

# *MARINERS*

*Vol. 2*

*Mariner Identity*

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1.

## Landfall

June 2075

“It must be the most beautiful thing in the solar system,” said Charlie Langlais, staring.

Sirikit looked at her husband with a smile. “You mean, more beautiful than me?”

He saw her smile. “You know what I mean! I would never compare you and Jupiter!”

“So, which is more beautiful, then?”

“You have more beautiful curves, my dear, and Jupiter has more beautiful swirls.”

She laughed. “Well said. I agree, as solar system objects go, it’s the most beautiful.” She reflected. “Mars has a pock-marked charm and Earth has clouds, blue, green, and brown. . . but Jupiter has pastels.”

“It’s amazing. And at 2 million kilometers, let’s see, we’re six times the earth-moon distance and Jupiter is 40 times the diameter of the moon . . . wow, no wonder it looks so big! This is what it looks like from Calisto, because it’s the same distance from Jupiter as we are right now.”

“It’s a shame we can’t come out here to look at closest approach, but we’d be fried by radiation,” said Sirikit.

“It is a shame, and a three-d screen won’t capture it, either.”

She pointed to a round moon barely to the right of the king of the planets. “Is that Callisto? It looks like it; it’s pretty white.”

“It should be; after we pass Jupiter, we’ll head straight out to it. Ganymede’s white, also. Europa’s gray, and Io’s orange.” Charlie stared at their future destination, which looked to be about a fifth the diameter of a full moon; it reminded him of Phobos, though it was rounder.

“And we’ll pass to the ‘left’ of Jupiter?”

“Correct, in a gravity assist maneuver that will fling us back into the inner solar system if the engines were to fail. We’ll pass within 50,000 kilometers of the cloud tops; very close, so we’ll be moving very fast. At such a close distance, a very small delta-v is sufficient to put you into orbit around Jupiter. If all goes well, we’ll do a gravity assist flyby of Ganymede and it’ll bend our path toward Callisto, which we’ll reach three days later.”

“A well planned dance with the celestial spheres. I hope all goes well.”

“Are you worried?”

“Well, aren’t you?”

“The arrival phase is perfectly safe; as safe as flights to Mars, anyway—”

“Sorry; that’s not what worries me. It’s what happens after arrival. I don’t know how we’ll integrate the teams together. Commander Cai hasn’t yet been able to have a decent conversation with Commander Chen Wei about plans.”

Charlie nodded. “I know. It’s going to be difficult. We’ve tried hard to build bridges with the crew of the *Gan De* and that hasn’t been easy; and we can walk to their ship!”

“I emailed an old friend of my father’s, Phan Quang Ty, yesterday. He’s one of the three Vietnamese on the Chinese vehicle on Callisto. He has endured a lot of discrimination. He said the Chinese are not looking forward to our arrival.”

“I can’t blame them, in a way; we outnumber the total crew there 2 and a half to one, and the Chinese ship five to one. We’re bringing a vastly more sophisticated set of technology, too. In a way, it won’t be their Callisto once we arrive.”

“I think that’s right. In contrast, the American-Marsian crew can’t wait for us to arrive. But Commander Chen Wei can make a lot of trouble. . . .”

“I know. But don’t worry; this will work out.” Charlie kissed her. “I suspect you’ll figure out ways to strengthen the unity between the crews, too. I know you.”

Sirikit smiled. “Well, I will try.”

“Come on, let’s get inside. There are a lot of preparations before the orbital insertion burn tomorrow.”

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Jupiter 4’s propulsion engineers prepared for a week to fire up the gaseous core nuclear engine for the orbital insertion burn. Whereas the departure from Mars required the gaseous core engine and two solid-core nuclear engines to fire for six hours, the arrival at Jupiter only required the gaseous core engine and a two hour burn. Jupiter’s immense gravitational field pulled the *Galileo*, the *Gan De*, and the *Barnard* in and accelerated them to nearly 400,000 kilometers per hour. Close to Jupiter, a very small delta-v produced a significant reduction in departure velocity. The gaseous core engine did its work well, so the solid core nukes were unnecessary, saving them for later use and saving the hydrogen they would have had to use for later maneuvers as well.

A day later, Jupiter 4 passed Europa, that moon bending its path and slowing the complex of vehicles further. Another day passed and Ganymede provided further course modification. Finally, three days later, they approached Callisto. The gaseous core engine fired again and in an hour they were in orbit around the solar system’s third largest moon.

But there still was no time to rest. The three vehicles had traveled together as a complex for 12 months; now it was time for them to separate. Some liquid hydrogen and oxygen tanks that had been arrayed around the outer hulls of the vehicles to provide radiation shielding had to be moved to the dorsal surfaces and connected to the chemical engines, which were located

along the dorsal “top” side rather than along the rounded “ventral” bottom that was covered by a heat shield. Cargo had to be moved around; the three vehicles together carried 400 tonnes of equipment. The vehicles also had 300 tonnes of water and gasses that could be offloaded and left with the three nuclear engines and their attached hydrogen tanks, which remained left in Callisto orbit. The volatiles could be converted into chemical propellant using the electrical output of the nuclear engines; once on the surface of Callisto, they could be replaced by local water, carbon dioxide, and nitrogen. Three more days passed before the vehicles were ready to descent to the Callistan surface. Internal rotation stopped and for the first time in a year, the inhabitants of Jupiter 4 were weightless.

The descent to Callisto Station took an hour; an initial engine firing on the *Galileo* put it on an orbit that would almost intersect the surface right above the station, then as it approached its low point the hydrogen-oxygen engines blazed alive and burned off the remaining 1.5 kilometers per second of velocity. The *Galileo* settled onto pad 3 on its six landing legs amid the cheers of its inhabitants.

Cai Xiaopeng looked around the bridge. They had been seated on a horizontal floor with screens on the wall in front of them; now the wall was the ceiling, the floor was a wall, they were seated horizontally, and the wall behind them had become the floor. With no centrifugal “gravity” to fling them toward the outer rim of the ship, Callisto’s pull was pulling them toward the ships dorsum.

“Propulsion system shut down,” confirmed the day officer.

“Excellent. Start rotation,” said Xiaopeng. A moment later, they felt the rotation begin. “Ah!” said Xiaopeng, relieved. He reached “up”—the ceiling was now at an angle and getting closer to feeling like a wall—and pushed an icon on the screen in front of him. “To all crew.

Welcome to Callisto! We have started the spin-up. Please use extreme caution moving around the ship because everything will be tilted at a 15 to 60 degree angle. It will be at least a week before we can realign all the floors, furniture, toilets, etc. Once we are up to speed, I will issue the all clear order and you will be able to move about the ship. Everyone has their ‘realignment’ duties and I wish you good luck and much speed with them. We will be hosting the existing Callisto crew for dinner in three days and I hope we have much of the work done by then.” He closed the circuit. “Especially the bathrooms,” he added.

“The *Gan De* just reported that it has made its deorbit burn,” reported the day officer.

“Excellent,” replied Cai Xiaopeng. The *Gan De* and the *Barnard* were descending as well, half an hour apart, although most of their crews were already aboard the *Galileo* and would not be moving back to their old ships. The *Gan De* would be departing for Earth in a few months with everyone who wanted to return to the inner solar system, some 40 personnel; it would be a crowded flight. The *Barnard* would be departing for Himalia and other moons several times over the next two years. As a result, neither vehicle would be set up for operation on the Callistan surface. Most spaces in the *Galileo* were designed so that a storage wedge could be removed from the ceiling and moved to the floor, tilting it just enough to make it flat in Callistan gravity. Furniture then needed to be bolted down to the wedges and some equipment—like toilets—required realignment. The atrium required the most extensive modification because it was close to the hub and therefore had the least centrifugal gravity. Once done, however, the *Galileo* would become a permanent part of Callisto Station. The galleons on Titan and the moon had undergone very similar modifications.

Cai emailed Commanders Vickers and Chen to confirm a meeting of the four vehicle commanders in two hours. Then he walked around the galleon to see how the realignment was

going, especially in the atrium where the kitchen needed to be ready to cook supper in a few hours. At 4 p.m. he headed for the hub. By then, personnel already on Callisto had installed a pressurized transparent plastic tunnel from the *Galileo's* exit to the Chinese and Marsian-American caravels already on the surface.

It was a strange experience to pull on a warm coat and walk between the ships through the pressurized tunnel. Callisto's rolling surface was dominated by gray ice "regolith" that in the dimmer sunlight resembled the surface of the moon. Patches of dark meteoritic debris, however, were not common on the moon, and only at the lunar poles did one find the pure white, fresh water ice that splashed about deeper impacts. The craters were soft and muted because of the slow slumping caused by gravity and sublimation of ice straight to water vapor. Unusual were two small ice knobs on the horizon, remnants of the hard icy floors of craters after the rest of the feature had evaporated into Callisto's vacuum. It was a remarkable, distinct landscape; Xiaopeng relished looking at it.

But even more impressive was Jupiter: huge, bright, multicolored, striped, lording over the entire sky from its place near the eastern horizon. He stopped to stare at it for a good thirty seconds, just before he stepped under the Chinese caravel. Orange Io and bright Europa and Ganymede—the latter fairly close and almost as large as the full moon—were also fascinating objects to see. Between their brightness and the glare reflecting from the Callistan terrain, the stars were washed out and invisible. Xiaopeng was surprised that sun looked almost as bright to his eye on Callisto as it did from the Earth, even though it was only a twenty-fifth as bright. Perhaps it was because he hadn't seen the sun for many months and had an indistinct memory.

Finished with his survey of the surface and sky, Cai Xiaopeng continued to the entrance of the *Tienan*, the caravel the Chinese had sent to Callisto eight years earlier, which remained

their headquarters. He took an elevator up to the hub, where he was immediately embraced by warm air and bright light. Chen Wei and Charles Vickers were waiting.

“Welcome to Callisto and Mù wèi sì zhàn,” said Chen Wei in Mandarin. He repeated himself in English, but didn’t bother to translate “Callisto Station.” He extended his hand and they shook.

“Thank you.”

“Welcome,” added Charles Vickers, and they shook hands as well.

Just then the elevator began to descend to pick up someone else. “That must be Wang Chenguang,” said Cai.

“Undoubtedly. How was your flight?” asked Chen.

“Good; quite routine. You’ve seen the data we gathered with our three penetrators. We were very pleased with how they worked out.”

“The fastest flight to Jupiter yet,” noted Vickers. “Though our flight back to Earth will be even faster.”

“Yes, transportation is getting more and more routine. It bodes well for the future of settlement of the jovian system.”

“Settlement,” said Chen, pondering the term, for it was not something China favored.

The elevator door opened and out stepped Wang Chenguang. “Welcome,” repeated Chen and Vickers, and another round of hand shaking followed.

“Thank you,” she replied. “I hope I’m not late. Getting out of a ship where everything is tilted at crazy angles proved to be difficult. My crew will be on its way here in a little while; the members who haven’t moved to the *Galileo*, that is.”

“We also have made some room for them on the *Pacifica*,” noted Vickers, referring to the Marsian caravel already on Callisto.

“Come down to my office,” said Chen, leading them to one of the elevators that descended to the outer rim of the caravel. They entered; the floor had a 45 degree angle to it, so it was awkward to stand on. Chen pushed the button to the bottom floor and they descended in an uneasy, formal silence. Centrifugal gravity steadily increased and the floor’s tilt neutralized, then began to feel tilted the other way.

“This way,” he said when the door opened. He led them a dozen meters to a conference room next to his office, where a pot of hot green tea and a robot pourer awaited.

“Please be seated,” said Chen, sitting at the head of the oval table. He waited for everyone to get their tea, then took a cup for himself as well. “I think all of us feel excitement when contemplating this immense expansion of human capacity in the jovian system,” he began. “Our population has gone from 85 to 276 in one day. Furthermore, the 85 of us were childless, but now our personnel include 6 children, and no doubt some will be conceived and born on Callisto in the next few years. From two caravels set up for Callistan gravity, we now have the same plus a caravel set up for space operation and a galleon that will more than double our gravitied area. You also came with several hundred tonnes of equipment, scientific instruments, ecological samples, and two 15-megawatt surface reactors; they alone will transform this place. We can only be grateful to the international community, and in particular to Mars, for this development.”

“We are delighted and honored to be the bearers of this expansion,” replied Cai. “It is hoped that the expansion will continue in future years, also. Jupiter ideally needs a community of 400 to 500.”

“Large enough for a professional dentist/hygenist and a beautician,” said Chen with some sarcasm, alluding to a report noting that at that size, both of those full time professions were needed. “And your first priority is station expansion.”

Chen had received the detailed schedule, so it wasn't clear whether he was asking a question or stating the obvious. Cai nodded. “Our first three days are dedicated to phase 1 of galleon conversion to Callistan gravity. Phase 2 will continue for another two months and will be more detailed. Starting our second week, we'll deploy our bulldozer and begin to excavate the foundation for our first C-100 bubble. They're prototypes for the Uranus mission, 100 meters long and 50 meters in diameter. Each consists of four layers of tough plastics with three gaps between them, each 1 meter wide, into which we will pump water. Once it freezes as hard as concrete in Callistan temperatures, we will have immense low-radiation spaces that we can develop for work areas and ecology. We will also set up our garage, surface lab, and fabrication shack; the latter will start to manufacture nickel-iron sheeting to place under the first enclosure. That necessitates collection of carbonaceous and nickel-iron meteorites. We'll deploy reactor one, activate it, and begin to drill a well.”

“Each C-100 needs what; 50,000 tonnes of ice to complete its shell?” asked Chen.

“Exactly. We'll take a year to fill them. But we can get started on construction inside after just four months, when the innermost ice shell is complete. Our mission goal is to complete both C-100s, which gives us plenty of volume for future expansion. The buildings inside will be constructed so that additional stories can be added to them later. As Callisto's population increases, the lower levels can be converted into agriculture and new industrial and laboratory levels can be added on top.”

“Each bubble has almost 200,000 cubic meters,” added Vickers. “That’s an enormous volume of oxygenated space. It’s too bad we can’t live full time in Callistan gravity, because if we could, we could spread across the moon’s surface very easily.”

“Well, they’re expensive to make, and there’s no economic basis for such expansion,” replied Chen. “I am skeptical we will ever use even one such enclosure fully, let alone two. We can be grateful that Mars has been generous in producing the C-100s, but I question their motivation.”

“How much time have you spent on Mars?” asked Cai.

Chen scowled at the question. “None; I came here straight from Earth.”

“Because you would understand the Jupiter 4 mission much better if you had spent time there. Our goal is to establish viable human settlements across the solar system. By viable I don’t mean economically self-sufficient; I mean socially and culturally autonomous, in other words, large enough to provide comfortable services to entire families. It is the experience of Marsian society that that’s the best model. Titan demonstrates it. The problems of isolation that Ceres and Mercury had demonstrate it as well.”

“The future role of nations such as China, I think, will change somewhat,” added Vickers. “National prestige will flow from the equipment and residents they provide to the settlements. Their nationals will spearhead specific expeditions or research projects.”

“Perhaps that will be true, but that is not current Chinese government policy,” replied Chen. He looked at Wang. “Am I not correct?”

She nodded. “You are. I understand where Commanders Cai and Vickers are coming from; I spent over a year on Mars and participated fully in the planning for Jupiter 4. I think this

new settlement approach will prove much better. China does support it; she agreed to fund an additional galleon for Callisto in 2077.”

“A galleon that now will be canceled, it seems,” replied Chen.

“True,” conceded Wang. “But nevertheless it represented a concrete Chinese commitment to grow Callisto to ‘settlement’ size. Two galleons can house 500 people, when they are supplemented by enclosures.”

“But China has never agreed to support elections, and certainly not elections to choose a chief executive,” said Chen. “That is the bottom line, for me. As long as I am acting overall Commander, there will be no elections. Admittedly, I will be overall commander only another six months; on January 1, 2076, you will assume the helm for 12 months, Commander Cai. I understand that. But I am in charge until then, and I’m not going away after that date, either. I will be in charge again on January 1, 2077. There will be no elected Chief Executive.”

There was silence in the room for a moment. “I am not aware that it is Chinese policy to forbid elections here,” said Cai.

“That is my understanding of Chinese policy. China does not want elections on Callisto; that certainly is clear.”

“Well, if that is the case, it sounds like there will have to be additional negotiations among the members of the Jupiter Commission,” said Cai.

“Correct, because we are their employees,” replied Chen. “*Not* their settlers.”

2.

## First Steps

July 2075

“So, this is the store,” said Martha Vickers, wandering into Sirikit’s newly arranged space. Sirikit was sitting at a table next to the check out area and rose.

“Yes, can I help you?” She frowned, recognizing Martha, but not quite able to place her.

“Sirikit Thanarat?” asked Martha, with a smile. “Remember me, I’m Martha Vickers! Of course, Charles and I left Mars in 2068; seven years ago. You were a teenager then!”

“Yes, I remember you! I knew you were here on Callisto, but I wasn’t expecting to see you right now!” Sirikit rose and the two women embraced. “How are you!”

“I’m very well. And you’re married to Charlie Langlais, right? That’s what I heard, I believe. How did you end up here?”

“Charlie was accepted to the crew of the *Barnard*, we decided to get married, and they needed someone to run the store and serve as cultural director, so they hired me.”

“Are you specializing in that?”

“No; I’m an economist in exile! But I’m taking courses with Dr. Park online, I’m also taking some from Stanford online. I’m focusing on ‘mariner economics,’ you might say. I was in that group of students who proposed that Ceres export nickel and cobalt in large quantities with arrangements whereby all the Commissions would get some of the profits.”

“Ah yes, I heard about that! So, *you* were involved in that. Very impressive.”

“Thanks. How long have you been here on Callisto?”

“Eight years; we arrived in 2067. We had planned to stay at least ten years, but we’ve decided to leave on the *Gan De* when it returns to Earth next year and give Cai Xiaopeng a chance to develop the place.”

“Has it been hard?” asked Sirikit. She pointed to a chair. “Here, sit down.”

Martha sat next to Sirikit. She considered her answer a moment. “I suppose that’s one way to describe it. Charles arrived as one of three commanders; there was an American, John McCormick, who came on the *George Washington*, and Tang Enlai, who was already here on the *Tienan*. We arrived with a mandate to ‘normalize’ and grow the place. We had three caravels and 90 people. We managed to get an agreement to put all three caravels here at Callisto Station, rather than setting up a rival station. Enlai was willing to support the election of a common Commander even though China was opposed, and since he had a Nobel Prize, he could have pushed it through. We started drafting a ‘Callisto Charter’ to define the structure; I was on the committee. But the United States, of all places, was opposed! So there was no election.

“Then the war started, we were cut off, and McCormick took the *George Washington* back to Earth with as many people from all three vehicles as could fit on board. We dropped to a total of fifty people on Callisto, morale was low, we figured we’d all have to leave for Mars, and we didn’t push for an election. Then the war ended and China sent out a caravel with Chen Wei and passengers for both caravels. We were back up to sixty. But Chen opposed elections and insisted that we run two more or less parallel and independent operations. So we concentrated on Jupiter—atmospheric chemistry, meteorology, modeling the interior, radiation belts, magnetism—and they concentrated on the Galileans. Sometimes some of us ate over there and sometimes some of them ate over here. The fabrication and food production operations specialized a bit, so there was some cooperation.” She shrugged.

“And now 191 people arrive.”

Martha nodded. “And the old arrangement is guaranteed to collapse.” She pointed at the atrium. “We have nothing like this! Or even like your store! I bet you’ve been mobbed!”

“Oh, yes, yesterday it was packed with people from the *Tienan* and the *Pacifica*.”

“I’m sure. The robotic fabrication facilities you’ve brought will allow Callisto to make things that Mars couldn’t make when we left it, and it had almost 4,000 people then! Furthermore, the *Galileo* has geologists—of the ice moon and galilean types—so the Chinese specialty is ended. I’m sure you’ve brought androids, Prospectors, satellites, atmospheric probes, and all sorts of other equipment that will advance research immensely.”

“Exactly; 1.2 billion redbacks of equipment, in fact, built on Mars and in many countries on Earth. They’re the single biggest expense of Jupiter 4.”

“I’m sure. But 1.2 billion redbacks can’t buy a new social and political arrangement up here.”

“Half the people here are angry that Cai Xiaopeng backed down about the election. The other half are angry but feel he had to.”

“It’s about the same on the *Pacifica*. We were hoping Callisto would enter the twenty-first century.”

“But there isn’t a lot he can do without Chinese cooperation.”

Martha thought about that, then shook her head. “I’m not so sure. Charles would do the same as Xiaopeng, I’ll admit that. He’s not one to precipitate a rupture. But as they say, if you want to make an omelet, you’ve got to break the eggs. I think this is a situation where the Chinese need to be pushed. Even if they refuse to give in and relations are poor for a while, they’ll have to come around eventually. Persuasion won’t work.”

“Really?” said Sirikit. “That’s too bad. I’m surprised you’d give such advice! You’re a counselor with a reputation for helping people to find compromises!”

Martha smiled. “Thank you, that’s kind of you. I’ve saved quite a few marriages; I’ve even arranged some! But in this case, there is no compromise: either there are elections, or there aren’t. And Callisto—the entire jovian system—isn’t going to grow unless we create a settlement here, which means there will be elections eventually.”

“And normal civic discourse,” said Sirikit, nodding.

“Exactly. And I want to see Callisto grow. Jupiter has a role to play in the solar system; in mariner culture, whatever that is.”

“Whatever it will be. Because it’s still forming.”

“Very true. And I think your generation will form it. My generation helped create Marsian culture; we launched it, anyway. With the drop in launch costs and in the cost of interplanetary transportation, Mariner culture will emerge next.” Martha stood. “I’ve got to get back to my office; I have an appointment in half an hour. It’s good to see you again, Sirikit.”

“Thank you. I look forward to talking to you.”

Martha smiled. “Thank you, I’d like that, too. See you at the welcoming dinner this evening.” She headed out of the store, leaving Sirikit with a lot to ponder.

