jets on the Peregrine?" asked Fahim.

"We have started to. It's not easy to do. The landing platform has plenty of open areas for escape of the thrust, but the anchors and hold fasts were not designed to hold the Peregrine in place when its jets are actively pushing upward. Consequently, the Peregrine is useful as a stabilizing force in a very limited number of cases, all of which carry the risk of losing the Peregrine as well."

"Ah hah."

"How many floatsondes are you proposing we keep in the air in front of us?" asked Mary.

"Three. In some cases it would also be wise to launch a drone, so it can explore weather fronts you can't avoid. We'll run them up here."

"That'll take human resources."

"Unavoidable. The other thing we'll need to do is keep the total amount of crushed basalt and activated charcoal added to the mass of the balloon under 750 kilos. Every kilo of those materials means one less kilo of stored liquid carbon dioxide, meaning you'll have less ballast and less propellant for the thermal jets."

"That's too bad," said Mary. "But is one chance in 950 'safe enough?'"

"No, it is not," replied Pauline. "We won't compromise our standards; you never do that. The other protocol we're adding is a level-1 evacuation to the Peregrine. Whenever you get in a bad storm, if the system judges an extreme risk to the Daedalus, you'll get an evacuation warning. You can always evacuate to orbit, even if we lose the balloon."

Fahim nodded. "That makes sense. I suppose that also means we should move rock samples to the Peregrine periodically."

"Definitely," agreed Patrice. "You've recovered some pretty important samples."

"If the Peregrine separates from the Daedalus, I suspect that will greatly increase its ability to handle a storm," said Mary.

"Yes, because it'll immediately rise five kilometers, and its thermal jets will have more effect with the reduced mass," said Patrice.

"Anything else?" asked Pauline.

Fahim looked at Mary, then shook his head. "I don't think so."

"I gather the upper chamber of the balloon is now filled with nitrogen," said Mary.

"Yes, twenty-five tonnes of nitrogen," replied Pauline. "So you have eight tonnes of extra lift, and you have eight additional tonnes of liquid carbon dioxide to the ballast tanks. That gives the Daedalus better margins, but it's still only enough to guarantee your safety 949 out of 950 times."

"How are the plans for Daedalus 2?" asked Fahim.

"We'll run them past you in another few weeks, but we may need an interim flight with another Daedalus 1," replied Pauline. "The money isn't there."

"That's really too bad," said Fahim, disappointed.

"We're looking at ways to save it, but if we can haul down another Daedalus 1, that will maintain momentum."

"Good, we're delighted to be pioneers for this effort," said Mary. "And what do we say to the media? We have an interview with *Der Spiegel* on Thursday."

"We'll send you the talking points," said Pauline. "Assure everyone that because you can escape on the Peregrine, your safety margin is still better than 1 per 1000, and that's what's important. We're doing everything we can to push the safety margin overall above 1 per 1000. Don't dismiss the difference between it and 1 per 950; the latter is not acceptable for the Venus Commonwealth. But if we lose the Daedalus, it's just metal and plastic; your lives are more important, and you are confident you are safe."

"Got it," said Fahim. "Thanks, Pauline and Patrice."

"Thanks to both of you, and thank you for your service to the Commonwealth!" replied Pauline. "Have a good supper and we'll talk in a few days."

"Bye," said Mary. Fahim joined her and the screen went blank.

He took a bite of his lasagna, which was now cold. "Well, we now have a safety protocol."

"Yes. I don't like having to cut back on my garden."

"And I don't like an additional burden on the drones. They're our lifeline to the surface."

"I know." Just then the Daedalus hit a pocket of rough air and rocked a bit. Their glasses of liquid jiggled, but nothing spilled. One of the thermal jets came on with a muffled roar to stabilize the vehicle.

"It's sunset," observed Mary. "There's always some turbulence here."

"I know," said Fahim.

Marshall was late for the Council meeting. He hurried from the family condo overlooking Cathedral Square through a long tunnel to Titan-1, their rotating C-200 habitat, and up a spiral ramp that deposited him in the "carrier" itself. It was spinning at 2.6 revolutions per minute, so it was easy to step onto the slowly rotating floor, which had a very slight tilt so that the centrifugal force and Titanian gravity together produced a "down" at right angles to the floor. He looked up; the entrance area of the C-200 had a remarkable view. Rising around him in all directions was a bowl-shaped park of grassland and flowers 80 meters in diameter, a paraboloid where gravity increased as one walked away from the center and the slope of the bowl got steeper and steeper. But it never felt like one was climbing upward away from the center, even though the outer edge was 50 meters above the entrance area; one just got heavier and heavier. He followed the sidewalk with a narrow red edge to it--six color-coded sidewalks headed straight up the bowl--and soon he was walking "up" a 70 degree slope, but "down" was always straight toward the sidewalk. It felt weird, but he always enjoyed the experience.

When he reached the outer edge of the bowl--which was a great public space for concerts, theatre productions, and town meetings--he cast a glance over it, enjoying it in the golden evening light the LED panels overhead were pumping out. Then he entered a door and followed a spiral ramp that took him farther outward, toward the spinning outer edge of the C-200, round and round around multiple floors of agriculture, down 60 meters until he reached the lowest level and gravity was 0.85 gees. He followed a main corridor past the entrance to Titan High School

and the Saturn Commonwealth campus of Martech to the offices of the Commonwealth government. There he ascended two stories to his office. It had large windows facing a park in the "top" half of the C-200, which had only two floors of housing beneath it. The circumferential strip, 50 meters wide and 600 meters around, had their soccer field, basketball courts, and tennis courts, all of which were easier to use in gravity approximating Earth's. Titan-1 had proved incredibly valuable to the settling of Titan. Of its 3.15 million cubic meters, they had converted a third of it into offices, classrooms, condos, and agricultural spaces, and had used the latter to make the crowded interior look open. Every family had their own small condo in a high-gravity area, usually with a window onto an area of vegetables or fruit and nut trees. The slowdown in the expansion of Cathedral had been made up by utilizing more of the interior volume of the C-200. Plans to convert the open space above the athletic areas would give them even more volume.

He hurried into the meeting space in his office. "Sorry; Willie wanted my help with a paper. I have to hurry back to hear Amelia practice the violin, too, which is still a rather painful experience. Do we have Iris on the line?"

"I'm here, Marshall," she replied. He turned and saw her image, broadcast from Enceladus.

"Excellent. Gwanya, tell us about your conversation with Mi Sanda."

"It was more than a conversation," she replied. "It was a 15-hour conference with huge time delays in between, involving us, Uranus, and Neptune. Mi Sanda had presented our self sufficiency needs to the Mars cabinet, which was reviewing their self sufficiency plan, and their resulting plan includes us. So it was the best possible result we could have expected."

"And one congruent with the Langlais Doctrine," added Marshall.

"Absolutely. The various major powers are accusing Mars of trying to exert hegemony over us. Meanwhile, none of them have lifted a finger to provide us with subsidies or assistance to protect us from possible future shortages. None of them. And the Mariner League has been contacting them all on our behalf. Mars has said it will purchase one tonne of Helium 3 from each of us per year and will pay us for it in goods and transportation services. That restores a basic revenue flow."

"That's a relief!" said Iris.

"That changes everything," agreed Gwangya. "Saturn 7 leaves Mars in March; five months from now. They have offered to add a large zero-gravity inflatable between the two galleons, giving the expedition more open space and raising the number transported to 500."

"Wow, they can do that?" asked Tomas.

"Galleons are rated to transport 650 from Earth to Mars on a 120 day flight and 500 on a 180 day flight. We're talking about a 360 day flight with a second galleon for backup. They won't be able to feed everyone with hydroponics, although in an emergency they could provide ¾ rations for several years. They can probably raise the total transported by two galleons even higher; this will be an experiment. It will enable all the outer solar system settlements to grow faster. Of course, there's no guarantee we can recruit 500 people in the next five months. Mi Sanda has also pledged 600 tonnes of cargo, but it will come separately and more slowly. They can ship us 100 kilograms of plutonium, which will guarantee us energy for ten years when our current supply is included. They are shipping as much of the specialized equipment we have

requested as they can, including their own spares, as long as replacements are on the way to Mars from Earth by the time our cargo launches. So they are being very generous."

"What else are we getting?" asked Marshall. "A vaccine manufacturing lab?"