But she didn’t have much time to ponder it. Some crew from the *Tienan* came in with friends of theirs from the *Gan De*. She used her bit of Mandarin and carefully pronounced their names; her goal was to get to know every person on Callisto, and she already knew the people on the *Gan De* as a result. The rest of the afternoon was very busy, as people arrived early for the welcoming dinner and hanged around the store with its automated latte machines. She spent a lot

of time answering questions about made-to-order items, none of which would be produced for at least a month while the personnel were busy setting up a larger “fabrication shack” outside.

Then Phan Quang Ty stopped by. “Sirikit Thanarat?” he asked.

“Yes; you must be Dr. Ty! My father will be so glad to hear we have met!”

“I am delighted to me the daughter of my good friend.” He offered his hand they shook.

“So, you have quite a store, here!”

“Thank you! You should have seen it three days ago, with everything turned 80 degrees. But setting up the atrium for Callistan gravity was the ship’s priority, so that we’d have a big useable public space. Some people were sleeping in here until last night. Charlie and I found sleeping on a slanted bed quite strange, but now our apartment is partially converted and our floors are flat, at least.”

He looked around. “It’s strange to see the floor of the atrium; it reminds me of a velodrome, with its angled circular floor for bicycle racing! But the angled floor is ‘down’ and the ‘flat’ space in between is a slope.”

“Once we have time, the ‘flat’ will have plantings. We actually have more space now than we had in transit. I’ll be able to make the store fifty percent larger and the dining area is large enough to accommodate everyone on all the ships.”

“How was the flight?”

She shrugged. “Long, a bit boring, punctuated by a lot of classes and trainings. I was also busy with economics classes; I’m now a Martech graduate student. And it was good time for my husband and me to settle into our marriage. We got married just a few weeks before leaving Mars.”

“Really? Then it must have been quite a memorable flight. As you probably know, I was on Mars for ten years—while you were small—then back to Vietnam for five years, then I came here in 2072-73, so I’ve been here just two years. I plan to stay four more, then head home.”

“What do people on the *Tienan* think of our arrival? I gather some are delighted and some are worried.”

“I think that summarizes the situation pretty well, but I would add another adjective: jealousy. I’m in information technology and we drool, thinking about the supercomputer the *Galileo* brought. I need to meet the people who manage it and see whether we can get some time! The people in environmental management are amazed at the ecologies you plan to setup. The geologists . . . well, we all know about that situation. The only people who are not worried are the biontologists, since Jupiter 4 didn’t bring any more specialists.”

“I’m sure it’ll take some time for the various teams to work out arrangements.”

“Yes. On the other hand, we are delighted to have so many new faces here. We needed the new blood rather badly! And since your crew is mixed—with Chinese and Americans, as well as others—I hope you can bring our split station together.”

“That’s what we hope, too, but now this election issue is causing trouble.”

Ty nodded. “Yes. That’s to be expected. Chen Wei is a traditional type of commander. He is very professional, demands a lot of his crew, seeks to inspire them, and expects obedience. He’s an excellent Commander, but he would be utterly lost if he had to function like a politician!”

Sirikit smiled. “That’s the best explanation of the situation I’ve heard.”

“He and Vickers had to come to an accommodation; their styles were opposite. That worked fine, but kept the two crews largely separate. The tunnel between the ships was not used much.”

“That’s too bad. I hope we can do something about it.” She pointed to the store. “If nothing else, the atrium and my latte machines will bring people together!”

“Yes, I think so!” Ty pointed. “Ah, here’s my wife, Amanda.”

Amanda Arroyo Phan walked into the store. She was Filipino and smiled at Sirikit. “You must be Sirikit! Your father has raved about you in his emails to Ty!”

“He’s too proud; a typical father. Pleased to meet you.” The two women shook hands. “Welcome to the *Galileo*.”

“Thank you. I love this big space; it’s half the size of a caravel! People will love coming here!”

“It’s quite special and made the trip here much more comfortable. So, what do you do?”

“Communications and control. And you’re a . . . storekeeper?”

“Storekeeper and director of cultural and recreational activities by day, graduate student in economics by night.”

Amanda smiled. “I’ve been there!”

“Do you have children?”

“A son; he works for the United Nations in Kenya.”

“Let’s go sit and eat; the buffet line is forming,” said Ty.

“Come sit with my husband and me; I’ll introduce you,” suggested Sirikit. They nodded and the three of them headed for the buffet line. It was slow; people were overwhelmed by or envious about the choices. Finally they slowly walked around the atrium’s circular floor until

they found a big table where Charlie, Firuz, Jean-Paul, and another geologist were seated. The three of them took three of the remaining four seats. Sirikit made the introductions all around.

“So, your father is Helmut Langlais?” asked Ty.

“Yes, and Sebastian’s my grandfather.”

“So, you are continuing the family tradition!”

“I guess so. And your name is Ty?”

“Correct. Ty is my first name or given name; Quang is my middle name; and Phan is my family name. But in Vietnam, like on Mars, we attach titles to people’s first names, not their family names. So in formal occasions, people call me Dr. Ty or Mr. Ty. But please just call me Ty!”

“Thank you. Call me Charlie. I just finished my Bachelor’s degree in Geology on the flight out—well, actually, I still have two humanities requirements to complete—and I’ve started my Master’s degree in the geology of iceteroids.”

“Congratulations.”

“His senior thesis was very impressive,” added Firuz. “What do you do?”

“Information Technology, and Amanda does communications.”

“So, what does the crew of the *Tienan* think about the matter of elections?” asked Jean Paul, not waiting for informalities to break the ice.

Ty pondered a moment. “All of us favor the growth of Callisto and are happy to see it increase so much. But not all feel the time for elections has come. Certainly, I think they are inevitable.”

“But not now?”

“This is not a good time. You see, Chen Wei is an excellent commander, but he is not one to know what to do with elections. They do not suit his personality.”

Jean Paul shrugged. “Screw his personality. We have a school for children on board and it has to get bigger because there are probably fifty couples planning to start families, we’re a branch campus of Martech, we have a store and some very small businesses . . . we are a community, a settlement, not a mission. I hear Chen Wei said to Cai that we are employees, not settlers. Well, the children on board aren’t employees; they are settlers.” He shrugged.

“You are right about the facts, I am sure,” replied Ty. “But the people on Callisto are not a community; they are five different ships and the ships are largely autonomous—”

“That’s not completely true,” interrupted Jean Paul. “The *Galileo* and the *Barnard* are under one command, and the *Gan De* is partially integrated. I see no reason to assume the *Pacifica* won’t integrate in as well. So that leaves the *Tienan*.”

“I take your point, but my point remains: we do not have one community here. Perhaps if we wait a few months, the situation will improve and elections will be possible.”

“And unity may be built,” added Firuz. “An election is an expression of unity; it can’t create it from scratch.”

“What would the elected Board and Executive do?” asked Amanda.

“Coordinate the school, cultural events, businesses,” replied Jean Paul. “That’s what they usually do.”

“Doesn’t the Executive run the station?” asked Ty. “He does on Ceres, Titan, and Mercury.”

“That would have to be decided,” said Firuz. “Every place has to draft a charter, a basic law, or whatever they call it.”

“The first task of the Council, usually,” noted Jean Paul.

“Well, for the next few months, we all have to get to know each other,” said Ty. “It’d be hard to hold an election otherwise. Would the election follow Marsian rules?”

“That would have to be determined as well,” said Sirikit.

“Sounds like we’ll ‘determine’ what to do for a few years, and nothing will be done,” groused Jean Paul.

“Maybe not,” said Sirikit. “Maybe we need to try some smaller steps.”

“We need to build unity first,” said Firuz.

“Ah; that’s true,” said Sirikit.

Charlie leaned over close. “What are you thinking?”

“I’m not sure yet.”

He nodded and turned back to his rice and myco-chicken with vegetables. She fell silent, pondering, while the conversation turned to the exploration of the jovian system that had been accomplished already and the plans of the next two years. When she finished eating, she got up to get herself a cup of coffee, but diverted over to Cai Xiaopeng’s table instead. Charles and Martha Vickers were sitting with him.

“I have an idea about the election,” she said.

Cai shook his head. “Oh, Sirikit, not now; people are driving me crazy about the election! It’s casting a pall over everything.”

“I know, that’s why I have an idea.”

He frowned. “Okay, tell me quickly.”

“I suggest two intermediate steps, the first to build some sense of community and the second to lay a foundation. The first is a conference titled something like ‘Are we Mariners?’ or

‘What does it mean to be a Mariner?’ or ‘Building a Community on Callisto.’ The idea is to get people together to talk abstractly about what community we want to build here. Step two is to elect a body to write a charter or basic law or declaration or something; it’d be a foundation for whatever is elected. Then there’d be an election for the body that the document defined.”

Cai’s eyes lit up. “That’s brilliant!”

“Don’t forget we drew up a charter, once,” injected Martha, who heard the proposal. “We could review that as well.”

“That’d be easier on Chen Wei,” said Charles.

Cai nodded. “And as Director of Culture, you’d plan the conference.”

Sirikit nodded. “We’ll need a task force that includes you.”

Cai nodded. “That’ll take 4 to 6 weeks. That keeps everyone happy, provides them something to focus on, and gives people time to get to know each other.”

“And time to get input from as many groups up here as possible.”

“Yes, that’s good. I’ll announce the conference in my welcoming remarks. Let’s go with ‘Building Community on Callisto.’”

3.

## Land

July 2075

“We haven’t had a cabinet meeting for quite a while,” said First Minister Jacquie Collins. “But the peace and quiet of mid-columbiad is coming to an end, and soon Mars will be plunged into the preparations for another flood of arrivals. I want to start by commending Henry Smith and the privatization effort. Have we turned a corner, Henry?”

“Absolutely!” replied Henry, with a smile. “Fifty new medium-sized businesses in a year; that’s four times larger than any previous year. And most have opened in the last four months, since the solar sailers began to arrive with automated production equipment.”

“It’s an absolute economy revolution,” said Hun-jai. “The war caused a collapse in interdependency and forced nations to be more self sufficient, so they poured tens of billions into automation and three-dimensional printing technology, and now we can produce almost anything we want.”

“*Small and medium sized companies* can produce almost anything we want,” corrected Henry. “With tax credits and interest free loans, anyone with a little fabrication experience can purchase a million redback system. It’s a big subsidy, but now we have lots of capacity and flexibility.”

“Let’s hope,” replied Jacquie. “Half the companies are in Uzboi, which provides a better employment base for that outpost and uses its surplus nickel-steel production better. Half of the rest are here and dependent on import of metal carbonyls from Uzboi.”

“But that’s not a problem,” said Henry. “Moses confirmed to me by email this morning that the metal highway to Uzboi will be completed by December 1. At that point, we can start hauling liquid metal carbonyl here in hundred-tonne tanks, ten at a time.”

“When will the metaling units be able to make their own paving modules from carbonyl?” asked Jacquie.

“The conversion will take a few months,” replied Hun-jai. “By March of next year, we’ll have all three converted over. It’ll be much more efficient to haul the carbonyl to the metaler than to haul modules and wend them together; the metaler will literally be able to extrude the highway and attached pipelines as it goes! The Uzboi Highway can handle trains of at least a thousand-tonnes and the built-in pipeline can provide the metaler all the methane and oxygen it needs. Hauling carbonyl all the way to Thymiamata, however, will be expensive and slow, since the trains can only carry a hundred tonnes at a time on a dirt highway. But it will be cheaper than building a major infrastructure for producing carbonyl there.”

“When will Dawes start?” asked Jacquie.

“Last month!” replied Hun-jai. “It has already extruded thirty kilometers of metal highway northward toward Cassini. Once Dawes’s ability to produce highway modules expands early next year, a fifty-person team with mobile housing will start building highway westward toward Meridiani. They’re more expensive than a metaler, which requires only eight people to run it, but fifty with a crane, robotic welders, bulldozers, and a steady supply of modules hauled in over the completed road can move forward about a kilometer per sol. Meridiani’s metaler has completed six hundred kilometers of metal highway to Kalgoorlie and is starting on the 500-kilometer stretch to Thymiamata. The Uzboi unit will be moved to Thymiamata in March, building eastward until it meets the Meridiani unit next summer; then it’ll shift to building

westward toward Aram and Aurorae. Unit five starts work at Cassini next fall, northward toward Dawes; we should have that connection completed in 2078. In January of this year, a fifty-person team will start on a connection between the Uzboi Highway to Thaumasia; they'll use modules produced at Uzboi. In January a fifty-person team will start at Aurorae and work westward to Tithonium as well. All three of the teams are temporary until we can replace them with metalers."

"What did the Chinese say?" asked Henry.

"They accepted a half billion redbacks for the cancelation of the contract and purchase of the license," said Jacquie. "The fact is, not only can we make these units ourselves, we can improve on their technology. The Chinese really can't test a carbonyl metaler in simulated Martian conditions on Earth; not cheaply, anyway. Martech's expanded civil engineering department can. We'll have six functioning units in the time we could have imported four from Earth and can make as many new ones as we need. So, we're on target to have a continuous metal highway and pipeline from Uzboi to Cassini by 2080?"

Hun-jai nodded. "With all the economic advantages that implies: the ability to share energy among all our major settlements and move very large quantities of goods very cheaply among them. It'll be an economic revolution."

"It may be my most important accomplishment as Chief Minister. Mikhail, how are the immigration plans going?"

Mikhail Shtockman, Jacquie's Minister of Space Exploration, nodded confidently. "Pretty well; we've planned much better for this columbiad. The first two galleons leave Earth about November 1 on a three-month trip here. They'll use solar thermal engines to slow down before aerobraking because of the high arrival speed, but that also means they'll have good radiation

shielding during the trip, so it is certified for transport of children. The two galleons will drop off their 650 each and immediately head back to Earth, arriving there in six weeks; again, they'll need solar thermal propulsion to adjust their arrival speed so that aerobraking is possible. They'll reach Earth on the day of opposition, load up immediately, and head back to Mars on a six-week trajectory, using solar thermal to adjust their arrival speed, and because of the quick transit they'll transport a thousand each. Again, they'll be rated to carry children, because of the quick passage and the hydrogen propellant. So two galleons will be able to carry a total 2,300 people. United Space Express and Lufthansa are both using a galleon and two caravels on four-month trajectories and will transport 1,000 people each; crowded, but inexpensive. Green World Community will be bringing 150. And we'll be sending two galleons and two caravels on six month trajectories with 1,500 more people. That brings us 5,950 people. The earliest arrivals will be late January of next year and the latest arrivals will be early July, so they'll be spread over almost six months."

"We'll have two corvets at Phobos in March, when the largest wave of arrivals hits," said Alexandra. "One will have been undergoing flight testing; the other won't be flight ready, but will have life support. Together, they'll give Phobos the ability to accommodate 2,000 people. That'll be plenty of accommodation for the arrivals before they fly to the surface. One of the corvets flies to Earth via Mercury in late spring, where it will become the new LEO Hilton. It'll normally accommodate 150 tourists in luxury accommodations, 400 kilometers above the Earth's surface, but during our transport periods it'll accommodate a thousand immigrants in transit. That'll solve a lot of our launch problems."

"Good, because the twenty-first columbiad is supposed to bring 9,000," said Jacquie. "Amazing to think that we have almost 18,000 people here, and in a year we'll have 24,000."

“And our GDP is advancing very impressively,” added Hun-jai. “In spite of the fall in PGM prices and the slight drop in gold production, we’re doing alright. Our domestic economy, including space vehicle production but not including metal and deuterium exports, has grown from 4.5 billion to 5.5 billion and should hit 6 billion next year, thanks to robots and automation. This represents a doubling of production of consumer goods, to about 400,000 redbacks per family per year. It also includes the potential to produce two billion a year of androids, robots, prospectors, satellites, and other equipment needed on the moon and on other planets.”

“So, what will that do with imports from earth?” asked Jacquie.

“Decrease them,” replied Hun-jai. “We are importing 5,000 tonnes this columbiad, but we may be able to cut that to 4,000 next columbiad. We could cut it even more, but we need to spend our gold profits on something. We can now supply 4/5 of the equipment a galleon full of people need to go to Jupiter, Saturn, Uranus, or Neptune; 4/5! We’re turning out four 20-megawatt reactors per year now; Jumla, Kalgoorlie, Thymiamata, and Alba all have one, and will get another one in the next three or four years. But I have two concerns to mention: the terrestrial economy, and hydrogen production.”

“The hydrogen supply is an issue,” agreed Mikhail. “We’ll be struggling to loft enough from the earth’s surface and the moon for the twentieth columbiad. Solar thermal engines save propellant mass, but they require hydrogen. And Alexandra and I are reviewing the possibility of switching to new 1150-second bimodal nuclear engines for most of our transport needs. They will use hydrogen more efficiently, but we’ll probably need even more of it. ”

“Phobos is already having trouble producing enough,” added Hun-jai. “Demand may soon hit 50,000 tonnes per year in Earth orbit. Helium-3 production on the moon is producing 1,000 tonnes of ‘waste’ hydrogen per year; not enough. If all of the hydrogen came from the

moon, it'd require production of 400,000 tonnes of waste oxygen; a huge pollution problem for the telescopes there, considering that the moon's entire atmosphere used to mass only ten tonnes. Phobos needs to make about 25,000 tonnes of hydrogen per year to handle transportation in and out the Mars gravity well. It's had three minor moonquakes as a result of the extraction. Prometheus rockets can launch hydrogen from Earth to low Earth orbit and from Aurorae to Martian orbit; we can make plenty of hydrogen at New Hanford. A small solar thermal engine can transport hydrogen from Martian orbit to Earth fairly well, consuming the boiloff to power the engine, but more exports to Earth would take a lot of our resources and launch capacity. We need to start to supply hydrogen from Ceres."

"Ceres?" said Jacquie, surprised. "Isn't it cheaper to lift it from here?"

"No. We can use hydrogen from Aurorae also, and we need to develop our transport capacity to launch hydrogen to low orbit. But it'd be expensive to export Martian hydrogen all the way to low Earth orbit and would use a huge fraction of our spaceport's capacity. Ceres has an infinite water supply; the crust has huge ice lenses in it and the subsurface ocean has a quarter as much water as all of Earth. They have a drill hole all the way to the subsurface ocean, too, if they ever need to use it. It has no astronomical facilities to pollute with the waste oxygen, much of which could be stored underground or pumped down into the subsurface ocean if they wished. They are now producing lots of cobalt and nickel. They could easily produce big hydrogen tanks, fill them with hydrogen, add a small oxygen tank and a cluster of home-made pressure fed engines, and launch hydrogen to Mars. We could capture it or use a gravity assist to send it to Earth. A tank thirty meters in diameter and sixty meters long could store 3,000 tonnes of LH<sub>2</sub>."

"They'd need a lot more power, though," said Jacquie.

“Several megawatt-years to fill each vehicle, but they can make solar cells, which are very effective there with concentrator mirrors. The other thing to remember about Ceres is that there are now a dozen companies clamoring to invest there. We need to move fast to encourage them, and the best way to do that is to send the galleon *Herschel*, which is scheduled to go to Ceres in mid 2077, to Earth in the late fall. It can pick up passengers and cargo and head straight for Ceres in December, when a launch window from Earth to Ceres opens. That’s a year before a launch window opens from Mars.”

“We know what the *Herschel* will carry, and some of it has to come from Earth, so we could be ready,” agreed Mikhail. “We could send a caravel from Mars to Ceres in 2077 as well.”

“Okay, look into it,” agreed Jacquie. “Especially if Ceres can start hydrogen production. With a solar engine to serve as a sun shade against boiloff, they could send hydrogen everywhere.”

“Once they can produce simple engines, they could even send nickel steel to the outer planets,” added Alexandra. “Callisto is mining small lag deposits in landslides and Titan is mining deposits in their methane riverbeds. I think even they could benefit. But the moons of Uranus and Neptune are decidedly metal poor. Ceres could send metal to Jupiter, where a gravity assist could send it to Uranus and Neptune. There, the metal tanks could literally be crashed onto the moons where the settlements will be set up.”

“Ask Martech for a study,” said Jacquie. “That’s an export for Ceres and a resource for our outer settlements. Sounds like Ceres has even more potential than we thought. So, Hun-jai, what about Earth?”

Hun-jai Park sighed. “Oh, Earth. I don’t know whether you saw any of that CIA report that was leaked to the New York Times the other day? It’s getting quite a lively debate on Earth; it’s controversial.”

“The one about increased political fragmentation and regional wars?” asked Jacquie. “I read it. What do you think?”

Hun-jai looked at Henry Smith, Alexandra, and Mikhail. “The report argues that the most recent war has produced an economic change whose implications are serious and destabilizing. I refer specifically to the new technology that we are benefitting from; the ability to set up, for a few tens of thousands of redbacks, a robotic manufacturing system able to turn out large quantities of items, even complex items that must be assembled robotically. For example, we can now manufacture our own rangers here; we can turn out a hundred a year. The total physical plant would have cost a few tens of millions of redbacks on Earth, as opposed to a billion-redback investment in the more distant past. Our cost is four or five times more because of import and construction costs, but the principle is the same. This technology became necessary when the war disrupted the flow of goods across the globe; every country started a crash program to make as many things as it could, often by stealing patented designs and making them public. It was expensive, but not anywhere nearly as expensive as it would have been in the past because of three-d printing and robotic assembly.

“What are the implications? First, large scale manufacturing firms are going out of business. Small and medium scale operations can turn out high quality items locally; a department store, for example, can buy the rights to make an item and produce it based on demand. This is the revolution that has stocked our stores with unprecedented quantities of consumer goods in the last few years.

“Second, it has made countries less interdependent on imports and exports. This has weakened the Grand Union and has stopped monetary integration. It has also weakened central governments in countries with potentially rebellious regions, which have become more economically independent. It has cut into tax revenues because people are making more things for themselves or for informal bartering arrangements. Overall, it has made citizens less interested in space exploration, too, because we are more self sufficient and they feel more autonomous. It has reinforced the isolationism that has spread in many areas.