"Yes, and a pharmaceutical lab, whether we can recruit the staff for it or not. We'll also get a chip manufacturing facility. They are saying we should hold off on the nanotechnology manufacturing facility. Right now, it'd cost us a billion redbacks. Mars itself only has one. We can buy nanotech from Mars; they have the spare production capacity. Marstech has a contract with the principal nanotech firm to produce a compact nanotech manufacuring unit that will cost only a few hundred million instead. The goal is to have the system mature for the Helia mission, but it should be ready sooner. Mi Sanda said we should think about purchasing one in about five years."

"Alright," said Marshall. "What else?"

"Sone new robotic medical equipment, a new supercomputer, and some new genetically modified plant species; they have a rice varienty that can grow in ¼ terrestrial light levels and reach harvest in 60 days, with great yield. We'll get a lot of the latest sensors to install on rovers and satellites, allowing us to study thirty more moons. We'll also get more equipment for manufacturing rockets ourselves."

"How much will all this equipment cost?" asked Rahula.

"Two billion, so it fits within the Helium-3 sales budget for two years. It'll move us very close to self sufficiency. In another two years we'll get 500 more people, pushing our population to 3,000, so we will have better human resources for self sufficiency, and with another 500 tonnes of equipment we'll have everything except the nanotech."

"And things that are just being produced for the first time now," said Marshall. "In a sense, we'll never be self sufficient, because there will always be something new that we will need."

"True," replied Gwangya. "But we will be self sufficient with ten year old technology."

"And with a larger population, we can keep up better," said Tomas. "You know that rice variety we're getting? They could send us the information about the genome and we could take our existing varieties and modify them to make that variety. With our current staff, it'd take us a few years because we don't have the spare people, but if we had twice as many agricultural scientists, we could do it ourselves."

"That's true of a lot of the equipment we're getting," agreed Rahula. "If we absolutely had to make it, we probably could. We have the capacity, but not the time."

"Well, we'll grow this place as fast as we can, then," said Marshall. "Because the situation on Earth doesn't look promising."

"Is the US even going to hold the replacement election?" asked Gwanya.

"Well, they'll hold it, but it's not clear everyone will be able to vote," replied Marshall. "There's too much unrest. They can't protect all the polling places."

"Meanwhile, the world economy continues to spiral downward," said Gwangya. "Even when the US rejoins the world dollar, the damage will be done."

"It won't be undone for several years," agreed Iris. "Our Helium-3 customers all say that there won't be demand again for 3 to 5 years."

"Fortunately, Mars can help us out in the interim," said Marshall. "Because they are also growing as fast as possible. Their economy is fifty percent larger today that it was two years ago

and will be fifty percent larger again in two years. That's the real key to our survival: Mars is growing." He looked around. "Any more questions for Gwanya?"

"How are you doing?" Gwangya asked pointedly.

Marshall hesitated. "You mean, the controversy about me on Earth? I'm trying to ignore it. The 2,000 threats of violence or death are harmless."

"You've had 2000 threats?" exclaimed Tomas, shocked.

"Yes; 2,300 as of this morning, I think. But Ivy--my AI--screens them out and just tells me the count. I don't look at any of them. None of them are from an off-Earth location, I should add, so none of them need to be taken seriously."

"But still, Marshall; that's crazy! All for an editorial about good governance published on a couple public media sites?" Tomas shook his head, disgusted.

"My father has hired a lawyer and a private investigation team because he has now gotten over 20,000 threating messages. His team is investigating every single one and sending a letter of warning to the perpetrator, and they plan to sue some of the most extreme ones. The local police won't do anything. They can't; this sort of thing has become overwhelming."

"What about the rumors and fake videotapes?" aske Gwangya. "Those must bother you."

"Well, I'm not viewing any of them. Rumors that my father had sex with an alien and I am only half human have been around since I was born, and I got used to them about 25 years ago. They're so stupid, I ignore them. But faked videos where they simulate my image and voice . . . they are very disturbing. Again, dad's people are suing for defamation whenever we can determine who created them."

"But that must be very difficult," said Gwangya. "There are so many secret groups, now!"

"Exactly. Last week there was an entire live 'interview' with my father on an anti-one-world website that was completely fake. They can get that site shut down, but some people will always believe it was real."

"Shut it down and sue!" said Iris. "The atmosphere on Earth has gotten incredibly, unbelievably poisonous!"

"It's destroying democracy because there are underground groups supporting every political party and they turn out outrageous faked videos of the candidates of the other side. Political campaigns must constantly deny statements their candidates didn't make; there's no time to get out their message. And if a candidate did make an inappropriate statement, he can deny it anyway!"

"Thank God we're here and not there," said Shiyoko. "I've almost given up trying to follow the US presidential campaigns."

"It is so confusing, even for experts, let alone the electorate," said Marshall. "Anyway, I don't want to discuss this; it's too sad. Let's go home."

"So you can hear a squeaky violin practice ," said Gwanya, with a smile.

Marshall laughed. "Exactly! I prefer it to politics!"

They all exchanged goodbyes and headed home. Marshall stopped at his desk to answer an email from his father's terrestrial lawyer, which just made him feel depressed. He hurried up the spiral stairs, which was "uphill" and "down-gravity" at the same time. As he walked "down" the sidewalk toward the exit at Titan 1's axis, his communicator vibrated with a private message.

Curious, he pulled out the phone; it was his old childhood friend, Sam Anderson, C.E.O of Thaumasia Outpost. He stopped at a bench and hit play.

Sam was a year younger than Marshall--44 years old--but still looked youthful. “Hey Marshall, haven’t been in touch with you a long time. I thought I’d videomail because I wasn’t sure you’ve heard that Maryam Islami is getting married next weekend. She’s the baby Cory and I gave up for adoption 25 years ago. Her father Ruhullah died on Earth about two years ago, so she and her mother returned to Mars last year. She’s marrying Oskar Langlais, Helmut’s younger son. It seems to be a good match. Everyone has agreed to go, which is kind of amazing; Mindy and Victor, but also Alberto, Cory’s husband, and both of their kids. It’ll be the first time we’re all in the same room together, which will be interesting. I had suggested they send you an invitation even though we all know you can’t make it, but apparently they didn’t.

“That’s most of my news. Thaumasia is doubling in size next year because we have to double our production of flourine for chloroflorocarbons. We have actually raised global temperatures a tiny but measurable amount. We also have to dig more strategic materials because Mars is moving closer to self sufficiency and we’re located at Mars’s only plate collision zone, where there are silicic igneous intrusions and pegmatites. I’m sure you remember that; we helped edit the new edition of our fathers’ Martian geology textbook! There are new wind turbines and solar panels going up along our hyperloop track because we’ll need a lot more power.

“My mom’s 88 and getting a bit frail, but she still lives in her own apartment here, with robotic assistance of course. We keep talking about her moving back to Aurorae, but she’s with us here, we have a good clinic, and with the hyperloop she could be transported to Mariner Hospital in about 2 hours. So she seems determined to stay. She’s everyone’s grandmother, so

she gets a lot of love and support. She was also invited by the Marsian Council of Churches to serve on the committee that drafted their statement about 'Christian elections'; that is, elections without lying. As you know, when it came out it generated enormous controversy on Earth.

"I saw your op-ed in the *Los Angeles Times* and read the published comments; my God, what an incredible range of responses, from fury to adulation! This campaign to condemn the lack of truth in elections has gotten incredibly angry. Even my mom has gotten some hate email, and of course she has prayed for all the people, then she writes back and tells them she's 88 and she has prayed for them. That has actually shut up most of them. I hope you are handling the craziness alright.

"Anyway, write me back when you can. I'd like to hear from you. Bye."

Sam's face faded from the screen and Marshall had to smile. They had been the first and second kids born on Mars, which was a bond they couldn't explain to others easily. He thought a moment, then hit reply.

"Thanks for videoing, Sam, it's really good to see you! We should keep in touch more often. All is well up here, Willie is 16, a year older than Vic, and doing pretty well in tenth grade. He'll be going back to Mars for university, I suppose; a rather frightening thought for us. Millie's ten and I am late to hear her practice violin. Amy is enjoying her ecological research; we're beginning preliminary work on Cathedral North, which we'll start to excavate in another year or so. It'll be a temperate climate with six weeks of winter every 200 sols. Amy's on the planning team. We're figuring out self sufficiency issues here, too, but we can rely on Mars, fortunately, thanks to the Langlais Doctrine. Starting next year we'll embark on a sort of settlement policy,

setting up C-50 drums on the other five major moons, and as the Commonwealth's population rises to 4,000 or so, they will become permanent.