“Third, it has deepened the unemployment crisis and increased the ranks of the permanently unemployed or the unemployable. India has suffered the most from this tendency. India survived the war quite well, but internal unrest is spreading as robotic manufacturing eliminates low-skilled jobs. Even the United States has seen its unemployment refuse to drop below 10%.

“I think you can see the implications for us. We can expect less support in space, but also less competition from terrestrial countries. We need to be sure we are using many spaceports, because some may be affected by unrest. The terrestrial economy is not likely to collapse, but countries are less likely to be predictable and reliable partners.”

“That’s depressing,” said Alexandra.

“But it fits what we have been seeing,” said Mikhail. “Countries make pledges and renege on them.”

“It’s a good think we pushed the development of Martech, because education will be our salvation,” said Jacquie. “It sounds, Hun-jai, like we can be a little more independent, where partnering is concerned.”

“And demanding,” he agreed. “The U.S., China, and Europe have less at stake, beyond low Earth orbit. The technology helps them less, the expeditions are less nationally prestigious, and the population is more distracted by other issues, like unemployment and pensions.”

“We’ll have to talk to our diplomatic team about that conclusion,” said Jacquie. She glanced at the chronometer. “I have an appointment in a few minutes, but I think we’re finished here. Anything else?” She looked around; no one else had anything to add. “Thank you, everyone.”

They all rose from the conference table and headed to their offices. Jacquie stopped to talk to a few people, but when she got to her office, she saw that her appointment had already arrived: Will Elliott, Silvio DePonte, and Érico Lopes. “I apologize for being late gentlemen,” she said. “So, this is the ‘Homestead Company?’” She looked at the white hair on their heads and couldn’t help but think they were as un-homestead looking as any group could.

“Well, it’s better than the ‘Geezer Company,’” replied Will, noticing her glance at their thinning hair. “We have eight investors, including Mr. Hans Muller himself.”

“That’ll keep Muller Mining out,” said Jacquie.

“Yes, he has pledged not to purchase any tracts in what we’re calling ‘Airy Borough’; the 15-degree quadrangle south and west of Airy Crater. The initial capitalization is 27.3 million redbacks. Silvio is the treasurer, I’m CEO, and Érico’s secretary.”

“You can buy a lot of range for that much.”

“Not enough, actually, but Sibireco and Consolidated have agreed informally not to purchase anything in the next five years,” replied Will. “We’ve bought hundred square kilometer blocks with known gold reserves; 15 million redbacks worth. We’re holding ten million in reserve. The rest goes to support services, and that’s why we’ve come here this sol. As we

understand it, the Commonwealth has pledged a million redbacks to road clearing in Thymiamata, Meridiani, and Kalgoorlie.”

“Correct. The companies are doing quite well with their small gold recovery teams; they’ve sent out ten teams of four personnel each and will send out ten more in the next year. They’re recovering seven million redbacks of gold each, on average. So we’re plowing some of the tax revenue back into the expansion.”

“That’s exactly what we’re asking for,” said Silvio.

“We want to put a million redbacks into the homesteaders, too, but we don’t know where to put the roads and other infrastructure,” replied Jacquie.

“We’ll advise you,” replied Will. “For now, a class-3 road from Kalgoorlie to Airy is essential; that’ll make movement to the borough much easier, especially in emergencies. We’re spending half a million on a prospecting team from Martech-Cassini to search for additional gold deposits and half a million on remote sensing analysis. We hope to identify thirty potential homesteading sites in the next six months. We already have six, three of which were purchased before we got involved. Once we have those sites, we need a class-3 road to connect all or most of them to Airy crater. We’re sending a well-drilling team down with the prospectors; as sites are identified, wells will be drilled at some of them. Then we’ll send down a team to set up radiation shelters. We’ll prepare a half dozen sites at a time, in order to stay ahead of demand but not waste resources.”

“We’d love it if the Commonwealth paid for the wells,” said Silvio. “Water is one of the big problems homesteaders face.”

“Thirty or forty wells?” Jacquie considered. “That’s probably two million redbacks. That’s a good investment for the Commonwealth to make.”

“We think so,” said Silvio. “We’re also investing 300,000 redbucks to pay Martech’s computer sciences department to automate and provide artificial intelligence for the older gold extraction equipment.”

“And we’re identifying old equipment that can be repaired and brought back into service,” said Érico.

“How will you get your money back; land sales? Sounds like the Commonwealth’s investment will generate your profit!”

“That’s what we’re counting on, frankly,” said Will. “The Commonwealth will get back the two or three million redbucks it invests through the taxes that result. We’ll charge twenty percent more on the land we resell, which will cover our investments in the geological research, the new software, and other support services. We hope to generate a ten percent profit; we’re not making lot of money.”

“In fact, it’s a lousy investment,” added Silvio. “A ten percent return in one year would be good, but we’re thinking it might take five to ten years to sell the plots. We could lose a lot of money.”

“You’re right,” agreed Jacquie. “But what you bring to the process is order and predictability. That’s been the problem up to this point.”

“We figure, once the borough’s population hits fifty, they should elect a government,” continued Will. “At that point, we’d like to sell the Homestead Company to the borough and let it expand it through its own taxes and Commonwealth subsidies. That could happen in two or three years.”

“And this creates a model for building other boroughs,” added Silvio. “If there are others, that is.”

“Oh, I am sure there will be,” replied Jacquie. “The technology for homesteading is pretty good, now, and there are lots of scattered resources that a couple or a small group could exploit profitably. This might even be a model for a Commonwealth ministry. I want to thank all of you for thinking about the future of Mars so foresightedly.”

“I think it’s one of our values up here,” replied Will. “We have to look long term and medium term as well as short term. When you do, you see ways to benefit everyone as well as oneself.”

“And working together; that’s another value up here,” said Silvio. “Even when we are supporting individual initiatives.”

“I’ll take your proposal to the cabinet next week,” promised Jacquie. “I want their input. But this looks very good.” She rose to say goodbye and escort them out of the office.

Will, Sergio, and Érico conferred briefly on the steps of the Commonwealth Building, then went their various ways. When Will entered his house, Ethel looked up. “How’d it go?”

“Quite well, I think. Jacquie was supportive and complimentary.”

“She should be. It was a good plan. I’m glad we were able to help.”

“I feel like I was able to do some good, this sol,” said Will. “Retirement can be boring at times!”

“You’ve had a series of interesting tasks. We need to find other areas with scattered gold. For that matter, we need to find more high-PGM impactors. We could use another Uzboi.”

“That’s for sure.” Will sat on a chair opposite her and pulled out his communicator. He had received several messages while in the meeting. “Oh something from Martha Vickers.”

“Really? Haven’t heard from them in ages.”

Will pointed the communicator at the nearest wall screen and pushed an icon, so the videomail would play there. He was pleased to see Martha and Sirikit seated side by side.

“Good sol, Will,” said Martha. “Siri and I have been appointed a task force of two—with Cai Xiaopeng as occasional member with veto—to plan a conference we’re calling ‘Building Community on Callisto.’ Our goal, basically, is to define a set of common values for a Callistan community. Most of us here are Marsians, but about forty are not, and most of them are on the *Tienan*. As you remember, before Charles and I left for Callisto, you talked to Charles about the need to move Callisto toward settlement status, with an elected government. That proved impossible, but with the arrival of the *Galileo* we can make a new start. So our first step is a conference; the second step is to elect a committee to draft some bylaws. We’re hoping that gradual approach will bring everyone along, or as many along as possible.

“It seems to us that you have defined the Marsian values—or in this case they’re Mariner values—in various speeches. In one of your annual addresses you spoke about developing ‘a governing system that minimizes disruptive dissidence and a social system that gives everyone education, health care, and employment.’ We’re basically trying to balance the individual and society in a new way. Sirikit told me about a conversation she had with you about the word ‘commonwealth’ and the need to balance greed, self-advancement, and competition with a communal focus. You’ve written a number of articles for *Mars This Sol* about this theme. We’d like you to pull your thoughts about this together and give the keynote address for our conference.”

“Maybe we should mention some of the other speakers we want to invite,” added Sirikit. “We had a great seminar on the flight out on the ‘Twenty-first Century Confucianism and Mariner Culture.’ Dr. Hong Cixi, who is on the *Gan De*, was very supportive, and we’ll ask her

to talk about *li* or ‘true humanity’ as it relates to our community. Martha’s going to speak—I’ve convinced her—that she has a lot of insight to offer, as a result of three decades of counseling practice in space. We’ll probably ask Helmut Langlais or Patrice Domkowski to talk about their experiences running small settlements, also. Patrice could be controversial, though, because he was elected at the end of Mercury’s very controversial first vote.”

“Please let us know whether you can participate,” concluded Martha. “We plan to hold the conference August 7<sup>th</sup>. Please say hello to Ethel for us. Bye.”

The screen faded to dark. Will stared at it, fascinated. “A clever plan to build unity,” he said.

“And a great opportunity for you to summarize your philosophy,” said Ethel.

He nodded. “I have to do it, and in my retirement, I don’t have much else I have to do, anyway.”

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Bill Hollingworth headed for the control room with a smile on his lips and a spring in his step. His wife Suzanne was well, in spite of only six weeks left to her pregnancy, and she had assuaged his guilt for being away with yet another assurance that it was the right thing to do for humanity. She was at Aram Outpost, Mars, nearly two hundred million kilometers from the asteroid on which he was located.

Themis control room was next to the captain’s quarters, so it was a quick trip. Irene Langlois was the day officer. “Morning,” he said. “Anything to report?”

“Morning, Bill. There seem to be two problems; one easy to fix and one more complicated.”

“Hydroponics?”

“No, they have that fixed; looks like we won’t have to dip into food reserves. The wheat has recovered quite well from the insufficient nutrient mix in the water and they have fixed the bug in the software. That’s really an unbelievable error!”

“That’s what we get for reprogramming everything.” Bill shrugged.

“No, the minor problem is with the plasma engine; voltage fluctuations. Jerry has shut it off and is suiting up now to check out the electrical system. He doesn’t think it’ll delay things, though.”

“I hope not. If we don’t get the rotation of Themis adjusted to 24 hours by next June, dome construction will be delayed. You can’t blast a beam of hydrogen plasma through a dome!”

“He knows and assured me to assure you he’d have everything working fine by afternoon. The bigger problem is with the dome extruder; trouble with one of the Kevlar rope production units. Cynthia and her team are busy repairing, but we may lose a day or two of production.”

“Damn. More trouble with that blasted extrusion unit.”

“At least the repairs to the plasma engine will have more time.”

He smiled at that. “At the rate we’re going, we’ll have Themis rotating once per 24 hours a long time before we have her enclosed! I’ll head out and help. I have a meeting with the Prophet at noon and I want to be able to give him a clean report.”

“I’ll be here in the control room and will let you know if there are any anomalies.”

“Any *more* anomalies. Thanks.” Bill turned and headed for the dorsal EVA preparation area. He and his thirty-five crew members had come to Themis a month earlier on the caravel *Materra*, a flying saucer shaped spacecraft thirty-two meters in diameter, with a curved bottom covered by a heat shield for aerobraking and a flattish top. Inside the tough outer shell was a

rotating interior, which gave them centrifugal gravity up to half a terrestrial gee; sleeping quarters and work areas were in the outer areas where gravity was higher and hydroponics occupied the lower-gravity middle. The flat dorsal top had also provided storage for several hundred tonnes of cargo essential for their mission.

It took less than a minute to reach the dorsal EVA area, located on top of the *Materra*. He quickly pulled on his space suit, attached and checked the life support pack, ran the diagnostics, then exited the rotating part of the ship and floated weightlessly up a tunnel to the airlocks on the caravel's "roof." Thirty minutes after leaving the control room, he was outside.

The top of the caravel, 15 meters above the surface of Themis, gave a great view of the rolling, gray, airless, nearly weightless asteroid all the way to the close horizon just a few dozen meters away. Themis was small: 312 meters in diameter. It was roughly spherical except for a large crater that occupied much of the southern hemisphere, centered not far from the South Pole. The crater had been made by a nickel-iron impactor and much of the southern hemisphere was underlain by metallic fragments and chunks. The caravel had landed close to the North Pole, the "highest" part of Themis, much of which was a pile of fragments of the original carbonaceous chondrite crust, with nickel-iron chunks mixed liberally in.

A few dozen meters from the caravel, at the exact North Pole of Themis, they had built a one-hundred fifty meter tall pylon called "the mast." They had assembled the pieces on the flight out—a tricky task to complete from the dorsal top of the caravel—and had erected it during their first two weeks. Bill could see a robotic crew busily extending the mast upward another fifty meters and attaching large solar panels to it, for it was in perpetual sunlight and thus could provide them all the power they needed, which was a lot. Three other towers were going up 120 degrees around Themis from the North Pole on higher points on the rim of the South Pole crater.

Attached to the mast, also, was the first strip of the dome they were building around Themis. It extended southward beyond the close horizon, to the extruding unit that was rolling across Themis's surface, manufacturing the dome as it went.

Bill turned away from the mast and the large spherical water tanks they had set up on the metal platform at its base and surveyed Themis around him with a mystical eye, rather than a scientific one. Almost daily the Prophet, Tree Rivers, had urged everyone on the team to "feel the spirit of Themis, daughter of Gaia, the embodiment of divine order, and act on its promptings." As commander of the Themis expedition, if anyone had to feel the spirit of Themis, it was he. Yet even when he prayed to Father Mars and Mother Earth, and prayed to Themis, daughter of Mother Earth, he still felt nothing—or almost nothing—in return. The best he could get was an image of the lifeless chunk, green with trees and grass, as it would be in about five years if all went according to plan. Increasingly, it made him feel guilty and uncertain that he should be on this airless fragment of a world, rather than at the side of his wife.

Bill turned and fired the jets in his backpack to send himself horizontally in the direction in which the 30-meter wide dome strip ran. Unfortunately, the extrusion unit hadn't gone far; a mere 150 meters. In less than thirty seconds he had to fire the jets on his backpack to head toward the surface. He carefully landed on a metal platform that extended from the extrusion unit, where the magnets in his boots could provide some stability.

"How's it going?" he asked Cynthia, as soon as he touched down.

She had stopped her work and walked over. "We can use some extra hands; could we spare someone from the pylon three installation or the drills?"

"I can stay two hours; if that's not enough, we can get someone from another project. What's it doing?"

“Temperature problems again, and ingredient mixing problems . . . you name it. The modifications for zero gee just aren’t adequate.”

“One problem at a time. Can you install a bigger fan and resolve the thermal problems?”

“Yes, that’s what we’re doing.”

“Why aren’t the other modules with the smaller fan overheating?”

“They will; the fans are all strained. This one began to fail.”

“Then let’s replace all of them while we can.”

Cynthia nodded. “I think that’s best. But it’ll use up all our spare fans. I don’t know how we can ever catch up on our production targets.”

Bill sighed. “I know. I’ll talk to the Prophet. If we can’t resolve these problems, we’ll need a lot of spare parts.”

“Or dome sections. Aurorae could make the entire three domes for Themis in a few months. If we could get even one dome completed—or better, two—the third dome could be completed here, slowly. If you want my professional estimate, this dome extrusion unit will take us a year or more of tinkering and modifying to get it working properly. It’s theoretically possible. If someone set a unit up on Phobos and paid big for a Martech team to work on it, it’d be done faster and better. It won’t be easy for us to do it.”

“And it won’t be cheap, either way.”

“Exactly. We’ve got a team of thirty-five here scheduled to do a lot of work that is dependent on dome manufacture.”

“And a hundred about to leave Earth to set up an ecology that can’t be set up, without a dome.”

She nodded grimly.

Bill considered the situation. “Alright, I’ll tell the Prophet when I call him at noon. He won’t be happy. This is not something that praying to Mother Earth and Father Mars can help us with.”

“I agree.” She looked at him a long moment. “I think I felt Themis this morning.”

“Really? What did you feel?”

“I was half asleep, half awake, just before I got up, and I suddenly had this feeling of warm embrace from her, like she was relieved we were here and were bringing her alive. It was an amazing feeling; I really can’t describe it. The pylons, the dome, the plant life: I felt the extension of *networks* over her surface, and she was pleased.”

“Really? That’s the most concrete experience anyone has reported, so far.”

“And you haven’t felt anything?”

He hesitated. “Perhaps a little,” he replied. “It has been just two weeks since the Prophet encouraged us to feel the spirit of Themis. It’s still early. I think she has to awaken.”

“Perhaps,” said Cynthia, a note of skepticism in her voice.

He pointed to the unit. “Let me help.”

Cynthia nodded and pointed to a task Bill knew how to do, and well. He had become very good with mechanical things over the last year. Over the next two hours, the team was able to replace the fan, test it, and get the extrusion unit working again. It was quite amazing to watch it, once it was functioning nominally; it was able to extrude a strip thirty meters wide and three meters wide every hour. But as fast as that was, a single dome around Themis would take a year, and they needed to produce three, then pump thousands of tonnes of water extracted from Themis up the towers and into the space between the domes, to provide them with radiation shielding and thermal control. It was an enormous task.

Crisis managed, Bill headed back to the *Materra*. He organized a quick report, then recorded it to send to Tree Rivers, the prophet of the Green World Community. “The last 24 hours have seen some progress, Prophet,” he began. “The problem with the hydroponics has been fixed and our food production should be fine. The masts are going up on schedule. The drills are operating down in the southern hemisphere crater and have begun to hit some permafrost, as predicted by the ground penetrating radar. Our goal of extracting our water supply via what will be the bottom of our future ‘sea’ is moving forward. But the plasma engine is down and shouldn’t be back up for another day, so that delays our work on Themis’s rotation rate. And the extrusion unit has major problems with overheating in zero gravity. It appears we have to replace all the internal fans and we don’t have enough of them. We may be able to rebuild some of them, but that will take a lot of hours. That means we probably can’t get the first dome up in time to do some preliminary pressurization to double Martian pressure levels. This is a serious problem because if we release too much water onto the surface, it’ll heat up, boil, and raise the air pressure to dangerous levels. I just ran another computer model. We won’t be able to start terraformation on time, at the current rate of production of dome material. We need at least one additional dome from Mars. When the crew arrives from Earth, we can set them to work processing the surface material; crushing rocks or sifting them out, piling rocks in craters, preparing large areas where plants can eventually be grown, etc. I’d rather try to stay on schedule, but to do that we’ll need a dome from Mars. I know that’s big and expensive, but I don’t see any other way.

“I’m sorry to send you such bad news. I feel like I’ve failed you, prophet . . . I really do. I’m sorry.” A tear came to Bill’s right eye. “I’m doing my best here. Morale is pretty good and we are working well as a team. But the equipment couldn’t be fully tested before it was brought

here, and it is only here that we could be sure what the problems would be. So we are doing our best to fulfill your wishes, prophet. Bye.”

Bill sent the message with a sigh; he hated to send bad news almost every day. He checked his emails and responded to a report from the team erecting mast 1. At least their work was going well. And fabrication reported that they’d be able to complete two ten-meter sections of mast in the next three days, now that they have enough nickel-iron meteorite to obtain the necessary metal. Inventory, however, reported that the nitrogen supply was dropping faster than projected and they’d need to import a lot more to complete the dome, unless the chondrite proved a richer supply than projected.

Then Tree Rivers responded to Bill’s report. He opened it eagerly.

“Thanks, Bill, for the sentiments and love you expressed, and the loyalty. It means more to me than the bad news, believe me. I know how difficult it is to do what you are trying to do. Aram was incredibly difficult to get started. We struggled and suffered. But look at it now, over twenty years later! So look to the end of the project, not the beginning, and see the final result: a green Themis. It will happen; I can see it already.

“As for a dome from Mars, I received the premonition about your need earlier and have already ordered it. I think we’ll be able to send it in December or January. So don’t worry about that. Themis will be terraformed. Bye.”

The screen went blank and Bill stared at it in astonishment. How did the prophet *know*? But then, that’s what prophets did; they knew about things in advance. Still, Bill worried a bit, as he had never heard of Rivers doing that before. It was remarkable, but unexpected.

4.

## Challenges

August 2075

“I feel very honored to be invited to open your conference about Building Community on Callisto,” Will Elliott began. “When I look back to 2028—almost fifty years ago—and Northstar 1, the return of human beings to the moon after the Apollo Project, I am filled with wonder at all we have accomplished in this half century. Consider that Northstar 1 was 59 years after Apollo 11, and for 55 of those years, human beings never left low Earth orbit. But what have we accomplished in the 47 years since Northstar 1! Human beings are on or in orbit around every planet in the solar system but the last two, and when 59 years have passed since Northstar 1, there’s a good chance the last two holdouts will have human communities as well!

“We’ve learned a lot about the technology to move people and cargo around the solar system in the last 47 years. But we are still uncertain how to build communities up here; there are different models. Gradually, I think, a general model is emerging, and it has huge implications for life back on terra firma. Let us hope it can help our angry, confused, disunified cousins on Earth how to live together better and in peace.

“Two facts shape our life up here. First, we are away from our home cultures. That means we are thrown together with others from other places and we have to make it work. Second, the air is neither free nor ubiquitous. Our envelope of air is fragile and can be lost in a matter of seconds or minutes, with drastic consequences.

“These two facts are the basis of what people have begun to call ‘mariner culture.’ The facts pull us in two directions: one, away from others and toward our own group; the other toward vigilant and careful cooperation. Even Mars, with its many enclosures, is not safe from

the loss of its air and ecology. Disaster can strike here just as easily as it can on Callisto; indeed, considering our greater complexity, we are more vulnerable in some ways.

These two facts force us to focus on the issue of trust. No society can be built without trust; the wars, trade retaliations, and social unrest on Earth demonstrate this truth all too well. But for us, the consequences of loss of trust are far more grave, because our air is endangered. We must talk, but we also must listen. We must speak the truth, because a lie can endanger our air; but we must speak the truth carefully, because truth expressed through anger or through selfishness may not be heard, and that can endanger our air.