"My op-ed has been widely republished, often without my permission, and you would not believe the storm it created. I think I've had 400 or 500 actual death threats and nearly a thousand others that are violent threats, but they are all from people on Earth, so they are disturbing, but physically harmless. I suppose I had better not visit Earth again, though! Dad has had it much worse. So have Helmut, Erico, Jacquie, Vanessa Smith, and several others. I hear a rich man flew up to Nunavut and offered them millions of dollars if they established partisan elections. I don't know how all this will end, on Earth.

"Anyway, best to ignore them; in a way, that's another aspect of the Langlais Doctrine. Tell them what isn't working and leave the rest to them. But let's keep in touch more often. Bye."

Sirikit looked up from the tv screen when she heard a sound at her office door. "Good afternoon!" she said to Maryam. "I'm glad you made it! Where do you want to eat lunch?"

"Sorry I'm a bit late. Everyone's distracted, this sol."

"I know." Sirikit pointed to the tv. "The bomb killed fifty people, waiting to vote."

"I heard. In some places, people were scared away from voting, and in others they turned out in droves."

"Yes, but overall, they say voter turnout was only 35% this election; the lowest ever. People have lost hope."

"Is there a projected winner? There wasn't, 15 minutes ago."

Sirikit shook her head. “No, and who knows whether it’ll hold up in court? They say about five percent of the polling places were unable to open because of bomb threats and other security problems.”

“By both sides, too.”

“Exactly. Paramilitary groups. Who would have imagined the United States would have all these groups?”

“Well, they refused to regulate guns, and that’s what results. How about the Parthenon?”

“Sure. Give me a sec.” Sirikit pushed a few icons to close screens, then they both headed out the door. “So are you nervous yet?”

Maryam laughed. “A little, and I’ll probably be panicking by Satursol morning! We’re picking up the dress morrowsol.”

“I can’t wait to see it. And you’ve got your new place all set up?”

“Yes, and all the catering arrangements for the reception are finished, and the honeymoon to Tithonium is set, and the rehearsal dinner is all planned . . . but I’ll be nervous anyway.”

“Of course, and it’ll all be beautiful. Just tell yourself: it doesn’t matter what little thing goes wrong, or even what big thing goes wrong, because it’s unimportant, because it’s your wedding day.”

“I’ll keep telling myself that!” She looked at Sirikit. “I think it’ll be fun having you as a sister in law.”

“I hope so! And I think you can help me with my one blind spot, where economics are concerned.”

Maryam frowned. “What’s that?”

"I've never been to Earth."

"Oh really? You've been to Callisto and Ceres, but not Earth!"

"Exactly. Dr. Park is a brilliant economist, but he has also been to Earth, though admittedly not for thirty years. His experience is getting old, but he still has some ground truth I don't have. All I have is television."

Maryam laughed. 'Interesting."

They reached the Partheon, were directed by a robot greeter to a table, pulled out their communicators, and ordered sadwiches and coffee. "So, I'm still not sure when Helmut talks about government stuff with us, and when he doesn't," said Maryam.

"He doesn't get going about confidential stuff very often, and I think it's usually when Oskar's not around, because he works for *Mars This Sol* and might accidentally say something. It doesn't matter much with Charlie, since he does geology. And you and I both work for the Commonwealth, so he can count on us being discrete."

"Even so, I see some things that he sees but you don't, and I report to Rory."

"Ask Helmut some time. He has been very generous with the economic team, though; we see just about all the diplomatic stuff. It's essential for us to make good forecasts. Everyone knows when Earth has a big political or economic crisis, gold prices will go way up and PGM prices will decline. But how much? That's the crucial question, and we don't always get it right."

"Have you ever seen gold prices this high and PGM prices this low?"

Sirikit nodded. "Sure, during the US-China war. And that tells you a lot about this crisis. Businessmen and economists think this is big and longlasting. Unemployment in developed countries has hit forty percent. Those receiving a permanent unemployment supplementation in

the U.S. and many Europen countries ranges between twenty-five and thirty percent. They are never getting a job, so they are feeling hopeless and often end up addicted. Three Americans are worth as much as sixtry percent of the U.S. population combined. A third of Americans now live in rental properties and will never be able to buy a house. The college attendance rate has actually dropped over the last decade because there are no jobs, even with a Bachelor's degree. The people with Master's degrees and doctrates want to come here."

"Americans are emigrating to Canada and Australia, too," said Maryam. "A lot of my college friends are unemployed. Three of their parents have managed to move to Swiftville or Mariusville, too!"

"So crazy: people are retreating to little principalities in space, where a company provides all their needs. They don't need democracy there, either, because they can always sell their investment and move to a secure gated community back on Earth."

"There are a lot of gated communities, but now they aren't always safe, either," said Maryam.

"Yes, paramilitary groups are actually invading them, so the gated communities now have to have armed guards. So people retreat the Swiftville or Mariusville."

"I don't know how things can get worse."

"Well, I think they can. Ultimately, the problem is ethical, even spiritual. World society can't agree on common ethical standards, so the focus is increasingly on power, money, and the individual. It's everyone for him or herself. The criminal justice system can't keep up any more, so people can get away with things, so the standards drop even lower. Here, we had to forge basic ethical standards from the start and we had to cooperate to survive. We're not perfect;

white men still have an inordinately large share of the good jobs. But their share is not huge, either. Women still take off more time for their children than men do, and that slows down their career advancement somewhat. But everyone has a good education and almost everyone here is an immigrant, so they've been screened. Social services don't cost us very much. We can maintain our standards easily."

"You are also making a case that Earth can't catch up!"

"It can, but it'll be difficult. There's plenty of money, but it's maldistributed. There need to be strong social and spiritual movements demanding change. We have seen such movements before, in India, South Africa, the US Civil Rights movement, even the effort to integrate Europe into a single union. Earth can change itself and we can help."

Their sandwiches and coffee arrived, so they paused to take a bite. "How do you balance your career and family?" asked Maryam. "I get the impression Oskar isn't planning to do much house work."

"A good household robot or robotic service will help a lot. Cleaning, washing clothes, washing dishes, meals: all those can be shifted to robotic service. But you have to be sure he is deeply involved in child rearing. Helmut wasn't, so both of the boys have not had a good role model. Certainly, Charlie didn't. When you guys have children, I'll push Charlie to talk to Oskar about that."

"Thanks! That's really what I'm worried about. I have a good career; I'm enjoying my work. I'm planning to finish my doctorate in political science and diplomacy."

"Good. You must. We have a highly educated society and we have to maintain it; if anything, we have to increase it. He'll come around. If anything, he has a more flexible job than most, as a writer."

"I've pointed that out to him, and he wasn't very pleased!"

Just then, Sirikit's communicator vibrated. She reached down to pull it from her purse; meanwhile, some people at a nearby table started talking suddenly and someone else in the restaurant cheered. "Two major media networks have declared a victory from David Omar."

"Good, that ends the attempt to subvert the election and guarantees the US will rejoin the world dollar."

"Stratford said he would return the US to the world dollar, too."

"Yes, but a lot more reluctantly." Maryam sighed. "Omar is a flawed man, in some ways; ambitious, but at least he's reasonably honest."

"Yes, he has left the dirty work to other people and groups."

"True, and there's no shortage of them. At least he'll continue President Lee's friendly space policy, though I suppose he won't have any money to devote to it."

"Has he commented about the Langlais Doctrine?"

Maryam shook her head. "No, we haven't heard from him about that, and that's an extremely important question."

"I guess we'll find out soon enough."

There was no such thing as a "traditional" Marsian wedding; the planet had too many cultures. People loved white wedding gowns and men wearing black tuxedos, although the

Indian-Marsians preferred that the bride wear red. Some held their weddings in places of worship, while others used rented banquet facilities at the Aurorae Hilton, the Aurorae Marriott, or the Interplanetary, and others reserved space in one of the larger parks, where the weather was always good. Oskar and Maryam chose the park near the Interplanetary for a brief ceremony that included Father Greg--a childhood friend--and the Imam of the mosque. Then the two hundred guests made a procession two hundred meters to the Interplanetary, where the reception was held.

A reception line formed, and the birth parents, their spouses and children, were the first ones to go through. “You first, Cory,” said Sam to his old friend, the fourth child born on Mars, gesturing to Alfredo, Carlos, and Isabella as well.

“Thanks.” She smiled at him and offered her hand. He smiled and they shook hands; a strange, cold gesture, but the only one that felt appropriate with their spouses present. Mindy shook Cory’s hand as well, and they formed their own little reception line where everyone in both families shook hands with the other. Alfredo sized up Sam as they shook hands, and Sam did the same.