“These facts force us to focus on selfishness. If we are out just for ourselves or our group, it can endanger our air. In a sense, true selfishness is altruism, because it is working with others, long term, that allows us to advance. Our air forces us to consider long term trends and not worry about day to day matters.

The consequences of our diversity and the fragility of our air have serious implications for our social organization. The principle of executive authority must be balanced by the principle of consultation, as expressed either in a council or a community meeting. The latter works best when the community is small, but when it grows large, a council works better, for obvious reasons. Any community needs one person to have ultimate responsibility, but that person’s sphere of action must be defined by the community, one way or another. Ultimately, the sphere of action and authority must be defined in writing. Too much centralized authority can create strife, undermine morale, and endanger the air supply; too little central authority weakens oversight and responsibility and endangers the air supply.

“On Mars we have found that voting without candidates and campaigning has some powerful advantages. First, no one is motivated to make lots of promises, whether good or bad.

No one is motivated to attack or tear down anyone else; we can treat each other professionally and courteously. No one is motivated to divide and conquer, an age-old tactic used to weaken opponents in order to dominate them. Nothing could endanger our air supply faster than ethnically based strife. If we meet to discuss potential good ideas as a group and watch each other express their experience and character, then we can vote based on whom we feel is most responsible and experienced, not who made the best promise or frightened us the least. As a result, Marsian governments are elected through the confidence of the voters, not through their choice of the least objectionable person, and the people can trust their government. That protects the air supply.

“Of course, the only way to make this system perfect would be to eliminate the people from it. For we are fallible, we tend toward selfishness sometimes, we are suspicious sometimes, and we sometimes tell only part of the truth. But we can also be motivated to admit our mistakes and atone for them, to serve others, to speak truth to power, to do what is right even when it hurts us, and to take a leap and trust when we don’t really want to. This is the so-called angelic side; the side that, if allowed to flourish, will ensure our air supply the best. For a community to flourish, it must strengthen the angelic side of its members. Some of that has to come from the example of the elected representatives; that really is the best way. But it puts an even bigger burden on the electors to choose wisely. The humane qualities and values of the elected leaders will set the tone for the society.

“Is this impossibly pie-in-the-sky? Yes, if we expect our leaders to be perfect. If we expect that, we can only be disappointed. But that doesn’t mean we should set low standards. It is standard leadership theory that leaders must lead by example. We need to set the bar as high as we reasonably can and raise it over time, as we can. Mars can’t expect its leaders to meet such

standards, after five years of independence. But our leaders, so far, seem to be of a higher caliber than most of the politicians on earth. That is what will protect Mars's diversity and its air supply. That is the goal mariners must aim for everywhere.”

Will Elliott nodded in thanks to the audience listening to him in a Martech auditorium, where there was vigorous applause. The crowd in the atrium of the *Galileo* applauded vigorously as well. They could not see the audience at Magellan Station, in Venus orbit, which had decided to eavesdrop on the conference and add their own discussion, but they were applauding as well.

Sirikit looked around the room. Chen Wei was sitting in the second row, frowning and not applauding. She rose and walked to the front. “In a moment, Martha Vickers will come up here to offer her comments and response. What comments do you have?”

“Great!” exclaimed someone.

“Hopelessly optimistic,” replied Chen Wei.

Martha rose and walked up front. “Dr. Elliott made a very interesting comment; that leadership theory also stresses leading by example. He is quite right about that, it is a standard observation in leadership seminars and books. It's also a standard comment about democratic elections, that elected leaders must lead by example. For that matter, it is a standard observation about good parenting. The question is, how high do we set our standards? That isn't a question of optimism or pessimism. We have to set our bar somewhere; that's a responsibility of any society.

“Let me give the example of Dr. Elliott himself. These are things he doesn't like to say, but they are fairly well known. During the war, he expended over half his personal wealth on charities on Earth and on private businesses on Mars, which were struggling. He and a group of investors just invested twenty-seven million redbacks on a company that may or make a profit to support homesteading. He took homeless people into his house after a fire. He is generous and he

has a reputation for honesty and trustworthiness. Jacquie Collins, his successor, has a similar reputation for integrity.”

”But how do we know?” asked someone.

“We never know someone’s character for certain,” replied Martha. “But we need to get to know people and assess their characters as well as we can. There aren’t so many of us on Callisto that we can’t do that. On Mars, people elect representatives from their neighborhood or area and the representatives have the obligation to get to know the characters of people who can be elected Chief Minister.”

“This entire conversation is assuming we are settlers when we are not,” injected Chen Wei. “It really is irrelevant.”

“I’m sorry, Commander, but many of us *are* settlers,” replied Beverly Lowell, one of the crewmembers of the *Barnard*. “My husband and I are planning to stay here on Callisto for some time. In fact, we plan to start our family here in the next year. That means we will be needing day care in a year or two and teachers shortly thereafter. Of the 191 of us who arrived, some 50 of us have made long-term commitments, which means Callisto will have 25 children in a few years and as many as 50 in a few more years. I know you are a national astronaut. But you aren’t planning to stay all that long. Fifty of us are making that long term commitment and another fifty or seventy-five are here medium term, some of whom may also make a long term commitment. My children will not be employees. They’ll be Callistans.”

“And mariners,” added Hong Cixi, whose comment startled several people.

Chen Wei was not moved. “Then clearly Callisto has no unity, and that will make the election of the sort of administration we just heard about very difficult.”

There was a long silence after that. Then Martha said, “if we have any questions for Dr. Elliott, we need to send them now. He’s 45 light minutes away, so we won’t get his responses for 90 minutes. We’ll send him some questions now, we’ll take a break, I’ll offer a few comments, then we’ll hear his responses.”

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”Here they come,” reported Goldi. The automated assistant for Giovanni and Holly DiPonte knew they were waiting for the arrival of their new neighbors and had been maintaining a watch for them.

Holly glanced at the chronometer. “About time; it’s 3 p.m.!”

“They probably had a lot of packing to do this morning,” replied Giovanni. “It’s a big move.”

“I know.” Holly looked around. “Hard to believe we’ve been here ten months already.”

“It really is. Time flies.” Giovanni glanced out the window at the rolling cinnamon-gray terrain outside. Their land. In ten months, they had grown quite fond of it. They had welcomed the isolation at the time, but now they were eager to have neighbors.

A moment later a ranger appeared over the southeastern horizon, pulling an old portahab, a vehicle rather like a terrestrial camper. It was followed by a used and dirty-looking Conestoga—a larger pressurized vehicle—pulling a trailer of equipment. “Thorvald and Monica Erstad splurged,” said Giovanni.

“I don’t know; it looks old. We have a Conestoga,” observed Holly.

“True. I suppose I shouldn’t project anything on them.”

“It won’t fit in our radiation shelter. They’ll have to park outside.”

“I don’t think they’re planning to stay here anyway; they have their own land.”

“I just meant tonight. I hope they’ll stay and visit for that long.”

“I hope so, too, since we have all this food almost ready!” He glanced at the microwave, which had automatically started to heat up the big chicken casserole dinner they had prepared.

The two of them stepped out of their Conestoga and into the B-75, their transparent plastic bubble of Earth, so they had a good view of the arrivals. People began to wave to them from inside the two arriving vehicles and they waved back. Lars and Celeste Petersen set their porthab to drive into the radiation shelter automatically and dock to the Conestoga’s cab, thereby connecting the vehicles together; the Erstads parked their Conestoga and waited until the portahab had made its dock, then told their vehicle to dock against the portahab’s rear airlock. In about ten minutes the three vehicles formed an airtight chain and people could move from one to the next easily. Giovanni and Holly went back into their main cabin to await the arrival of their guests.

Lars and Celeste were first; he was Norwegian and she was Ugandan, as white and as black as human skin could be found, with blond and black hair and blue and brown eyes respectively. Thorvald and Monica were nearly as diverse; Thorvald was a blond-haired, blue-eyed Norwegian like his best friend, while Monica was of Quechua background from Peru. She was the one the DiPontes had never met before. “It’s so good to meet you!” said Holly, embracing Monica.

“Thank you so much. I’m very happy to meet you as well,” she replied, in heavily accented English. “You have a nice, comfortable place, here.”

“Lots of radiation shielding!” exclaimed Lars. “Good to see your androids have been hard at work!”

“Now that we have them programed and adjusted to the work, they do an excellent job,” replied Giovanni. “We’re pumping almost a tonne of water from our well every sol, now. Half goes in the B-75 to extend the garden and the other half is added to the radiation shielding. The surplus solar heat from the B-75 is going down the well hole, also, to heat up the rock down there.”

“The garden’s looking pretty good,” said Celeste. “Did I see tomatoes?”

“Yes, and they’re yielding well, now,” said Holly. “I can give both of you a kilo, if you’d like.” She pointed to their small table, around which they had squeezed six seats. “Sit down.”

“Can I help?” asked Celeste and Monica simultaneously.

“Yes, sure, but there’s not too much. Take the salad to the table. Sorry it only has lettuce, tomatoes, and cucumbers! That’s all we’re growing.”

“I can give you some ideas for other things to grow,” said Celeste.

“We should coordinate what we grow, and trade,” added Monica.

Holly pulled the chicken casserole from the oven and brought it to the table. “That’s a good idea because I only know how to grow three things, now!”

They all laughed. She sat and dished out food for everyone while the salad went around. “So, in an email you hinted at a big find,” noted Lars to Giovanni.

Giovanni nodded. “You know how it is; you can mine for weeks and months and recover a half dozen or a dozen grams per sol and wonder how you will make ends meet. And then you hit a pocket of nuggets and everything changes.” He paused. “Two weeks ago we hit such a pocket. In two sols we recovered 1,135 grams of gold.”

Lars whistled in admiration. “A hundred thousand redbacks; very nice!”

“We’ve been here 260 sols and had averaged about 9 grams per sol, so this was one third of our haul so far,” agreed Giovanni. “You never know when you’ll hit a pocket, though.”

“I hope the placer deposits on my land have pockets,” said Thorvald. “But we’ll just have to start and see what we get.”

“Have you decided where you’re going to put your residence?” asked Holly.

Thorvald nodded. “There’s a fairly fresh 1-kilometer crater that punched most of the way to the permafrost table, so we plan to set up there.”

“Not far from the edge of our land,” added Celeste. “We’re setting up about 2 kilometers from them.”

“I thought you were going to set up next to that prominence?” said Giovanni, surprised.

Lars shook his head. “This should be more convenient because we can share resources and divide up tasks.”

“We’re planning to rotate cooking meals, for example,” said Celeste. “We can add the two of you into the plan, if you want.”

“Happy to do it,” added Monica to the DiPontes.

Giovanni looked at Holly, surprised, who looked back to him the same way. “Yes, we’ll participate,” he agreed, though he wondered about the convenience to everyone; the crater Thorvald was referring to was about fifteen kilometers away.

“I should add that the Homestead Company said they’d drill a really big, deep well and install a solar power plant we can all use, and we suggested they put it in Erstad Crater,” said Lars. “It’s the logical spot because it’s the only place nearby where the permafrost table is close to the surface.”

Giovanni nodded. “That makes sense.” It also occurred to him, though, that a two-kilometer power cable wasn’t all that expensive, and Lars and Celeste would benefit from that placement as well.

“It’ll make methane and oxygen, too, so it should be fairly easy for you to obtain power from it,” added Thorvald. “It wasn’t my idea to put all these things on my land, believe me!”

“That’s alright,” said Holly. “It does sound like a good arrangement.”

“What about radiation shelters?” asked Giovanni.

“When the Homestead Company team arrives with the deep drill in two weeks, they’ll also bring four radiation shelters,” replied Lars. “They’ll place our two. The other two they’ll place on the ore vein farther to the northeast and southwest so that others can homestead to those spots. Once the radiation shelters are in place, there’s a supply of water and power, and there’s a good dirt track—the Commonwealth team to bulldoze a track arrives with them—we can expect to acquire more neighbors.”

“We might actually have five couples!” added Celeste. “We’ve talked to a lot of people in Kalgoorlie who are jealous of us.”

“We’ll be a borough in no time, at this rate,” said Giovanni with a smile, but it sounded like he was not happy with the possibility, even though he was. “Do we know the route of the new dirt track?”

“It’ll go from Kalgoorlie straight to Airy Crater. It’ll be a brand new route,” explained Lars. “Then it’ll come here, then past our two homesteads to the northeast, with a branch from here to the southwest following the gold. We’ll all be on it. After that, it’ll snake around to known gold concentrations.”

“And my father, Elliott, and a few other old timers set it up,” said Giovanni. “Our government couldn’t, but the old timers could!”

“They got the gold companies to hold off and not take over the area, too, so we’d have a chance,” added Thorvald. “I’m not sure the four of us would have gotten down here as quickly as we did, if the Homestead Company hadn’t come along.”

“I thought you were planning to arrive back in June!” said Holly.

“We were,” confirmed Lars. “But it’s complicated to make plans, when there are so many unknowns.”

“So, what are your plans for the next few sols?” asked Holly.

“Set up,” replied Lars. “We both brought down solar arrays and we’ll set them up right away.”

“Helping each other, so it’ll go faster,” added Thorvald.

“And we’re splitting one B-75,” added Celeste. “We’ve learned from you that one is too big for a couple! We’ll set it up in Erstad Crater, where the water is, and where its excess heat can be routed underground. I’ll be working on that.”

“And I’ll help,” added Monica. “We were hoping we could borrow some water from you, so we could get it started. We won’t have a functioning deep well for 5 or 6 weeks, they say.”

“Of course,” said Holly. “We’ll be glad to haul it over.”

“No, we can come get it,” replied Lars. “No reason to inconvenience you anymore!”

“No, it won’t be an inconvenience,” replied Holly. “We want to be involved.”

“We insist,” added Giovanni.

The other four looked baffled for a moment. “Oh, alright,” agreed Lars. “Thank you, the four of us appreciate the gesture.”

“No problem,” replied Giovanni. “There are only six of us down here; we have to work together. The four of you are already close. We don’t want to be left out.”

“That’s true; sorry, we didn’t mean to look like a clique,” said Thorvald, looking at his wife and the Petersens, who nodded.

5.

## Enclosures

Late August 2075

Charlie looked at the expanse of plastic in front of him with amazement and pride. It filled a “trench” 100 meters long, 50 meters wide, and up to 50 meters deep, thanks to the berms of regolith they had piled up along the edges of the trench. Two robotic bulldozers had worked for over a month on it, and after they finished a team of workers, including Charlie, had carefully unrolled the C-100 enclosure across the space.

“So, was it difficult?” asked Firuz.

Charlie turned; Firuz and Jean-Paul had walk up from behind him, so he hadn’t heard them arrive. “It was slow and tedious, but not difficult. I’ve never done something manual with fifty-five other people in spacesuits! The enclosure masses 100 tonnes, but in this gravity it weighs 12 tonnes, and we just pushed slowly to unroll it. The trench was designed with a slight downhill slope, which helped. It took 90 minutes.”

“Thanks for doing it,” said Jean Paul. “We had to assign four of our people to do it.”

“How was the expedition? I wish I could have gone!”

“Good,” replied Firuz. “But you didn’t miss much. The exposures were typical cryo-regolith, mildly lithified by impact shock.”

“Callisto is the largest iceteroid in the solar system,” commented Charlie.

“Exactly,” said Jean Paul. “The most important part of the trip is the relationship with Chen Baozhi and his team. The more we focus on our professional relationship, exchanging insights into the geology and critiquing each other’s papers, the more we get to know each other.”

“So, are you offering seats to them for the trips to the outer moons?”

Jean Paul nodded. “Definitely; we’ll add four of them to the trip to Himalia. In return, they’ve agreed to add at least one or us to their expeditions across Callisto, which they have studied with great thoroughness.”

“And the probes, androids, and prospectors we brought for Io, Europa, and Ganymede, obviously, are for both teams,” added Firuz. “That was always the arrangement, since China paid for some of them. But it appears we won’t just split them between two teams. We’ll plan research projects together and build teams for each project based on interests, regardless of citizenship.”

“Well, sometimes,” added Jean Paul. “The Chinese are concerned that they get credit *as a team* for a lot of the work, in order to justify their funding.”

“Politics; it can’t be avoided,” said Charlie.

“Exactly,” agreed Jean Paul. “We have to show our accomplishments as well. But if we presented a list of fifty projects and all were collaborations, the Commonwealth wouldn’t complain; they’d say ‘great work’! The Chinese are in a different situation.”

“Have you gotten a sense how many of them are in favor of voting?” asked Charlie. He looked at Jean Paul in particular.

Jean Paul thought a moment. “There have been only the subtlest of comments because we are assiduously avoiding politics. But my impression is that many of them are not opposed to voting.”

“I agree,” said Firuz. “None of them are ‘settlers’ of course, but they want this place to grow and become stable. They see that it can have a future. And once the future involves hundreds of people and families, it needs to have an elected board of education and culture, for example.”

“At least,” agreed Charlie.

“So, what does Sirikit pick up, running the store?” asked Jean Paul.

“She overhears a lot of conversations around the latte machine,” replied Charlie. “By the Chinese crew as well, because they’re often sitting with the Brazilians or the Vietnamese from the *Tienan*, and those conversations are in English, as often as they are in Chinese. Some Chinese are in favor of an election; some are opposed. The Brazilians and Vietnamese are in favor of elections. About half the Chinese on the *Gan De* seem to be in favor.”

“That sounds right,” agreed Jean Paul. “What do they think of Chen Wei’s various outbursts?”

“Some thought they were inappropriate.”

Jean Paul laughed. “He was a dickhead! He did more to advance the cause of elections that Sirikit and Martha could have done!”

“And guaranteed that the subject would cause disunity,” said Firuz. “That’s the sad thing.”

“He has forced us to break eggs to make an omelet.” Jean Paul shrugged.

“Oh, look!” said Charlie, pointing at the enclosure. The plastic mass had started to move.

They watched a few seconds. “Rising just like the French bread in my mother’s oven,” said Jean Paul. “Wow, it’s going up pretty fast, for such a huge enclosure!”

“They’re just inflating the outermost three envelopes. Each has a volume of more than 16,000 cubic meters. They’re putting a tonne of oxygen into each, raising the air pressure to five percent of the Earth’s atmosphere at sea level. That’s enough to keep slightly warmed water from boiling, which allows it to spread out in the envelope longer before freezing, but it keeps the

pressure down low enough so that very little oxygen dissolves into the water, which will make the ice clearer.”

“So, we’ll be able to look outside through it?” asked Jean Paul surprised.

“Probably not, but when the sun rises, we’ll know it inside, and we’ll be able to see the disk indistinctly. They *think*.”

“Making these two enclosures was a real bitch of a job,” said Jean Paul. “Pierre Archambault was telling a bunch of us at breakfast the other day that as chief of construction, they wanted him involved. The combination of plastics is very different from the combination used on Mars because of the cold temperatures.”

“On *Uranus*,” added Charlie.

“Yes; this is the first full-scale test of their system. It’s even different from the combination of plastics used to make the bubbles on Titan, but those had to deal with methane and other organic solvents, as well softer cryogenic conditions.”

“I’m amazed we’re inflating and moving into *two* of these enclosures,” said Charlie. He pointed. “It’s almost half way up, now!”

“When will we be able to go in?” asked Firuz.

“We asked,” said Charlie. “They can put three hundred tonnes of oxygen into the enclosure in a day or two, but they also need to heat it all and keep it reasonably warm, and they want to test the integrity of the layers. It’ll probably be a week, and we’ll have to wear special shoes to protect the plastic. Once the first section of floor has ice filling all three envelopes underneath it, they’ll drill down through the ice to emplace steel anchors into the Callistan regolith underneath and install nickel-steel plating. The first thing they set up inside is the

nickel-steel processing facility, so they can start producing very large nickel-steel sheets and beams in order to set up the enclosure.”

“I wish Vickers had been able to accumulate more meteorites for us,” said Jean Paul. “Then we wouldn’t have had to postpone the Himalia mission a month. But we’ve been able to collect enough for the fabrication and soil production folks to get started.”

“At least Vickers was able to build up a supply of fifty tonnes of nitrogen,” said Charlie. “That’s enough to get enclosure 1’s atmosphere buffered to some extent. We’ll be dealing with a rather low oxygen content inside in order to suppress flammability until we can get the nitrogen content up.”

“There will be plenty of nitrogen in the 50,000 tonnes of water they have to process and pour into the envelopes,” said Jean Paul. “Well, gentlemen, I’m going inside. I’ve been on my feet five hours and I’m tired! Besides, I have a meeting with Commander Cai now. Politics.” Jean Paul shook his head and headed for the construction shack and its airlocks. Charlie reluctantly followed; he had wanted to watch the enclosure inflate to its full size. But it was rather like watching bread rise.

The three of them went in and stripped off their space suits, then went their separate ways along the various tunnels. Charlie headed to the *Galileo* to see what Sirikit was doing. The store was pretty busy at the moment, but since people could get robotic help for everything, she was busy pouring over economic data and generating an analysis for Dr. Park, her economics advisor, on Mars. She kissed him when he arrived. “Dr. Park was pleased with my report on gold and PGM futures.”

“Are they fairly predictive?”

“They’re not bad; Dr. Park actually seems to be predicting the price a bit better! The news is mixed, as usual: further economic decline, which means stronger gold prices and weaker PGM prices. But the price of platinum itself has been strengthening because it is being used increasingly as a precious metals investment, so the PGM prices are holding up better than expected.”

“That’s good news for Uzboi and Ceres.”

“It is. Ceres has started producing cobalt ‘cannonballs’ with PGM ingots inside; they finally have the molds set up and ready to fill. So they are stockpiling the spheres for export, once the Prometheus launcher and the guidance and control systems arrive.”

“Yeah, dad told me they’ll start producing nickel-steel roadbeds in three months,” said Charlie. “They’ll just produce them and make a pile. Once they get the road-laying machine they’ll start building a ‘highway’ around Ceres from Central to the two other high-platinum impactors. I still can’t imagine a metal road on Ceres!”