Then they went through the line, shaking hands or hugging everyone. Nadia, Helmut, and Clara were beaming. Sebasian Langlais, at age 93 the oldest person on Mars, sat in a chair and greeted everyone warmly. Charlie and Sirikit were very happy. Maryam and Oskar looked a bit dazed and overwhelmed.

They headed for their tables, which were near each other, so Sam turned to Cory and said, “Did you ever imagine this sol would happen?”

"I suppose I knew it would, but I never imagined it'd be like this. When Ruhullah and Nadia took Maryam to Earth, I thought I'd never see her again."

"Me, too. And here we are."

"Yes, Here we are. So . . . how are you?"

"Pretty good. Busy, of course. And I guess you could say I've changed."

"From bad boy to outpost CEO."

"Yes."

"I've changed a lot, too."

"I hear you are on Cassini's planning commission. A big, responsible task."

"It keeps me busy," she said.

Just then Madhu slowly walked up; she had stopped to talk to Nadia. "It's so good to see you, dear."

"Thanks, Madhu." Cory hugged her.

Erico and Carmen Lopes were next. "It's been a long time, Sam!" said Erico, giving the man a hug.

"Thanks. This is my wife, Mindy, and our son, Victor."

"It's good to see you both again, after so many years." He hugged Mindy and shook hands with Victor. "I remember when you were born and Sam said he named you because in spite of our hardships, he was sure of our victory."

"Yes, that's what he told me, too."

Paolo, Cory's younger brother, came along next, with his wife and two young children. That generated quite a round of hugs and handshakes because they lived on Phobos, so Sam

hadn't seen him in years and had never met his wife. Before they got to sit, Will Elliott and Ethel MacGregor approached, followed by Liz, Mike, and their kids Jason and Shayda, who were just seven weeks younger than Vic, so they knew him through videoschool. That generated a long conversation.

"Can you believe we're all here, together?" Will said to Ethel, Erico, Carmen, and Madhu, as the younger ones sat.

"It is amzing," said Madhu. "I wish Roger were here this sol."

"Yes, he's the first one to pass," said Will. "We all miss him."

"But look at where Mars is," said Erico. "Who would have imagined . . . all in less than half a century."

"And we can't even imagine what the next century will bring," said Will. "Oskar and Maryam will see it, they'll raise their children in it . . . Mars will have millions of people. We'll *really* settle this world."

"We'll start to terraform it," added Ethel. "And let us hope we don't become the only world where humanity has survived."

"Let's pray about that," agred Madhu. "Will, have you seen the statement of the Mars Council of Churches about the Christian responsibility in elections?"

"Yes, I read it yestersol. Thank you for helping make it possible, Madhu. I see that it has received some very positive comments from major theologians and some terrestrial church leaders."

"Yes, it has. It has also been roundly condemned by others. Some just quote 'render unto Caesar that which is Caesar's and render to God that which is God's' as if that absolves us of

civic responsibility. But don't worry, Will. Your ethical stand about elections free of campaigning has awakened a new ethical consciousness in all Marsians, and we'll awaken the consciousness in all people on Earth eventually."

"Thank you, I'm confident that you are right. This has been a rough campaign for me, as you have probably heard; the number of emailed threats is now approaching 30,000, with organized, systematic attempts to crash my email and website."

"And you're going after some of them, I hear," said Carmen.

"Yes, and Erico is using my lawyer and private investigators as well, since he is being attacked for his statements. I'm being attacked on Earth for fighting back, too. But I have the financial resources to go after the organized efforts to spread hatred, so I am going to use them. Someone has to fight back. Fortunately, I am completely safe on Mars, and I don't need to spend more than an hour a sol directing the effort."

"Good for you," said Madhu.

"What do you see happening on Earth?" asked Erico.

"Well, President Omar won't be sworn in until January, and he has made it clear he won't try to rush legislation through. He still hasn't replied to any of my messages., so I don't have any insider perspectives. He strikes me as a brash man, but also one utterly pragmatic. We'll have to see what he intends."

"He won't be able to do much," said Erico.

"Maybe," replied Will. "Remember, this re-run of the election caused three seats in the Senate to change hands, so he will have the same strength there that Peters had. He won't have the House, that is true, but the other party's majority is slim and some people vote fairly

independently. He may not be hamstrung. But we don't know what he will propose. We will have to see."

"He'll have a much weaker economy than Peters, though," noted Ethel.

"Yes, this is very true," agreed Will. "But it's still an economy four times bigger than the economy that got us here a half century ago. We can't count it out."

Plot Summary

March 2085: Saturn 7 arrives with 300.

May 2085: Saturn sends two down to the aerostat for several months to make upgrades; work on Triton pipeline and geothermal system start; work on drum on Portia starts; US starts planning its own Sedna mission; Swiftville finances in jeopardy as entire Earth economy tanks

June 2085: Commissions in Texas, Ohio, and Florida conclude President Peters was not elected and Omar was, and concludes the Senate is flipped, but Peters refuses to vacate the White House and his party supports him; huge unrest in USA and calls to refuse to obey anti-robot legislation and readapt the world dollar. People want to flee Earth but can't. Wealth flows outward in spite of economic collapse. Neptune 3 arrives at Callisto for 1-month visit, brings some crew, picks up some crew.

July: Maryam and Oskar decide to marry; marry in November?

End of 2085: Enceladus C-100 is completed, work starts on C-50s for Tethys, Rhea, Iapetus, Mimas, Dione

Late January/Feb 2086: Columbia entrance tunnel, Triton, enclosed and terraformed.

Saturn sends out a group of spytors

Autumnal Equinox: Mar. 20, 2084

Mars-Ceres opposition: 2084.209 = March 17, 2084

Dust Storm Season begins: May 11, 2084

Dust Storm Season ends: Oct. 6, 2084

Opposition 24: Nov. 10, 2084

Vernal Equinox: Jan. 19, 2085

Mars-Jupiter-Neptune flight possible

Autumnal Equinox: Feb. 6, 2086

Dust Storm Season begins: March 28, 2086

Dust Storm Season ends: Aug. 23, 2086

Vernal Equinox: Dec. 7, 2086

Opposition 25: Dec. 7, 2086 (Carrier for Pluto to Earth)

January 2087: Neptune 3 arrives at Proteus

Mars-Ceres opposition: May 31, 2087

Autumnal Equinox: Dec. 24, 2087

Dust Storm Season begins: Feb. 15, 2088

Dust Storm Season ends: July 10, 2088

Vernal Equinox: Oct. 24, 2088

Opposition 26: Jan. 31, 2089

Autumnal Equinox: Nov. 10, 2089

Dust Storm Season begins: Jan. 1, 2090

Dust Storm Season ends: May 27, 2090

Vernal Equinox: Sept. 11, 2090

Opposition 27: March 6, 2091

Autumnal Equinox: Sept. 28, 2091

Dust Storm Season begins: Dec. 19, 2091

Dust Storm Season ends: May 14, 2092

Vernal Equinox: July 29, 2092

Opposition 28: April 11, 2093

Autumnal Equinox: Aug. 15, 2093

Dust Storm Season begins: Oct. 6, 2093

Dust Storm Season ends: Feb. 28, 2094

Vernal Equinox: June 16, 2094

Opposition 29: May 26, 2095

Autumnal Equinox: July 3, 2095

Dust Storm Season begins: Aug. 25, 2095

Dust Storm Season ends: Jan. 20, 2096

Vernal Equinox: May 3, 2096

Autumnal Equinox: May 20, 2097

Dust Storm Season begins: July 11, 2097

Opposition 30: July 31, 2097

Dust Storm Season ends: Dec. 5, 2097

Vernal Equinox: Mar. 21, 2098

Autumnal Equinox: Apr. 7, 2099

Dust Storm Season begins: May 29, 2099

Opposition 31: Oct. 18, 2099

Dust Storm Season ends: Oct. 23, 2099

Vernal Equinox: Feb. 6, 2100

Autumnal Equinox: Feb. 23, 2101

Dust Storm Season begins: Apr. 14, 2101

Dust Storm Season ends: Sept. 9, 2101

Titan northern spring equinox: Aug. 11, 2009; (+29 yr 5 mo 17 days); Jan. 28, 2039; July 14, 2068; Dec. 31, 2097. Northern summer solstice is late Feb. 2077

Started volume 7, August 2018; lost 100 pages of text on 30 Sept. 2018; dropped volume in Oct. or Nov. 2018; resumed writing, August 2019. Completed volume, 20 Oct. 2019.