“I wonder whether Ceres could send nickel-iron this way?” considered Sirikit. “I’ll have to ask the construction folks. I get the impression they’re spending a lot of time trying to find nickel-iron meteorites and refining them. With gravity assists from the various moons, a nickel-iron sphere could be dropped here pretty easily, or even on Titan.”

“Titan would be even easier, with its atmosphere,” said Charlie. “And if they started sending spheres to Uranus and Neptune in the next year or so, there would be reliable supplies of metal there when the crews arrived.”

“That’s a thought! I’ll suggest that!” she agreed.

Just then, Sirikit’s communicator beeped with an incoming videomail from Mars. Charlie’s communicator beeped simultaneously. “Who’s trying to reach both of us?” she said.

“Wicahpi-Luta and Esther!” exclaimed Charlie, reading the names on his screen. He sat down next to his wife and activated the videomail, so they could both watch together.

Their good friends looked incredibly excited. “Hey all!” exclaimed Wicahpi-Luta, for the message was being sent to all their friends at once. “We just got accepted to Uranus-1! We are absolutely thrilled!”

“I’m thrilled I got accepted, because I didn’t think I would!” said Esther. “Of course, mom and dad will be very unhappy, but what can you do! The expedition is now scheduled to depart in early 2078; two and a half years from now! We’ll start in low-level training next summer, when the rest of the crew will be selected.”

“And I guess we’ll get married, eh?” said Wicahpi-Luta.

“Yes, we’ll get married next summer!” she replied, giggling.

“So our lives are set for about five or ten years; a rather frightening thought! The crew going to Uranus is mostly young; they intentionally aimed for ‘settlers’ because of the long distance. Three galleons and 444 adults; they’re going to be packed full, 1,000 tonnes of mass each, not including the hydrogen propellant. Looks like about half those going have just come from Earth or will come from Earth in the next year. And we’re not going with a lot of androids and prospectors and satellites, by the way; we’re going with the equipment to *make* them instead! The goal is a virtually self sufficient community. It’s so amazing!”

“A real privilege to be accepted!”

“Anyway, we’ve got to talk to our parents, now. They probably know because they were watching for the announcement, too. Hope everyone is well; looking forward to hearing from you! Bye!”

“Bye!” added Esther.

The screen went dark. “Wow, they did it!” said Charlie.

“I’m not surprised. Wicahpi-Luta’s going to be an amazing propulsion engineer, and Esther doesn’t even realize how smart she is,” said Sirikit.

“Our generation has done pretty well.”

“Mars can be proud of its children.” Sirikit saw Jean Paul entering the store. She waved to him; he smiled, though rather seriously, and walked over.

“You just met with Cai?” asked Charlie, sensing the serious mood reflected the meeting.

“Yes, with Vickers and a reluctant Wang Chenguang. Martha Vickers was there, too.” He paused. “We’ll ask people whether they want to elect something.”

“Really?” said Sirikit. “Sort of like a poll, then?”

“Exactly. If a clear majority wants an election, Cai will call one.”

“What about Chen Wei?”

“To hell with him,” replied Jean Paul.

Sirikit frowned at that. “I hope we don’t make things worse.”

“All we’re doing is asking people for their opinions. That doesn’t make things worse. But Chen can if he wants.” Jean Paul turned to the latte machine and issued it a verbal order. Then he waved goodbye with his drink and headed out.

“Hum,” said Sirikit. “The vote will certainly be positive. Everyone in here is talking about having an election.”

“The conference did create a consensus among most people,” agreed Charlie. “Let’s reply to Wicahpi-Luta and Esther.”

She nodded. They sat together and Charlie held his communicator out in front of them so that its camera would take in both of them. But just then their communicators buzzed with another incoming video. “It’s Giovanni!” said Charlie, pushing play instead.

“Everyone’s congratulating them.”

The screen was blank for a moment, then Giovanni appeared. They could see Holly in the background, but she wasn’t part of the conversation. “Hello Wicahpi-Luta and Esther and congratulations! I’m not surprised at all! You’re both among the brightest and most talented and will make great additions to Uranus 1. How long are you planning to stay? It’ll be at least two years to get there, right? I suppose you’ll be away at least a decade, then, longer if you start a family. So incredibly exciting. I’m very excited for you.

“Things are finally looking up here to some extent. There are three couples in ‘Airy borough’ as we’re calling it. The other two couples are good friends with each other and that’s awkward; we feel like the odd ones. The Commonwealth just sent a robotic bulldozer this way. It left Kalgoorlie yestersol. Turns out, they’ve been clearing type-3 roads south of here for months for the mining companies! Thanks to the Homestead Company, they’re now clearing roads for our borough. They’ll reach Airy Crater in just three sols; the equipment can operate 24.6 hours per sol with minimal remote supervision. It was supposed to come here next, then spread out across the borough, but it turns out it’s heading straight to Erstad Crater, where the other two couples are located and where the Homestead Company plans to drill a well and install a big solar power array next month! So we’re ticked off about that. But Erstad’s only fifteen kilometers away; it won’t be too bad. And we’re finding more gold now, so the payback is alright. We love our land.

“Anyway, keep in touch and good luck with your training. Congrats again. Bye.”

“Interesting,” said Charlie. “I’m glad to hear that Bill’s ‘crazy’ idea is working out alright.”

“Still, I wouldn’t do it,” said Sirikit. “A little bubble of air, only one other person, and hours from help? And not even a big income!”

“I agree, but for some people the independence is important, and the land . . .”

“Yes, land is special. All of us can’t wait to have the first enclosure open, even if it’s just for a walk ‘outside.’”

“Exactly,” agreed Charlie. He held up the communicator at arm’s length so both of them were visible on the screen, then reached up and pushed the button.

“Hi Wicahpi-Luta and Esther!” he began. “We are thrilled with your news! Congratulations! Like Giovanni, we *aren’t* surprised. You will make great Uranians, or Mirandans, or whatever you’ll be. Or maybe you’re just a new species of Mariner, I don’t know. I think we are already a new species of Mariners, this Mars-born generation, scattering to the four corners of the solar system! And our kids or grandkids will be heading for the stars!”

He turned to Sirikit, so she said, “Congratulations again! I’m proud of both of you; really, of all of us. We’re lucky or blessed, I don’t know which, with opportunities most never get. Here Charlie and I are on Callisto; I never could have imagined that! And Giovanni, homesteading in Airy; Charlie and I were marveling at the risk, but also the idea of having your own land. We’ll have a big bubble—50 by 100 meters—inflated in a few days, but it’s for 250 people. You have *square kilometers* of space! I guess all this is part of being a mariner as well; independence but in a group, opportunities, teamwork. I guess that’s my definition! And soon there will be a version of it in Uranus space.

“Not much new here. We’re going to take a poll about voting. After the conference about the future of Callisto, in spite of some steadfast opposition, most people wanted a civic organization of some sort. The *Galileo* is all settled in and unpacked, and we’ve started to set up the new Callisto station facilities. So two steps forward and half a step backward, I guess. That’ll be part of Uranus as well. Bye.”

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Bill stood on a narrow, steep edge of the rim of South Pole Crater and looked up at the dome.

“It’s really coming along. It’s hard to believe.”

“It is,” agreed Cynthia. She nodded, but it wasn’t visible in their spacesuits. “Of course, after 43 days, at 72 meters per day, we should have produced over 3,000 meters of dome; that’d be six loops around. It’d be ten percent of the total surface area. But we have only four loops.”

“A year and a half of work to get one dome finished.” Bill contemplated that. “The *Illumination* left Earth two days ago and will be here in five months with 100 people.”

“We already have at least one micrometeoroid pinprick in the dome, too. The seismometer picked up the vibration of the impact four hours ago.”

“That’s easy to fix. The Prophet has ordered a dome from Phobos; last I checked, it’s scheduled for launch on January 5, but it’ll take eight months to get here because it needs to come via Venus. Can we take a strip of dome material—say, 100 meters long—knit the ends to make a cylinder 10 meters in diameter, and close the ends? That’d give us a temporary enclosure to start setting up the ecology.”

“We can, but that would require us to cut a 100-meter section off the big dome, then knit a new section onto the stub. That’d take several days. Closing the 100-meter section to make a

cylinder would take another week or so. So it would definitely delay our progress further. Have you prayed to Themis about this?"

"I have, but I am awaiting the word of the prophet, not the word of Themis."

"But he asked us to feel the voice of Themis."

"He did, but I would worry about my imagination speaking to me, rather than Themis.

When the prophet speaks, I know what I am hearing."

"That's not his advice, Bill. I hear Themis. She wants the dome; we need to speed it up if we can. If you can give me six more people, Bill, it's possible. We need to keep up with the repairs faster and optimize dome production more quickly. We are up to 2.3 meters per hour. I think it can be doubled if we concentrate."

"Cynthia, we still have to drill the wells, we have to raise the three southern masts higher, we have to string guywires from the north mast to the three southern masts, the ion engine is still acting up, there are nitrogen shortages that will slow dome production if we don't maintain the chondrite processing machinery, we're beginning to run open cycle because we can't recycle water and CO<sub>2</sub> fast enough, we're working 12 hours a day . . . you're not getting six more people."

"Bill, if you knew how to manage this situation better, it would be possible."

He turned to her. "Cynthia, I am confident in your ability to optimize this equipment. Let's brainstorm about the problems, let's consult with Martech, and let's seek the prophet's advice. But you're not getting six more people."

"Okay, Bill," she said dismissively.

“I’ll call Martech and set up a meeting,” replied Bill. He turned toward the North Pole and fired his jets. He soared upward, almost to the dome, then aimed downward and headed toward the caravel. In a little over a minute he had traveled the 250 meters to the *Materra*.

He was agitated by her stubbornness and her implied insubordination. He also felt inadequate, unable to feel Themis on Themis itself. Five of his 39 people had now felt her voice, but she was still silent to him. It bothered him all the way inside, while removing his suit and getting to his office in the ship’s spinning lower floor.

He stared at a picture of Suzanne and their newborn baby boy, Jeremy. He didn’t like the name; the Prophet had given it to him, without explanation. At least Suzanne was recovered from the delivery, which had occurred two weeks ago, and Jeremy was healthy. But they were several hundred million kilometers away. It was another source of frustration and inadequacy.

Domes, domes, domes: what to do about them. He turned to his tablet. “Pull up the dome order from Phobos, please.”

“Acknowledged.” In a flash the screen updated with the invoice and specifications. The dome his crew was building was 551 meters in diameter. Phobos was providing one 554 meters in diameter and another one 557 meters in diameter made in hemispheres that they’d knit together. The void space between the top and middle domes and the space between the middle and lower domes would be filled with water—3 million tonnes, perhaps a third of the water in Themis—to shield them from ultraviolet and radiation, and radiator fins extending from the both poles would cool the water envelopes to remove accumulating solar heat and freeze some of it into ice. It was a simple, elegant design, assuming it worked.

His eye fell on the invoice details. The domes were massive and heavy things, 300 tonnes each. They'd still have to manufacturing cabling to wrap around them and ensure their integrity; meanwhile, the air pressure would have to be kept down. His eye fell on the order date.

*15 July 2075.*

That surprised him; he looked more closely. No question about it. The problem was that the Prophet had assured him he had just ordered the two domes on July 10, the day he had called to apologize for the delays. There was no doubt about it; he was sure of the date.

The Prophet had lied.

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“How dare you call a vote.” Chen Wei stared at Cai Xiaopeng. He hadn't even said hello or sit down.

Cai sat in a chair and gazed back at Chen Wei, saying nothing for a moment, seeing whether the man would calm at all. He did not. “This isn't a vote; it's a poll. The software is very basic. You log in, enter your name and email address, click either yes or no to the question ‘do you want a proposal for civil organization,’ and if you click yes, a box appears for ‘comments suggestions, and nominations.’ When you're done, you get an email indicating you have completed the poll and containing the results. Simple.”

“Then stop the poll immediately.”

Cai pulled out his communicator and tapped an icon on the screen. “As of this instant, after three hours, 67 people have already participated. It's too late.” He turned the screen so Chen could see the number.

“There will be severe consequences for this act of insubordination. I suggest you resign your commandership of the *Galileo* immediately.”

“I was given that commission by the Commonwealth of Mars, not the Jupiter Commission. I serve at their pleasure, not the Jupiter Commission’s.”

“Very well.” Chen stared at him a moment. “Get out of my office.”

“A pleasure to speak to you, Commander,” replied Cai. He rose and walked out.

6.

## Drafting Committee

September 2075

“I still can’t believe he appointed me,” Sirikit said Beverly Lowell, the *Barnard’s* expert on remote sensing. Beverly had come into the store for a latte.

“I’m not surprised, Sirikit. You have a great vision about the future, you’re bright and articulate, and because you run the store, you know just about everyone. Commander Cai knows that.”

“Thank you. What do you think the drafting committee should do?”

“Me? I think we should aim to become a borough of the Commonwealth. I don’t trust the Chinese or the Jupiter Commission, which is a political body, not dedicated to the exploration of Jupiter. Mars is the best anchor we can get.”

“I agree, but it’s the Commonwealth of Mars, not the Mariner Commonwealth.”

“Maybe they’d be willing to change their name, or sponsor a wider umbrella organization.”

Sirikit nodded, digesting that idea. “A wider umbrella organization; that’s a thought. Maybe that would be possible.”

“Maybe. I doubt the various Commissions and nations would agree to it, though. The Commissions system sucks. These worlds need to be thought of as communities that are semi-autonomous, and their autonomy grows as they get larger and more self-sufficient.”

“That’s the standard theory,” agreed Sirikit. “But the devil is in the details. We have almost 300 people here. What stage should we be in? That’s the question the drafting committee has to resolve.”

“Better you than me! We need to elect a council of five or seven members and a Chief Executive who has emergency powers.”

“That’s standard, too, like Ceres, Titan, and Mercury. I’m sure we’ll be looking at their charters closely.”

“Of course. Good luck!” Beverly picked up her latte from the machine and waved goodbye. Sirikit waved good bye and walked back to her table, feeling a bit frustrated. Public opinion, if it could be called that, appeared to be inconsistent and vague. She sat and immersed herself in gold production data. Cassini and Dawes had both started shaft mining with robotic diggers, installing ice barriers to prevent collapses. The Meridiani boroughs had shifted many of their people and equipment to small oasis operations. As a result, gold production was moving up. She preferred to work with data; it was something she had control over!

But after an hour, she found herself unable to concentrate. The first meeting of the drafting committee was that afternoon; she yearned to have a clear idea what to propose. She put up a sign that she would be away the rest of the afternoon—the store ran itself anyway—and headed for the enclosure. She put on special overshoes to protect the plastic surface and entered. Since the enclosure had been inflated two weeks earlier, the contents of the construction shack had been moved through the freight airlock into the first section. A metal walkway led from the smaller personnel airlock around the construction area and down to the floor, where a series of greenhouse bubbles had been inflated. The hydroponics of the *Galileo* and the *Barnard* were rapidly being transferred to them, so that the living and work space in those vehicles could undergo further expansion.

At the time, two people were jogging in the hundred by fifty meter space, which was shaped like a sloped soccer field; up one wall until it nearly reached vertical, then a quick turn

around, a diagonal jog back to the bottom, and a run straight up the other side. It was excellent exercise, in spite of Callisto's 1/7 gee. But Sirikit was more interested in just walking, looking, and thinking. The first thirty meters of the enclosure was completely surrounded by ice, which in Callistan temperatures froze as hard as concrete. The floor was cold, in spite of the overshoes. Sunlight refracted through the nearly transparent ice shell; the sun was a shimmering but fuzzy ball and the nearby crater rim was a vague shape. When she walked past the section encased in ice, however, she was just looking through three transparent sheets of plastic, and the Callistan surface spread out before her. She walked up the sloping bottom as high as she could to maximize the view. The enclosure was oriented southward away from the northern interior slope of Outpost Crater, so the view of the entire crater was impressive. She wished they could install some windows to keep the ice away from a few spots; it'd be nice to be able to look out, especially those personnel, such as herself, who had no reason to suit up and go outside. She made a note to suggest that to Commander Cai.

At the far end of the enclosure, she watched the robotic bulldozers doing their work to prepare the ground for enclosure 2. It would be inflated in two months, giving them even more pressurized, heated space to run around in. Of course, the result would be about the size of two to five suburban house lots on Earth, but it was enormous on Callisto. It would be very welcome.

Sirikit headed back into the *Galileo* to attend the meeting, hoping that she would find some inspiration. Gradually, the six of them gathered: Charles and Martha Vickers, the experienced couple who had been on Callisto six years; Sirikit Thanarat-Langlais; Firuz Moulin, their resident "philosopher"; Hong Cixi, a physician on the *Gan De* and resident Confucian expert; and Phan Quang Ty, friend of Sirikit's father and a resident of the *Tienan*.

“As all of you know, we had a committee to draft a charter, back in 2070,” said Martha. “I can project it onto the screen, if you want. We put a lot of time into it, didn’t we, Ty?”

Ty rolled his eyes. “Wow, did we; hours and hours, over weeks and weeks! We even had equivalent texts in Mandarin, English, and Portuguese!”

“But almost all the Brazilians have left, since then,” said Charles. “I appointed half of that committee; I remember the work well. I wish Xiaopeng hadn’t appointed me to this committee. I’m not sure the memory will help our friends on the *Tienan*.”

“You are our resident graybeard,” replied Firuz. “People respect you, Charles.”

“They do,” reiterated Sirikit. “Martha, why don’t you project the text and summarize it quickly? I read it; I thought it was good.”

“So did I,” said Firuz.

“Alright. I’m glad you liked it.” Martha connected her tablet to the wall screen and projected the ten-page text. “I’ll have to summarize it for now; it’s pretty long. The age of majority is 18, which includes the right to vote and be voted for. Voting is according to the Marsian standard: no mention of names, no nominations, no campaigns, but people are encouraged to say what they think the community needs to do, and the election has to be preceded a week in advance by a ‘Future of Callisto’ public meeting. The Council consists of a Chief Executive, elected biennially by the voters, and six members, also elected by the people at the same time. The size of the Council can be changed by a vote of the Council and ratification by the people; that’s true of all changes to the Charter, actually. Council meetings are closed, but ‘detailed minutes’ are to be made available to the public within a month. The Chief Executive has full emergency powers when she or he declares an emergency, but within a month the Council has to ratify the declaration of emergency. One provision we added that the Ceres

Charter didn't have: if the Chief Executive is incapacitated, the person who received the highest number of votes to the Council becomes his or her replacement, and if any Council members die or incapacitated, the person with the next highest number of votes is added to the Council. Based on this provision, the Council and Chief Executive are infinitely renewable.”

“What about ties?”

“Broken by lot,” replied Martha. “The Chief Executive chooses a panel of three judges, ratified by the Council, whose members cannot be the executive or members of the Council. At least one of the three has to be on Callisto; the other two can be anywhere. A resident judge handles the actual court cases and the three-judge panel handles appeals. The Chief Executive can pardon, with approval of the Council. The Chief Executive proposes the budget and a majority of the Council members must approve. Either the Chief Executive or the Council can initiate legislation; it is approved by the Chief Executive and three Council members, or five Council members if the Chief Executive votes against.”

“But what can they do?” asked Firuz.

Martha smiled, embarrassed. “We never finished that part, because it was subject to negotiation by the Commission countries. But we made a list of powers ‘subject to approval by the voters and the sponsoring nations’; that was the phrasing we used instead of ‘the Jupiter Commission.’ The powers began with ecological and environmental management of all stations, public education of children, sponsoring of cultural and artistic activities, judging of all infractions, misdemeanors and felonies, and budgeting for the same. The second tier included judging capital crimes, licensing and inspection of businesses, issuing titles to personal property and to real property within the borders of the outpost, and budgeting for the same. The third tier included jurisdiction over all of space within the jovian gravitational sphere of influence,

regulating all human travel and deployment of probes in that space, and authority to sign contracts involving the development and exploitation of all resources in jovian space. The third tier, essentially, is sovereignty.”

“Nothing about the powers of war, for example?” asked Firuz.

“If unauthorized passengers enter jovian space, the third tier of authority implies the power to board, investigate, and turn back,” replied Charles. “That’s essentially a military power. It’s all Jupiter would need.”

“The bigger problem is that even first tier authority is a long way away, and third tier is millennia,” comments Cixi. “Well, perhaps not millennia; a century or so.”

“I’m not so sure,” replied Sirikit. “There are two processes at work, after all: our growing capacities and Earth’s diminished interest. “Another galleon, and we’d have 500 people here, and that’s a pretty substantial community.”

Cixi shook her head. “I doubt 500 is enough. We’re importing these gigantic bubbles from Mars, after all, and all our probes and androids.”

“Don’t be so sure,” replied Charles. “I was talking to Pierre Archambault yesterday about the bubbles. He plans to leave in two years, but his assistant, Cindy Tan, is a ‘settler’; she and her husband plan to stay and raise a family here. They’ve been making long-term plans. The next galleon that arrives will bring even more metal carbonyl separation equipment. He told me they’d be able to make sheet nickel-steel—stainless, corrosion resistant—five meters wide and as long as they want. They can make rings 50 meters in diameter and robotically weld them into tubes as long as desired; they could make rings 100 meters in diameter, even 200 meters in diameter, if desired. Assemble the rings, weld them air tight, throw plastic sheeting over them and add water into the space between the ring and the plastic—as thick as you want—and you

have homemade enclosures. We could do it now, but the construction team is too small and the equipment too slow.”

“Just like Titan,” said Sirikit. “They have almost 500 people there now. The formula there is: almost one third of the adults are occupied in fabrication, construction, and maintenance; one tenth in horticulture and ecological management; one sixth in education and health services; one sixth in support services, business, and administration; and one quarter in planetary research.”

“That’s what we have now!” said Cixi.

“And that’s why we’re importing so many things,” added Charles. “With 500, we can also make probes, androids, and simple rocket engines. The technology that is now available is amazing, but you need a critical mass of people with the skills and equipment to use it.”

Cixi nodded. “I concede that point. But we still need national support, and we won’t get that if we insist on even ‘first tier’ authority.”

“I’m not so sure of that,” replied Sirikit. “Because the situation on Earth is changing fast. The technology that makes us independent has also made regions more independent and weakened the power of large corporations. The disruption of the supply chains and power during the war forced many people to purchase solar panels, wind turbines, and three-dimensional printers, and the widespread hacking and disruption of the internet encouraged millions of desperate people to trade in bootleg software. There are many people printing spare car parts in their garages using bootleg designs and bartering them with their neighbors; things like that are now widespread. Another consequence is widespread unemployment and concomitant social unrest. Governments are scrambling to provide unemployment, shore up tax collections, hire people in construction projects, and cover rising pension and health costs. As a result, how many governments have been able to send a galleon to Jupiter?”

“That’s not fair,” replied Cixi. “China has made a commitment to send a galleon, and presumably will be able to do so in two or three years. There are two Chinese caravels here, too.”

“Two Chinese caravels, a Marsian galleon, a Marsian caravel, and a Marsian-American caravel,” said Sirikit. “I mean no offense; China is a great nation, and its commitment has been much larger than the American commitment, even though the American economy is larger and the American space budget is larger. But consider: China’s economy is a thousand times larger than Mars’s. This is the reality of the situation.”

“Even so, China has enough votes on the Commission to block any devolution of authority; even the ‘Tier 1’ authority here,” said Cixi. “Personally, I would support such a devolution of authority. I think many of the Chinese up here would, don’t you? But it doesn’t matter if China blocks it.”

“I agree that most of the Chinese here would personally support an elected civil government,” said Ty. “In that sense, we’re all Mariners.”

“But the Chinese government; what you say is true,” agreed Charles. “If they block any devolution, that’s it.”

“What are the chances they’ll block it, though?” asked Sirikit. “Officially, they aren’t opposed to the elections; just Chen Wei.”

“If the Chinese government wanted to support elections, Chen Wei wouldn’t be an obstacle,” replied Charles. “Their public position, I think, is contradicted by their private position.”

“Oh,” replied Sirikit, surprised and feeling naïve.

“Be that as it may,” said Firuz. “We were appointed by Xiaopeng to make a recommendation *to him*, and he noted we could also publish the recommendation. That’s our mandate; not convincing the Chinese government. Presumably, that will be his task.”

“How will he do that?” asked Sirikit.

“Leave that to Xiaopeng,” agreed Charles. “Firuz is right. I suggest we go over the proposed charter very carefully and thoroughly, sentence by sentence, and ask Martha and Ty questions about every phrase; they will no doubt recall a lot of the discussion and debate that shaped it. Then we’ll modify it, propose how much authority the community should request, and get all of that to Xiaopeng. The next step will be his.”

“Unless the population gets restless,” said Cixi.

Firuz shook his head. “There won’t be a revolution or anything like that. But if the community is unhappy, it will be manifest in other ways; poor morale, more people wanting to leave, etc. And the Commission will have to take all that into effect. Giving the residents what they want will probably be cheaper and more effective, anyway.”

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He hadn’t been able to sleep right for ten days.

Bill Hollingworth turned over in his bed and looked at the clock; 6:30 a.m., half an hour later than when he had checked last. But there was one difference: the holoscreen on his wall had begun to glow. Dawn was approaching Aram and his screen was programmed to simulate the view from the nearest peak of Aram’s rim. In a few minutes the entire settlement and its many domes would be bathed in morning light, and his room would be brightly lit as well.

Time to get up. Bill rose, used the bathroom, then came out to watch the sunrise. He switched to a view on the west side, inside the dome over Genesis crater, and watched the sun peek above the horizon and flood the verdure with life-giving energy.

It was time to call the Prophet.

That popped into his mind as forcefully as a revelation from Father Mars and Mother Earth. He was startled by it and didn't believe it was from either; well, he didn't think so. The Prophet's "contradiction" had been eating at him for too long. It aggravated his anger about the naming of his son, who inevitably would be closer to his "godfather," the uncle of his mother, the Prophet Tree Rivers, than to his own father. All that aggravated his sense of inadequacy in feeling the spirit of Themis, and the silence of Themis made him doubt the Prophet as well.

He sat, pulled up Tree Rivers' internet address, and started a video recording. "Good morning, Prophet. I just awoke and haven't been out to the bridge yet, but I thought I'd summarize yestersol for you. We got the dome production up to 2.4 meters per hour; 59.8 meters in the last 24.6 hour period, to be exact. The production rate is slowly improving. When we finish this 'loop' around Themis, we'll be at an optimal point to cut out a section of dome and manufacture a temporary enclosure, so that when the crew arrives from Earth, they will be able to start setting up an ecology immediately. We still haven't received your permission to do this.

"The plasma engine has now worked properly for five sols in a row; a record! We anticipate that the problems we had with it are in the past and that we'll be able to adjust the rotation of Themis on time.

"One final matter I want to ask you about Prophet." He paused because his voice was choking up. "A matter of great importance to me. You may recall that on July 10<sup>th</sup> I called you because of the problems with dome production we were having, problems we are still having,

unfortunately. You responded by saying that as a result of a premonition, you had already order two domes from Phobos. Not long ago I received the invoice for the domes and I was checking the specifications, which were correct, but I noticed that the dome order was placed on July 15, five sols after our conversation. I was wonder whether you had an insight into this discrepancy.

“Thanks. Bye.” He said the latter word with an air of finality that surprised him. His faith in the Prophet was, indeed, deeply shaken. He sent the message with a shaking hand and felt tears stream down his cheeks. He wondered what he looked like to Tree Rivers, when the message arrived in Aram some ten minutes later.

He went back into the bathroom to shave, shower, and dress. The activity made him feel a bit better, but somehow he felt dead. He had no appetite for breakfast; no appetite for work, even. He wanted to lay in bed and stare at the picture of Suzanne and Jeremy.

Then before he had to choose between the bed and the door, his communicator beeped. The Prophet had responded immediately; only the speed of light had delayed the message.

Tree Rivers looked old and tired. “Thanks, Bill, for the message. I’m glad to hear that the dome is going a bit better. We won’t stop the dome and make an enclosure yet. The caravel coming from Earth has two bubbles, and the two vehicles together have a lot of hallways and other underutilized space that could be used briefly for ecological purposes. So for now, we’ll pursue that strategy.

“As for the invoice, I will be very frank with you, Bill, because you are now a member of my family and I love you as a son. I truly do; you are a pure soul, genuine in your feelings, deep in your faith. Sometimes I do indeed feel promptings from Mother Earth or Father Mars. Sometimes I feel a prompting and I’m not sure which sent it my way. I also feel Themis

sometimes, and there's a fourth one out there as well that has been communicating with me; I think it's Nereus, the truth-telling son of Mother Earth, but I'm not sure yet.

“Sometimes, I can't tell where the prompting comes from; whether it has an external source or springs from my genius. And other times, it is just my own creative genius, and I use Father Mars and Mother Earth as metaphors to describe its source. It's a mix, Bill. But that's complicated to explain; it's easier to just say it's a prompting from Mother Earth or Father Mars. Do you forgive me? That's what happened on July 10.

“I checked last evening with the people on Phobos and they confirmed that the two domes will be ready on time. So the launch is set for January 10, 2076; four months and a week away. Since the caravel will be encased in two 300-tonne domes and will have 500 tonnes of liquid hydrogen and the very latest Sunfire-6 solar-electric thermal engine, it will have radiation protection of nearly half a tonne per square meter, a truly robust shielding and adequate for the transport of children, based on existing regulations. So Suzanne and Jeremy will be on the caravel and you will have them with you by next summer.

“Please be confident in your work on Themis. I am confident in you. Themis will be enclosed within a year. Within 18 months, it will have three domes in place and an atmosphere will be accumulating. It will have a population of almost 200 people and you will be the commander and my ‘chief steward’ on that little world. The entire human race will be looking at Themis in wonder and you will go down in history as its leader. Even your parents will come to appreciate that, Bill.

“Best wishes with your many tasks for the day, Bill. Ciao.”

The line closed; the screen went blank. Bill leaned back and thought about the response. The Prophet had admitted that he had been speaking “metaphorically” on July 10, but that was a

stretch; he didn't order the dome until five days later. It seemed that he was honest about the nature of his promptings; Bill no longer felt so bad that he didn't hear or feel Themis. Perhaps he should listen to his own genius more. And the prophet had closed with a remarkable flash of vision, a quite specific vision. That startled him. It was vintage Tree Rivers; no doubt under other circumstances he would have said it was a prompting from Mother Earth or Father Mars. But it was the vision of an optimist: Themis had 30, 100 were on the way from Earth, and at least 25 would come from Mars in January; in 18 months the dome they were constructing in strips would be finished and the two arriving domes would be in place; and the world would be impressed. In short, it was the reasonable prediction of a genius. But nevertheless, it was impressive.

He'd have to think about the whole conversation, which simultaneously shook his faith and inspired him,

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"I can't believe they killed him," said Will, shaking his head again and again. He, Ethel, Mike, and Liz were staring at an image of the White House with half its west wing blown off.

"It's a terrible day for America," said Mike, and his voice even broke a bit.

"I'm so sorry, Will," said Ethel, and she hugged her husband.

"What will the US do now?" asked Liz.

"There will be a state funeral and a great deal of grief," replied Will. "And all the people who hated President Mennea will express horrible shock and disgust at his assassination and the destruction of part of the White House, while working very hard to overturn everything he managed to accomplish."

"Which wasn't much, because they were against him all along," added Mike.

Will nodded. “That’s the nature of American politics now. It’s dominated by hate of the other side and a determination that the other side accomplish nothing, even if it is in the best interests of the country. Mennea did his best; he was slow to act, but deliberative and built coalitions to the extent he could.”

“He has a reputation for doing very little,” agreed Liz.

“He couldn’t do much,” replied Will. “As it was, the US had to endure twenty percent annual inflation and more than ten percent unemployment—sometimes twenty percent unemployment—because that was the best anyone could do. No one wanted to buy US bonds, or anyone else’s bonds either, because there were no government bonds in the world that were stable and reliable savings instruments. So money poured into property and precious metals, making those bubbles worse. The extreme patriots fought any internationalist efforts and the internationalists fought the extreme patriots, and most Americans just wondered where their nation’s glory had gone and why couldn’t someone bring it back.”

“And no one can, because the rest of the world caught up and the US share of the world economy has shrunk drastically,” said Mike.

“Exactly.” Will pulled out his communicator. “The emails are piling up. People want me to comment.”

“How much did you know him in college?” asked Mike.

“We didn’t know each other well, but we both made an impression on each other,” replied Will. “He had a strong Catholic faith and he wanted to devote himself to serving people. He had considered becoming a priest, but ultimately decided to go into law to assist people with their problems, and from there he got involved in politics. He knew I wanted to be an astronaut and

that I had a passionate concern for the education of minority children. We were both involved in interfaith work. So we were sympatico, you might say.”

“What’s the US going to do now?” asked Liz.

“Well, Vice President Casselberry has become President. She was already running for President and not doing really well in the polls, so that suggests she either has to do something dramatic, or continued to be weak.” Will shook his head. “And one thing the US doesn’t need now is legislative gridlock. There are too many important matters to decide.”

“If they can be decided,” said Mike.

“Yes, if it’s possible.” Will rose. “I had better draft a statement about President Mennea, and while I’m at it, work in pleas for civility and duty to country.”

7.

## Return from Ganymede

“Chen’s absolutely furious,” Martha said to Sirikit.

“How do you know?”

“I was just talking to Dr. Cixi. She met with Chen just half an hour ago and tried her best to persuade him. He accused her of treason and of betraying China; of becoming a *Marsian*, and it wasn’t a compliment. He’ll never agree to the election.”

“What do we do?”

“I told Charles, and he’ll talk to Xiaopeng. We’ll see what he decides. He could always call an election in January, after he takes over the rotating commandship for the year.”

“That’ll make a bloody mess, though; we’d have an elected leader one year and an appointed leader the next. I bet there won’t be a lot of cooperation, either.”

“I’m sure of that, too.” Martha shrugged, “I still think we just need to force the issue and hold the election. We’re mariners, after all. This is not a little national outpost anymore; it’s a settlement with families. You can’t oppose progress. In ten years, Callisto could have a thousand people, including a hundred or two kids. It has to, if we’re ever going to explore the jovian system well and study its implications for humanity. That’s the trajectory of this place.”

“I definitely agree. Mars is committed to this place. The price of transportation is down to about a million redbacks per person, so it is no longer difficult to send settlers, and the technology for manufacturing our own stuff here has advanced impressively. It’s a whole new world, compared to ten years ago. But pushing the matter and creating conflict will exact its own long-term costs.”

Martha sighed. “Yes, I think you’re right about that. But the drafting committee did its job. It’s up to Xiaopeng now. I’ve got to run; I have an appointment in ten minutes. See you tonight. I suspect there will be a lot of questions at dinner.”

“I’m sure. Bye.” Sirikit waved goodbye to Martha Vickers, who headed out of the store and down the stairs to her office next to the sick bay. The drafting committee had spent two weeks reviewing the old charter, revising it, delineating the initial authority—tier one—and just that morning had sent a copy to Cai Xiaopeng and posted it to the outpost’s website. Sirikit sat at her computer and pulled up the discussion board. The charter had already generated twenty comments, nineteen of which were favorable. The one negative comment came from someone with a Chinese name, and Sirikit was pretty sure it was a pseudonym. She read through everything and posted a response to a question, then it was time to head to the airlock. The *Barnard*, with Charlie on board, was on its way back from Ganymede.

There was a small crowd waiting at the airlock area when she arrived. The screen showed the *Barnard* in its final descent. She still found it strange to watch caravels and galleons land. The big, flying saucer shaped craft had a curved bottom—the ventral side—covered with heat shield. Its flat “top” or dorsal side had fuel tanks and engines, so it approached Callisto “upside down,” engines blazing, the useless, curved heat shield on top. The dorsal surface also had surface vehicles in slings, so they could be lowered to the ground after landing.

The *Barnard* had been lightened by removing most of its hydroponics and other equipment for interplanetary travel. It had taken off with 600 tonnes of liquid hydrogen and oxygen and had refueled in Callistan orbit so that it had enough fuel for the trip to Ganymede and back to Callistan orbit, where it had refueled again for landing. Sirikit was greatly relieved to see a huge cloud of mist and snowflakes rise from the surface as it landed a half kilometer away.

Within half an hour, the crew had lowered their two surface vehicles to the ground, exited the *Barnard*, and driven over to the airlock area, and entered the arrival area. Charlie was one of the last ones out.

“Welcome home!” exclaimed Sirikit, waving to him, as he exited the conestoga. He waved back and hurried over. “Wow, you grew quite a beard! It didn’t look that thick on video!”

“Do you like it?” He kissed her; she felt it against her face.

“I don’t know; I’ll have to get used to it first!” She kissed him again, then nodded slightly. “It’s alright.” They started walking out of the airlock area. “Seems like it was a good trip.”

“Yes, it was a good warm-up for the Himalia mission. Ganymede is interesting, to the extent we could see it.”

“The radiation environment really limited you.”

“Our exposure is fine, but we couldn’t go outside at all, except under the ship and for five minutes beyond it. The rangers were pretty well shielded once we put several tonnes of ice on their roofs, so we got in three expeditions that way, but always using the remote manipulators from inside. The Chinese were pretty collegial; we stuck to geology and it worked out fine.”

“And got a lot of samples.”

“That worked out quite well; we recovered all the samples that the Prospectors had accumulated over the last three years, and took some excellent samples ourselves from the best sites. We now have half a tonne of samples of frozen subsurface ocean from three different vent regions five hundred kilometers apart. They’ve never gotten more than thirty kilos of samples before, and with that they were able to identify ten species of bionts. And the two automated rangers we left there with a reactor should be able to make a complete circumnavigation of the

moon over the next two to four years, stopping at every ocean vent and crustal fracture system that's known. That's the exciting development; we now have a hugely expanded telepresence on Ganymede. Europa's next, but the rangers and the reactor will have to be delivered remotely and deployed robotically because the radiation will fry humans in hours."

"And Io?"

"A few more months. We don't have as much to deploy there because of the high radiation and because Callisto doesn't have the personnel to support major activity there. Callisto needs to host four teams of a dozen or more each, just to continue the research on the four Galileans. What has been the reaction to the charter?"

"Most people are in favor, but apparently Chen Wei is totally opposed."

"We were talking to Dai Guofeng briefly before landing. He had looked at the charter website. He said 'good' which I think was as positive as he dared to be in public. The Chinese crew, by and large, want a civil authority here. They know it's a necessary part of the future of this place."

"The problem is the Chinese government." Sirikit shook her head. "I worry for this place. It's impossible to build community."

"We'll have to stick to professional relationships. The geologists get along fine when they stick to geology!"

"Yes, that works, but I have to do something, as director of arts and culture."

"Watch out. The problem, basically, is politics."

"It is, but I can still bring people together over other things; concerts, movies, lectures. And now that the initial set-up period has passed and work hours are cut back to normal, it's possible to schedule events."

“But hasn’t Park been running you ragged with research requests, since I left?”

“Oh, yes! Ten hours a day! The U.S. stock market hasn’t recovered from the plunge following Mennea’s assassination, President Casselberry has been unable to inspire confidence—all the lawsuits against Mennea have been transferred to her—interest rates are going up everywhere, real estate markets are slowing, several nations are threatening to reestablish tariff restrictions, the price of gold is going through the roof and the price of PGMs is dropping . . . it’s absolutely crazy. It’s impossible to tell whether Mars will make its budget or not, sol to sol, and all national space commitments are looking shaky. But my primary job is supposed to be here, anyway, so I’ll have to tell him I need to spend more time here. I’m sure Cai would agree. He’s been very generous with me.”

“He has been; he has been very kind.”

“What about striker? You’re going to be here for two months, before the Himalia mission starts. Could you adapt it to Callistan gravity? There’s plenty of room to play it at the far end of the enclosure.”

Charlie thought about the idea. “We can give that a try. The four teams that played during the flight out might be interested. It’d be great exercise, too, so Cai would support it. Alright, I’ll talk to people at the dinner tonight.”

“Thanks.” She kissed him. “By the way, did you hear? The *Herschel* is going to be sent to Ceres via Earth next year.”

“Really? Why?”

“Mars proposes to expand Cereran exports of hydrogen and nickel steel, and there are a lot of terrestrial companies that want to invest in Ceres. We’ll see whether the economic slowdown causes any of the companies to back out of commitments. But even if they do, Mars is

in a radically different position than it was before the war; it has twice the population and four times the economic output. It can guarantee loans to them or step in as a substitute.”

“It’s a real country!” agreed Charlie, with a laugh.

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Charlie and Sirikit remained in their quarters half the day and emerged about an hour before the dinner welcoming the crew of the *Barnard* back to Callisto station. When she returned to the store, Martha was sitting at a table with Jean Paul Poirier, Pierre Archambault, and Phan Quang Ty drinking coffee and talking. She headed toward them, but just then Commander Cai waved to her from another table, so Sirikit detoured over to him instead.

“What do you think about moving the store into enclosure 1?” he asked.

“You mean, away from the atrium?”

“No, we’re moving the entire contents of the atrium to enclosure 1 at the same time; the kitchen, eating areas, store, the hair and beauty salon, and meeting rooms. It’ll be two months. We can probably give you twice as much space.”

“Yes, that’ll be good. Enclosure 1 is neutral territory, too.”

“I agree, that’s one reason for accelerating the move. It’ll be the center of Callisto Station. We want to convert the atrium into additional living and work space, especially once we can increase the rotation rate of the *Galileo*. With fabrication and agriculture moved out, we’ll have three times as much space for housing. That’ll make Callisto Station more pleasant.”

“Excellent. I wanted to check with you about something: I want to announce a film series and a series of cultural and musical events. Charlie will reorganize the striker teams, too, because the enclosure provides a big space where a low-gee version of the game can be played. We hope these events will help build some unity.”

Cai considered a moment, then nodded. “Yes, do them. It’s very important and will help.”

“I doubt they’ll resolve the issues.”

“No, but they’ll be an element in the effort. Good idea, Sirikit. Make an announcement tonight at the dinner.”

“Alright, I will.” She walked away from Cai’s table and toward Martha’s to elicit additional help. There was a long list of people to find and talk to in the next hour or so, especially the Chinese on the *Gan De* who had led discussion of Chinese films.

“Sirikit, we need your help,” exclaimed Jean Paul, as she approached them.

“Good, I need your help also,” she replied.

“We’re working on ways to continue pressure on Chen Wei,” Jean Paul said. “Here in the store, you can talk to dozens and dozens of people informally.”

“What are you planning?”

“We want to ask everyone to email him and copy the Jupiter Commission, asking him to reconsider and accept an election,” said Jean Paul. “If most people email him and the Commission, it will be clear where a majority stands on the issue.”

“I think everyone should email Jacquie Collins, too,” added Pierre Archambault. “Mars can exert diplomatic pressure.”

“Email NASA, too, so they’ll know and will apply pressure as well,” suggested Martha. “We can get everyone the email addresses.”

“If people post their emails to the Callisto Station Bulletin Board, everyone can count the number of emails,” said Jean Paul. “Then no one can lie and say they didn’t get them.”

“If you can help spread the word, we’ll be able to reach more people,” said Martha. “We don’t want it to be very obvious who is coordinating the campaign.”

“I see.” Sirikit hesitated. “I have a series of plans, too. I’m going to ask Lai Zicheng and Sun Taiji to lead us in discussion of some Chinese films, and Jean Paul, you did such a great job that I was hoping you’d lead discussion of a film as well. I want to plan a movie night this Saturday and Sunday evenings, and the weekend after as well. I want to ask Wang Chenguang to perform, and the string quartet that formed on the trip out, and the ‘American band’ as well. We had a nice theatre troupe form on the flight out and I think it’s time for them to be reactivated. They want to try a Gilbert and Sullivan.”

“The arrival phase is over,” agreed Jean Paul. “Good idea.”

“But can you encourage the petition idea?” asked Martha.

“Let me think about it. I don’t want to cause disunity and strife, Martha; I want to create unity. If there’s a way to encourage a positive expression of public opinion, I’m all for it, but the petition you’ve described could be very divisive.”

Jean Paul scowled at Sirikit; Ty was pensive; Martha said nothing at first. “I understand your position, as a Bahá’í,” she said. “You try your way, Sirikit, and we’ll try ours.”

“Maybe I’ll be the good cop to your bad cop,” said Sirikit.

Martha smiled at that. “Maybe, but I’m not sure your ‘good cop’ approach will help at all.”

“I don’t know, either,” agreed Sirikit. “But maybe if your way works, the social bonds I’m trying to weave will speed the healing process. Because a healing process will be necessary.”

“We all agree with you, there,” said Ty.

Someone had walked over to the desk where Sirikit usually sat to ask a question about a package, so she pointed. “I had better answer that woman’s question.” She hurried over to help the customer. It was also the excuse she needed to get away from the “plotters” and think about

their plan, the goal of which she very much favored. But she knew their means would cause trouble. A loving approach would take much longer, unfortunately, and many people were not patient.

She answered the woman's question, then walked all the way around the atrium looking for people she could talk to about the events she was planning. She found several and talked to them about movies to watch and musical pieces to feature. Back in the store, she emailed several other people. Then it was time for the welcoming dinner celebrating the return of the *Barnard*. It featured tilapia; Callisto Station allowed a large increase in their aquaponics and they now had ample fish. She sat with Charlie, Cixi—the physician had become a friend—and with Ty and Amanda, and steadily avoided discussion of politics.

When everyone was finished eating and was focused on coffee and tea, Chen Wei, overall commander of jovian operations, rose. “We are here to celebrate the return of our first ‘manned’ mission,” he began. “Ganymede, the largest moon in the solar system, is tantalizingly close, but from the point of view of human health is just out of our reach. But a brave and well shielded crew can accomplish much in a week, especially with several years of robotic preparation. Now we have the samples to analyze Ganymedean bionts in greater detail than ever before. I received an email just an hour ago from our dear friend and former Commander, Nobel prize winner Tang Enlai saying ‘congratulations to Callisto Station for its first expedition to one of the most important objects in the solar system. The expedition bodes well for your great scientific accomplishments over the next two years, as well as the spirit of collaboration that must characterize all your efforts. Best wishes for a bright future, Dr. Tang Enlai.’”

Chen Wei paused; a few people applauded. “Dr. Tang has made some excellent points in his email. We have an expedition to Himalia scheduled to set out in November: 1 ½ months to

traverse the ten million kilometers to it, a month to stay there, and 1 ½ months back, with a possible side trip to Themisto if they are able to produce hydrogen and oxygen propellant at Himalia. Themisto, as you may know, is not a moon of the Himalia group, but appears to be a captured asteroid all by itself. Then a year later, once we have manufactured the necessary liquid hydrogen, we will send an expedition to Ananke to sample that moon and by extension, that group of moons. That is a much more difficult and ambitious expedition because it is farther out and orbits retrograde, so it requires more delta-v.

“So we have many ambitious and exciting plans for the next two years. Callisto research will proceed as well, we can now explore Ganymede much more thoroughly than ever before, we will soon land new equipment on Europa and Io, and we are hoping to obtain much more advanced systems for exploring Io in the next three to five years. We have more balloons to deploy in the jovian atmosphere; one is on the way now and after a series of gravity assists, it will enter the atmosphere in January. We hope to deploy automated systems on Amalthea and the other inner moons in the next ten years. Exploration of this immense and fascinating mini-solar system is proceeding and can only expand year by year. Our peaceful and science-centered collaboration will make it possible. As Dr. Tang has noted, collaboration over science must be our focus; nothing else is as important. Let us dedicate ourselves to the effort, just as the recent crew of the *Barnard* has demonstrated.”

Chen nodded to everyone in thanks, then sat. “That was good of him, to focus on us,” said Charlie.

“And completely ignore—and by implication, criticize—the discussion about voting!” said Ty. “How dare he do that! And use Tang’s email to justify it!”

“That was galling,” agreed Cixi.

“Well, we won’t ignore the issue, will we?” said Ty.

“We can’t,” agreed Martha.

Sirikit, not wanting to argue, rose to get another cup of coffee. But she passed Chen Wei and that reminded her of her plans. “Commander, I’d like to make an announcement about a movie night this Saturday and Sunday evenings. Next weekend there will two more movies and the weekend after, a concert. A Gilbert and Sullivan play is planned for late October, and striker teams will be organized over the next week.”

“Oh? Excellent. They are very important; they will build community and normalcy. Go ahead and make the announcement right now.” He waved her toward the microphone. She nodded, unhappy by the reference to ‘normalcy’; he understood her plans as a distraction. He stood and watched her as she walked over and made the announcement, which was greeted by some applause. Then Chen Wei walked over to the table of Cai Xiaopeng and beckoned him to come stand away from the others. “Everyone has seen the report of the drafting committee by now,” he began. “I read it through as well. There is to be absolutely no effort to call an election. There will be severe consequences otherwise. Is that clear?”

“Commander Chen, the majority of people want an elected council and executive with domestic powers. That is quite clear, is it not?”

“It doesn’t matter, because it isn’t going to happen. Period. Not while I am overall commander and not while you are overall commander. Because everything within five kilometers of the *Tienan* is subject to the original command structure of the *Tienan*, that is, the Jupiter Commission. If you want an election, you will have to move the *Galileo*, its associated vehicles, and associated enclosures, at least five kilometers.”

“That’s a forty year old *lunar* treaty and does not apply here.”

“We can let the lawyers argue that point, if we want. The Jupiter Commission makes all final decisions about the overall command here. China has 55% of the votes, and China does not want elections.”

“Very well. Best wishes with that position, Commander.”

8.

## Compromise

October 2075

“We’ve done quite well.” Martha said to Jean Paul, Ty, and Pierre over a latte in the Atrium.

“Two weeks of word of mouth, and 119 people have placed their emails to Chen Wei on the station’s bulletin board.”

“Out of 254 adults,” said Jean Paul. “We’re a bit below 47%. We need to get the numbers over 50%.”

“Remember, 40 people are planning to leave in January, and most are opposed to an election,” said Ty. “If we have 119 out of 214, we have 55%.”

“But Charles and I are leaving in January and we’re in favor of the election,” replied Martha. “We don’t know what fraction of those leaving is against the election. Besides, no one has left yet. No, we need to persuade more to send emails to Chen and the Jupiter Commission. We need at least thirty or forty more.”

“A lot of people don’t want to make a public commitment,” said Ty. “That’s true of the Chinese especially. They’ll cause Chen to lose face, and he could retaliate.”

“I doubt he’ll retaliate,” said Jean Paul. “In the last two weeks, he seems to have decided to play good cop to the Commission’s bad cop. He’s ignoring the whole thing. Meanwhile, the Commission is trashing the whole idea and attacking Mars for pushing elections.”

“Even so, he could retaliate later, or the Commission could delay promotions or raises,” said Ty. “Those are powerful disincentives.”

“If we could get one or two prominent Chinese to send the email, that would help,” said Pierre. “Dr. Hong Cixi: she’d be particularly noteworthy, and there’s not much that could be done to her.”

“I’ll talk to her; we’re pretty good friends,” said Martha. “We need eight more to reach 50% and we should be able to do that.”

“And then what?” asked Pierre.

“Charles and I were talking about that,” replied Martha. “The Cinnamon Revolution was precipitated when there was an unofficial but unambiguous vote for independence. I think our next step is to set up a poll: ‘Do you approve of the Callisto Charter?’ People won’t have to make a public commitment to vote on it; it’ll be a secret ballot.”

Ty nodded. “We’d get more than 50%, especially if we said that the vote was support in principle.”

“In principle?” asked Jean Paul.

“That the Charter can still be debated in public and modified.”

“I see what you mean,” said Jean Paul, nodding. “Good idea.”

“Alright; we have a plan,” said Martha. “Thank you, my friends.”

The other three nodded and they all rose from the table. Martha looked at Sirikit, sitting in her usual place fifteen meters away. She walked over. “Good morning.”

“Good morning. How are you doing today?”

“Pretty well. I see they’ve started on the commons area in the enclosure.”

“Yes, so I hear. The eating area will be designed to accommodate 600 and the store will be twice as big as the area I have now. So, how many pregnancies do we have now? I’ve heard several numbers.”

Martha smiled. “The official number is 29, now. Callisto is well on its way to become a normal human community; that is, one with children. It still doesn’t have retirees. Say, I have a question: I see Charlie emailed Chen two days ago. Do you think you can do it? It’s not an illegal act or a violent act, after all, and it stands for a principle you Bahá’ís hold dear: consultation with the people.”

Sirikit sighed. “You’re right. I don’t think it violates a principle, though it is a rather political act and an act that causes disunity.”

“So will the decision not to send the email; we’re just about at 50%, after all.”

“That close? Congratulations.”

“Well, think about it. We need everyone who agrees with the charter to say so.”

“Alright, I’ll think about it.”

“What do you hear, here?”

“About the same as everyone else. The main topic of conversation is the charter and an election. Very few speak against it.”

“Any news about the terrestrial economy?”

“Dr. Park says this will be a severe recession because none of the governments can borrow money anymore; they’re maxed out. The price of gold is up again and should keep climbing, so the Marsian budget appears to be solid, which is good news for us. Platinum prices are pretty good, but the other platinum group metals are dropping, so Uzboi, Ceres, and Parenago will be alright.”

“Thanks. Have a good day, Sirikit.” Martha waved and headed out of the store.

Sirikit watched her go, feeling terribly torn. There were emails to Chen Wei she could write, in good conscience: *As a member of the drafting committee, I can say with all my heart*

*that we worked hard, deliberated with great care and thoroughness, and came up with what we all felt was the best for the future Callisto. I urge you to accept the drafting committee's results and put them into practice.* Something like that was principled, fair, frank, and friendly. She jotted down the words so she could pray about them.

The problem was building unity. The movie nights had not worked; mostly, the Chinese had come to the Chinese films and the others to the English films. The concert had worked out better because she had mixed Chinese and other art forms together. The Gilbert and Sullivan might work because everyone loved light comic operettas. At mealtimes, everyone came to the Atrium, but most ate separately based on language. She had already emailed her father; he was a font of good ideas about building unity, and he had shared her letter with the National Spiritual Assembly of the Bahá'ís of Mars as well. It was time to see who else could get involved.

She turned to her tablet and set up a videomail to Dr. Park.

“Good sol to you,” she began. “I think all of us up here on Callisto need some help. As you probably know, there was an informal poll of everyone and the vast majority wanted a plan for local civil authority, so Commander Cai—who is not the overall commander of jovian operations—appointed a drafting committee, which included me. We reviewed work done several years ago for a Callisto Charter, which would set up a civil authority with limited jurisdiction over schools, arts, and culture, modified it, and submitted it to Cai and Chen two weeks ago. It was also published on the station's website. Chen utterly refuses to consider it, based on Jupiter Commission policy, which is basically Chinese government policy. There's an email writing campaign and it is getting close to fifty percent of the population; they're writing Chen and the Commission asking that the charter be publicly debated and considered. My impression is that support is really 75 to 80 percent, but some people are too afraid to speak up.

I'm getting very worried about the strife this could create. Can you talk to Jacquie Collins or someone about the situation? I suppose they're aware; Cai is probably sending them reports. But they need to know that the atmosphere is getting poisoned, and that is very worrisome. As Will Elliott says, the air is not free here. We need to protect our air supply.

"Thanks. Bye." Sirikit hit send.

She rose and went for a walk around the station; she was too distracted to do anything for a while. Enclosure 1, as usual, was her refuge; it was always interesting to see how far water had been added to the enclosure's outer layers. Enclosure 2 had been inflated as well and opened to foot traffic, doubling the length one could walk. She walked all the way to the end and back, then through the inter-vehicle tunnels all the way to the *Pacifica* and back to the *Galileo*. By then, Dr. Park had replied.

"Sirikit, I have been following the news from Callisto closely. *Mars This Sol* has been publishing daily reports and several terrestrial news companies have released stories. So people are aware. But I'll forward your videomail to Jacquie, if you don't mind. Perhaps I'll send it to Will Elliott as well. They need to act primarily on the advice they get from Dr. Cai, but I'm sure we all agree that he has good judgment. Be confident that he is working behind the scenes as well as he can on the matter.

"Thanks for checking with Pierre Archambaud about the value of shipping Cererean nickel steel to Callisto. We'll convert his estimate into a potential order and send it to the Jupiter Commission, along with price estimates. Ceres has such immense potential! And please do get to me today a review of the articles about the Indian real estate bubble. The terrestrial economy has very serious problems; I am pessimistic. Bye."

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“Two thousand three hundred grams?” Giovanni whistled. “That’s incredible, Thorvald!”

“Thanks!” he replied excitedly. “The placer deposit seems to have more, too, so morrowsol we’ll be ‘panning’ for more. We’re celebrating morrowsol evening; can you and Holly make it?”

Giovanni looked at Holly, who nodded. “Sure, that’d be great! We’ve done pretty well lately, too; 150 grams of gold in the last week.”

“That is good. Come by about 5 p.m. And morrowsol is the first automated ranger run from Kalgoorlie, so if you need supplies, get on the web and order them. We have friends coming down on that ranger and staying overnight to join the party. It should be fun.”

“Can we bring anything?” asked Holly, loudly enough so that Thorvald could hear her.

“No, we’ll supply anything, though we could use salad fixings.”

“We’ll bring a salad.”

“Great, see you then. Bye.”

“Bye.” Giovanni closed the circuit. “Well, they’re doing well. So now we need to hope Lars and Celeste will hit a lode. So far, they’ve had bad luck.”

“It’s a shame,” said Holly. “I regret the start of automated ranger runs, though. A trip to Kalgoorlie is a welcome distraction!”

“We don’t have to take it; we could always rotate the shopping trips among the three of us,” said Giovanni.

“We should suggest that morrowsol night.”

Giovanni nodded. “We’re just about big enough for business!”

Giovanni pondered the idea of “business” the rest of the evening. He had reveled in isolation; now he was thinking in terms of a borough of scattered homesteads. It surprised him and occupied thought in the back of his mind the entire next day.

He and Holly set out for Erstad Crater at 4:45 p.m. the next day. They told Goldi, their automated assistant, to follow the new road the Commonwealth team had completed; it was wide and smooth, allowing a 15 minute drive to cover 15 kilometers. It was remarkably straight, too, gradually bending around obstacles and generally following higher areas. It provided a great view.

Erstad Crater was five kilometers in diameter and half a kilometer deep. Thorvald and Monica had placed their Conestoga on the floor, where the Commonwealth Company had drilled a deep well and installed a 1000-peak kilowatt solar power installation, which also produced 2,000 thermal kilowatts. Their placer deposit was 5 kilometers away, outside the crater; Lars and Celeste parked their portahab in Erstad most of the time as well and worked their gold deposit six kilometers away. The two couples shared a B-75 bubble, and in two months their robots had managed to install farmable ground in half its 2,500 square meters. When Giovanni and Holly arrived, the ranger from Kalgoorlie was already docked against the Erstad’s Conestoga, so they docked their Conestoga to the portahab and walked through.

“Wow, it’s crowded in here!” said Giovanni, walking in. He had expected three couples, but saw four.

“Yes, there will be ten of us, so we’ll have to move into the B-75!” said Thorvald. “Allow me to introduce four more neighbors! Rajesh and Radha Patel are friends of ours from Kalgoorlie; they worked in ecology. Muhammad and Julia Rahman are their friends.”

“Pleased to meet you; Giovanni and Holly DePonte.” He offered his hand and they all shook.

“So, you’re homesteading?” asked Holly.

“We are,” replied Muhammad. “Julia and I have claimed the gold vein southwest of Lars and Celeste.”

“And we’ve claimed the vein northeast of you,” added Radha, looking at Celeste with a smile.

“With the price of gold doubling, we can expect a lot more people moving in, too,” said Rajesh. “I think half of Kalgoorlie is looking at the situation here, especially the people serving small, local mining teams for the companies.”

“Do we have any estimate when the automated software for the gold extractors?” asked Giovanni.

“No, but they have started the software development at Martech,” said Lars. “That was in *Mars This Sol* yestersol.”

“We’re buying our equipment from the Homestead Company next week,” said Muhammad. “The price is pretty good. They’ve already deployed radiation shelters at both locations and blown a meter of regolith over them, which is why we’re buying the plots we’re buying.”

Holly laughed. “You all have it so easy! We’re still covering our radiation shelter!”

“The Homestead Company has made everything much easier,” conceded Radha. “By the way, Rajesh worked in ecology, but I didn’t; I’m a nurse. So our borough now has some medical training.”

“Let’s move the table and chairs outside, into the B-75, so we have room to sit comfortably,” suggested Thorvald. He stood and picked up his chair, so everyone followed his lead. They walked into the B-75 and set up the table.

“So, when are you all moving?” asked Giovanni.

“Two weeks,” replied Rajesh.

“Four weeks for us,” said Muhammad. “My guess is that there will be two or three more couples in another month, too.”

“The rising price of gold is quite an incentive,” agreed Lars. “I just wish we’d find some!”

“You will,” replied Giovanni. “Do we have any idea whether the price rise will last, though?”

“It will for a while,” said Lars. “The stock markets are falling; rich people are shifting some of their assets to precious metals.”

“And the dust storm season is still 18 months away, so there’s reliable power,” added Radha. She looked out of the B-75 at the solar power units, big cylinders that rolled across the ground to keep their mirrored hemisphere pointed at the sun. “We’ll need more of those.”

“It’d be very helpful if the Homestead Company could provide a robotic fuel truck,” said Rajesh. “That way, we wouldn’t have to drive here every two sols to refuel.”

“I think my ranger could do that at night,” exclaimed Lars. “It has the software. Maybe we can ask the Homestead Company to provide a tank trailer instead.”

“I can ask,” said Giovanni. “My dad’s on their board.”

“Oh really?” said Muhammad. He thought and said, “Oh, DiPonte, of course. Yes, call him.”

“I will.”

“The price for power is good; they are charging just their cost and making no profit on it. That makes it easier for us to extract gold and pay them for land and other services,” said Lars.

“I’m buying the power, too,” exclaimed Giovanni. “My solar system only makes enough for 6 hours of mining per sol. I wanted to get more panels, but the up-front investment was too much. This has been a good solution.”

“You guys really struggled,” said Celeste. “I admire you!”

“Thanks,” said Holly. “It was very, very hard. But it’s easier now, and having neighbors makes it easier as well. And we have a lot of surplus vegetables in our B-75. We brought some as gifts. We would have brought more, but we didn’t know we’d meet four homesteaders!”

“We need to coordinate our vegetable gardens and trade surpluses,” suggested Celeste. “I can set up a database, if that’s helpful.”

“Yes, that’d be great,” agreed Monica.

Giovanni smiled. “It sounds like our borough is getting its first organization!”

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“So, the samples from Coptos Facula were particularly rich in bionts?” said Jean Paul to Chen Baozhi, head of Galilean exploration on the *Tienan*.

Baozhi nodded vigorously. “As you know, it’s in the middle of a line of cryovolcanoes. They probably were formed by slow drift of the ice crust over a hot spot in the subsurface ocean, and the heat source ‘fed’ the bionts with sulfur compounds. But even the walls of Tiamat Sulcus have yielded biont fossils, and they’re early Nicholsonian in age! The entire crust of Ganymede ultimately comes from the ocean, and we still haven’t found crustal samples that date before the development of the bionts.”

“That’s really interesting; they go all the way back,” said Jean Paul.

“Well, we’re still not sure of the date of the oldest crustal units,” replied Dai Guofeng, the chief geologist on the *Gan De*. “But clearly life evolved early in the jovian system, and since there were a lot of openings in the ice crust to the subsurface ocean, life evolved on one of the three Galileans and ended up on the other two as well.”

“It probably originated on Europa and was transported to Ganymede and Callisto on impact debris,” speculated Chen Baozhi. “It had the most heat and the most contact with the silicate crust under the ocean. Unless, of course, Io had an ocean briefly in its history. We’ve found some evidence suggesting that.”

“We need to bring more samples back from Io,” agreed Jean Paul. “That reminds me: back when the Chinese galleon was scheduled for launch in 2076, were there plans to send more Io landers?”

“Of course,” replied Baozhi. “We wanted to set up an automated ‘base’ near Loki and stock it with three Prospector-240Gs. The base was going to have a 30-meter solar concentrator, allowing it to produce 12 kilowatts of continuous power when the sun was up, and hydrogen-oxygen fuel cells to store power. That would have been plenty to run an automated facility. Eventually, if robotic technology advanced enough, it could have had a geothermal well also.”

“That would be quite a sophisticated facility,” said Firuz, who was the fourth member of the lunch party. “How far could the Prospectors have explored?”

“Five hundred kilometers with supplemental oxygen and hydrogen tanks.”

“Very impressive,” said Firuz.

“We had some excellent plans,” agreed Guofeng. “Europa would have had a similar facility near the south pole, and a second facility somewhere in the northern hemisphere a few years later.”

“At least we will land something on Europa and Io soon; not quite as sophisticated as the Ganymede Base but an improvement,” said Jean Paul. “Do you think a 30-meter solar concentrator could be mounted on a ranger?”

Guofeng nodded. “Probably. I suspect 40 or 50 meters would be possible because the reflecting mirror is quite light in weight. The vehicle would retract the mirror and move at night, then stay put during the day to collect power. Forty to fifty meters would collect 16 to 30 kilowatts; that’d be enough to run a ranger, right?”

Jean Paul looked at Firuz, then they both nodded. “Thirty kilowatts, definitely,” said Firuz. “The ranger could serve as a mobile base for prospectors; that’d be even more efficient.”

“It’d save a lot of money over a nuke,” said Jean Paul.

“And we’re just about at the point where we can make the mirror, so we could experiment here,” observed Firuz.

Baozhi frowned. “No, I don’t think fabrication is *that* capable.”

“Maybe not,” conceded Firuz. “If we expand to 500, we’ll be able to, though.”

That caused Guofeng to frown suspiciously.

“We’ve never landed on Amalthea or the other inner moons, either,” said Jean Paul.

“Have there ever been plans for that?”

“A wish list. With close to one hundred moons, a Callisto station can study more objects quickly and easily than any other station in the solar system,” said Baozhi. “The inner ones are particularly interesting because they formed so close to Jupiter that they were heated somewhat

by the planet's formation. The impact of sulfur from Io and the intense radiation makes their geology unique. We really need to get some Prospectors on them and recover samples. But we'd need a very powerful chemical rocket or a nuclear rocket, and we've never had either to spare."

"Pretty high delta-vs, even with Io and Europa gravity assists," agreed Jean Paul. "I think I'd try to land a ranger with a 50-meter mirror with solar panels, three or four Prospectors, an android capable of making some repairs under remote control, and stuff the ranger's cab full of scientific instruments and repair equipment. It could be kept heated so the equipment can function normally and the airlock could be modified so the android could go in and out. A mobile base like that could explore any moon for several years, then a sample return vehicle could be sent to pick up materials for analysis here."

Baozhi nodded. "Most of these moons are so small, I wouldn't use an ordinary ranger; the gravity's too low. You need something like a ranger, but able to fly short distances; a hopper. That's what should be on the wish list."

"You're right," agreed Firuz. "It could be used to explore the moons of Saturn, and Ceres could use it to explore dozens of asteroids."

Guofeng looked at Jean Paul and Firuz closely. "I don't suppose Mars has asked you for a report about what we need?"

"We're speculating," replied Jean Paul. "I think it's a good idea to maintain a wish list of future projects."

"You didn't answer my question," persisted Guofeng. When Jean Paul and Firuz looked at each other, embarrassed, Guofeng added, "why does Mars care?"

"Someone's got to grow Callisto and the human population of the jovian system," replied Jean Paul, defensively. "Stock markets all around earth are melting down. Gold is going through

the roof! China promised another galleon and can't send it. I doubt the US can send it, either. But Mars can, all of a sudden; it can even pay terrestrial space programs to participate because it has to spend its gold on Earth."

"So, they asked you?"

"We're guessing they will," Jean Paul lied.

"I see," replied Guofeng, skeptically. He looked at Baozhi, who was the overall director of jovian science, but who had much less experience collaborating with Jean Paul's Martech team.

"Interesting," said Baozhi, derisively.

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"It was a most unusual request," said Teresa Alvaro, the Director of Saturn Moon Exploration. She was sitting with Sydney Kilgore, Director of Saturn Planetary Exploration; Marshall Elliott, who was in charge of Titan Exploration; and Rahula Peres, Director of Fabrication and Construction. Their meeting room overlooked "Titanus Lacus," their fresh water pond, with its sandy beach, cattails, fish, and geese.

"Who did it come from?" asked Marshall.

"Huma Mubarak, Jacquie Collins's chief of staff. This is the sort of request that should come from the Minister of Space Exploration."

"That is strange," agreed Rahula. He looked at the memo, which was projected onto the wall. "A basic exploration package for a small icy moon; we certainly could use that. How many moons do we have?"

Teresa laughed. “What minimum size? We usually use one kilometer as the cut off, but a basic exploration package that’s cheap enough could crawl around the larger debris lumps in the rings, too.”

“The memo mentions the asteroid belt and the moon systems of Jupiter and Uranus,” said Marshall, pointing. “That’s a huge market; hundreds of such packages. So mass production is a possibility, with considerable reduction of price per unit.”

“But if this is something we are expected to make, it has to be reasonably basic,” said Rahula, pointing to the second paragraph. “It isn’t something Mars would mass produce for us. We can make several alloys now, but they’re all steel based, so they’re heavy compared to aluminum alloys.”

“But we can extract aluminum and titanium,” said Marshall. “Not in huge amounts, but we have been extracting them.”

“True, we could expand production somewhat. We could make carbon fiber structures, too; strong and light weight.”

“We could use something like this on the larger moons as well,” said Teresa. “We have Prospectors and androids deployed on three moons other than Titan, but there are nine others over fifty kilometers in diameter. If we had another fifty geologists up here, we could easily keep them busy with robotic exploration of the twelve major moons. Then there are over fifty others bigger than a kilometer in diameter. I’d deploy seismic networks on all of them as well.”

“But we’re talking about a big energy bill,” said Rahula. “Seismometers would be scattered around and would need radiogenic generators. And almost everything would need Americium heaters to function reasonably well.”

Marshall pointed to the memo. “They’re asking about solar concentrators. We have one on Mimas and it works pretty well, right?”

“Yes, but I wouldn’t mount it on a moving vehicle,” said Teresa.

“We can test it,” replied Rahula. “There’s an expedition going to Enceladus in November and they’re taking a ranger. If the vehicle moves slowly, it could balance a fifty-meter concentrator on its roof. They’re pretty light in mass. You couldn’t point it and drive at the same time, but they’re talking about driving it at night to reach new exploration sites and use Prospectors and Androids for the actual exploration.”

“That would work, but for Uranus, they really need nuclear power sources,” said Teresa. “Nuclear would work much better here, too. Solar would be fine for the asteroid belt and maybe for Jupiter.”

“Their specifications strike me as fitted for the asteroids or Jupiter,” said Marshall. “So I wonder, why did they ask us?”

“We’re the largest facility off Mars,” said Rahula. “Ceres has 150 people, Callisto 300, and they’re both pretty busy with their projects. We’ve just finished the bioarchive caverns and we won’t have any work to do for the Saturn aerostat until 2077, so fabrication is entering a slack period. The *Ptolemy* arrives in three months and it’s bringing us new fabrication equipment and expertise in preparation for the aerostat project. This is really a perfect project for us.”

“It will use the advanced capabilities we’ll need and are developing,” agreed Teresa.

“We could even export to Jupiter and Uranus,” said Marshall. “I doubt that’s in the cards, but in the next few years the planetary alignments are right.”

“More likely, Mars will create the initial design, we’ll implement and refine it, then we’ll train Ceres, Jupiter, and Uranus how to duplicate it,” said Rahula. “Ceres gets a galleon in 2

years and will have a population of 300. Jupiter will get another one eventually and have 500. Uranus will start with 500 and most of the capacities we have now. In 2079 or 2080 we'll get another galleon and our adult population will expand to 650 to 700."

"Do you think this will accelerate or strengthen our expansion?" asked Marshall.

Rahula considered. "Maybe. If we can produce a dozen exploration systems a year, we'll need a team of 100 to 150 fabrication personnel and the systems will require teams of a half dozen scientists each. If we want to create permanent teams to explore the 50 largest moons, that'd require 200 or 250 scientists."

"That's about right," agreed Teresa, nodding. "Plus an equal number of terrestrial researchers. The biggest question is whether we can argue in favor of an expansion of that size."

"If we can build the systems with 150 fabrication personnel, we'll have that capacity available starting next year for three years," said Rahula. "So this really is a good time. We were considering a project to melt and enclose one or more very large caverns. But we really have no need for them now, and no power to light and heat them, and no spare personnel to maintain them."

"This is a better project for Titan," agreed Marshall. "I'd favor recommending this to Yuri."

"Definitely," agreed Teresa.

"As long as it doesn't displace or slow down the Saturn aerostat project," said Sydney.

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"How disruptive would a demonstration be?" asked Jean Paul. "Its main purpose would be media attention, and it'll get that, maybe on Beijing television. We now have 64% of the population here who have sent emails to Chen Wei and the Jupiter Commission. They're in favor."

“It’s a drastic act and disruptive, but it’s time,” said Ty. They had discussed a demonstration over the last two days.

“It was my idea, but now I wonder whether there isn’t an alternative that’s better,” replied Martha. “I was talking to Firuz and Sirikit this morning; they came to me to brainstorm about ‘unific’ actions, as they called them.”

Jean Paul rolled his eyes. “Don’t let them talk you out of necessary efforts, Martha!”

“No, they didn’t do that. We were talking about Marsian independence and how it proceeded, and that gave us a new idea: ask people to vote using the same polling software we used before. Most of the emails that were sent indicated that they want the Charter to be ratified, including first tier responsibilities. It’s easy to set up a poll that is secure. In contrast, a demonstration will get some people angry and generate ill feelings. The atrium’s not a huge space and any demonstration will be noisy and distracting.”

“So, we’d ask people to vote to ratify the charter, and if a majority did so, we’d ask people to do an informal vote for Council members?” asked Jean Paul.

“And a Chief Executive,” said Martha, nodding. “The first step is basically what happened during the Cinnamon Revolution. Once Marsians voted for independence, negotiations began. If we got more than 2/3—and that’s likely because it’s a secret ballot instead of a public email—it’d be hard for the Jupiter Commission and Chen Wei to refuse.”

“And if the people elected a Council, there’d be a body to do the negotiating with the Commission,” added Ty. “I like the idea.”

“I do, too,” agreed Jean Paul. “So, will you set up the referendum?”

Martha nodded. "Give me 24 hours to draft the text and I'll run it by all of you. Once we agree on the wording, I can set it up in an hour. By the way, Chen Wei is furious about the emails; Xiaopeng told me he insisted Xiaopeng stop it, and Xiaopeng said he really couldn't."

"Chen Wei can't retaliate against you, too," said Ty. "You have no position to remove, and you and Charles are leaving next year, anyway."

"I know. Let me take care of it," said Martha.

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Jacque Collins looked out the window of her office overlooking Andalus Square and reviewed the facts. The Marsian ones were easy to remember, but the terrestrial ones were more complex. The Hong Kong and Shanghai stock markets, down thirty percent each in the last 5 weeks since the assassination of President Mennea; American and European stock markets were down forty percent. Chinese unemployment pushing 12% and climbing at 2% per month. Major strikes and demonstrations all across the country. Chinese currency, down 30% compared to the euro, 20% compared to rupee, 10% compared to the dollar. Chinese GDP forecast to shrink 8% in the next year. Chinese inflation about to jump to 50% per year with the printing of massive amounts of currency.

It wasn't a pretty picture to put on top of an unofficial referendum about a Jupiter charter that had already gotten 20% in favor and 6% against after 36 hours.

She saw Ambassador Zhao Tao step out the front door of the Chinese embassy and head toward the Commonwealth Building. He was on his way. She ordered black marabica coffee for him; it was ready, with some nice little cakes, when Huma escorted him into the Chief Minister's office.

She stood and walked to the door. "Ambassador Tao."

“Chief Minister Jacquie.” They shook hands and she pointed to the table. “How are Mario and Mary?”

“They’re doing very well, thank you, and how is Puilan?”

“Very much enjoying her latest crop of Mandarin language students at Martech. Most of them don’t have one or two Chinese parents, either; there’s strong interest.”

“I’m glad to hear it. Several languages are flourishing here, including Chinese. I think you know the general topic of our meeting today.”

“Indeed I do.” He paused to take a sip of his coffee. “I have consulted further with Beijing, and they wish me to assure you that our policy against an election will not change.”

“I would hope they will at least hear me out. Because Mars is developing a shift of policy where Jupiter is concerned, but there are several ways we can pursue our policy, and some are more friendly to China than others. Mars has excellent relations with China and wants to continue them.”

“I see. I will be pleased to convey your plans to my government.”

“Excellent. There are several facts to consider. The first is that our large immigration of the last columbiad of 4,000 people has been successfully assimilated. Between their labor and the 1,500 tonnes of manufacturing equipment we imported, the domestic economy has grown substantially and now stands at 5.5 billion redbucks. It is considerably diversified; if earth disappeared into a cloud of nuclear fallout tomorrow, we’d manage. In the next year, we will gain 6,000 more adult immigrants and our domestic economy in two years will stand at 6.8 billion. That does not include gold exports, the worth of which as you know has gone from 12 billion to 25 billion redbucks in the last three months. Six months ago, I faced a potential budget deficit. Now I literally can’t spend it all.”

“China is envious of your situation.”

“I’m sure. Everyone is. But with the 30% shrinkage in the Chinese economy, the 12% unemployment, and the potential collapse in the value of the currency, China is indeed in a very difficult position.”

“And what do you propose to do? Flood Jupiter with migrants?”

“We propose to expand the human presence throughout the solar system. We are now in the position to send out a galleon or two of people—150 per vehicle—every year on average. The corvet will fly starting next year and will accommodate 300 to the outer solar system, so we’ll switch to it in a few years. In 2076 we will send a galleon with 150 to Ceres from Earth, and a galleon with 150 to Callisto, also from Earth. In 2077, we’ll send a galleon or a caravel—or possibly both—to Ceres. In 2078, we’re sending three galleons to Uranus and one to Saturn. In 2079 we’ll send a galleon to Callisto from Earth and probably one from Earth to Ceres as well. In 2080, we’ll see; a galleon or corvet will certainly go to the outer solar system and that year Mars can send to Jupiter, Saturn, or Uranus. These are minimum numbers. We’re still not certain about our commitment to Venus; we have to talk to the Venus Commission further about the potential in Venus orbit. Mercury already has a galleon dedicated to transport and they don’t need galleons on the surface, so their needs are covered for now.”

Ambassador Tao looked at Jacquie as if he were a defeated man. “I beg you to reconsider and scale back your plans. No one can keep up with them.”

“Mr. Ambassador, we can produce two or three vehicles per year at Phobos and we need to keep the workers employed. We’re talking about ten galleons in five years, 2076-80. If we produce corvets for the Mars/Earth run, all our current galleons will be freed for the outer solar system. This is not difficult for us. And it will not be difficult for Earth to be involved, either.

That's one reason we will fly at least four of the ten from Earth. The other reason is to utilize more launch windows and decrease the burden on Phobos. Each launch to Jupiter and beyond will require nuclear engines and power reactors; that's eight gas core engines and eight reactors. All of them will require satellites, prospectors, rangers, and robotic manufacturing equipment that can come from Earth. And the crews can be recruited from Earth. Those are a lot of opportunities to contribute to the effort. We are prepared to be generous, especially if the cultural and social requirements of settlement are met."

"You mean . . . elections."

"Precisely. They are standard everywhere but Callisto."

"And if we don't agree, you'll send the galleons anyway."

"We will. We can set up an outpost elsewhere on Callisto, if you prefer. We could even set it up on Ganymede, in spite of its adverse radiation environment. We can send new C-100s and leave the C-100s set up on Callisto for use by your crew. But we don't want to do that to China. We are willing to make this a partnership. The galleon coming from Earth can have a Chinese name and be a Chinese mission. If China can contribute a third of the crew and pay for their equipment and the propellant to send the vehicle to Jupiter, it can be a Chinese expedition."

"Callisto—Jupiter—can *never* become a borough of Mars."

That startled Jacquie. "Ambassador Tao, we have no designs on Jupiter. We have never had borough status in mind for Callisto. The jovian system is too big. In the future it will have many boroughs of its own sovereignty."

Tao shook his head. "No, that seems very unlikely because the jovian system doesn't have resources. Its big worlds are uninhabitable, except Callisto."

“I’ll rephrase, then; the jovian system is too big for Mars. We are the Commonwealth of Mars, not the Commonwealth of the Solar System.”

“We want Callisto to preserve its distinctive Chinese character, Madame Chief Minister, and you are making that impossible!”

Jacque nodded. “A jovian identity will emerge and it should be Chinese as well. Europe has taken the lead in Mercury and Venus and is shaping the identities of those worlds. Titan is part American, part Indian, and part Russian. Jupiter should be shaped by China; we have no objection to that. We are willing to make a requirement that anyone flying to Callisto on our galleons should speak Mandarin, or should make a commitment to learn it on the voyage out.”

Ambassador Tao nodded. “That is a fair and reasonable expectation.”

“Mars is not one hundred percent English speaking. Everyone knows some, and most people are fluent, but you will see people in Andalus speaking to shop owners in a national language and relying on machine translation, and many languages are spoken around the tables in the restaurants. Our schools do not teach just in English, either. Callisto can be dominantly Mandarin speaking, but it will always be multilingual.”

“That is acceptable to us. Indeed, that is the best anyone can expect, nowadays.”

“Exactly. Our vision of solar system exploration is that nations will continue to sponsor expeditions and patronize projects. China has taken the lead in studying the geology and biology of the Galilean moons. Make that your national commitment. Let non-Chinese participate under your sponsorship. Chinese will participate in other nations’ projects as well. But all those personnel will reside at a Callisto station that votes for a Council and a Chief Executive who will possess tier 1 *and* tier 2 authority.”

“Both?”

She nodded. "Give them full civil responsibilities. If you want to give them partial civil governance, some people up there will emphasize the advantages of Marsian borough status. Callisto needs to have the same authority."

"I'll take that to Beijing. There is the issue of votes on the Jupiter Commission. This will make Mars the biggest financial partner, but China must retain the majority of the votes."

"As long as China votes for civil authority, they can keep their votes. We have no desire to humiliate China. She has always been a strong and reliable ally to Mars and we want that to continue. We can make this a loan or a gift to the Commission."

"That'll work. I'll take your proposal to Beijing."

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"It's been three sols," said Sirikit to Charlie. They were seated in the Atrium, eating supper with most of the population of Callisto.

"Since what?"

"Since Collins talked to Zhao Tao; that is, if the information Dr. Park reported to me is correct." She knew it was correct, but she didn't want to boast or expose Dr. Park too much.

"These things take time. Maybe it's the economic situation."

"No, the rallies of stock markets around the world are temporary; they've turned back down again since. And this new terrorist attack against a supertanker in the Straits of Hormuz, closing the strait for a week; that's messing up energy prices. I hope this crisis will be over before you leave for Himalia!"

"I hope so, too." Charlie leaned close to her. "You worry too much." He gave her a quick kiss. "The Himalia flight is still several weeks away. Meanwhile, the automated Europa landing is tomorrow. That will keep some of us distracted from the civil situation."

“A nuke, a ranger, and three prospectors. That’ll be quite an expansion of capacity.”

“We need a real robotic base, though, and equipment to excavate or drill for biont fossils. A few more years. Once that’s done, we’re off to Himalia, then back here and deployment of the new Io equipment, then off to Ananke late next year.”

“You love that.”

“I do, but I love being with you, too.”

She smiled at that; Charlie could be very romantic. She took another bite of her vegetarian chicken and reflected how strange and wonderful life had proved to be, that an economist could be married to a planetary geologist and part of a community on Jupiter’s second largest moon.

Chen Wei walked to the podium and turned on the microphone. “May I have everyone’s attention.” He said it first in Mandarin, then in English.

Charlie and Sirikit looked up—literally “up” because the podium was nearly overhead for them—to see what the Commander had to say.

“I have several announcements, which I will deliver in English. First, I want to commend the Galilean team for Europa orbital insertion, which occurred this afternoon about 1:30.” He paused for applause. “The Thunderbird-J is scheduled for landing tomorrow at 11 a.m. The ranger will exit the vehicle tomorrow afternoon and deploy the nuke; it should be operational in a week. Meanwhile, the prospectors will be collecting samples. By the time the Thunderbird-J is refueled next January, it should have up to 500 kilograms of samples to bring back here. It will then be deployed to Io with the new equipment for that moon. We will see a major advance in our ability to study the Galileans over the next year.

“Second, the fabrication and construction department says that we will be able to move the store, kitchen, and cafeteria into Enclosure 1 by January 1! In three months, we will begin to operate in our new space. I want to thank construction for their diligent, careful, and efficient work.”

Charlie leaned over to Sirikit and whispered, “Since when has he ever commented about construction!”

“It is surprising.”

“Third, and most important: I received an important communication from the Jupiter Commission this morning. The Commission has been deliberating about the future of Callisto and is happy to announce that the 2076-77 expedition has been restored, thanks to sacrificial efforts on the parts of the member countries. The expedition will involve a galleon and a caravel with 180 people for permanent expansion of Callisto’s population to about 400. The galleon will remain; the caravel will provide a return trip to Earth. There will be a focus on young couples, so that Callisto acquires families and long-term settlers. Preference will be given to Mandarin speakers or those willing to learn Mandarin. The two caravels here will be retrofitted for jovian system transport. The cargo manifest for the 2077 expedition can be modified somewhat, and we have been asked to propose changes. I think we can all be immensely thankful to the Jupiter Commission and its member countries that this doubling of our capacity has become possible.”

He paused again for enthusiastic applause to sweep the atrium. “A third galleon will probably be deployed here in 2079 to 2081 to raise our population to 500 to 600, depending on the number of children. I should add that collectively, we are currently expecting 23 children, so the character of Callisto Outpost will change drastically over the next year. This is one of the principal reasons for my last announcement: the Jupiter Commission, after lengthy deliberation,

has decided to authorize an election for a Council and a Chief Executive, to assume civil authority over Callisto Station on January 1, 2076.” He paused because there were whoops and cheers, for which he smiled and nodded. “There is a charter that has been proposed for Callisto and an informal vote is underway. We propose that the informal vote be suspended so that a minimum of two ‘town meetings’ can be held to discuss the Charter more thoroughly and publicly. The informal vote will certainly have meaning, but a formal vote after open, transparent, and public discussion is preferable. The town meetings will be held this Sunday afternoon and next Friday evening. The Commission is willing to extend civil authority through ‘tier 2’ responsibilities listed in the current Charter draft. If the Charter is approved by secret ballot in 2 weeks, a vote for the Council and Chief Executive will follow within a month. There will then be 2 months for transition. I call on all residents of Callisto to forget any animosity and suspicion and participate in this civil process in a responsible, restrained, and active manner. Thank you.”

Chen Wei stepped down from the podium. Sirikit turned to Charlie, delighted. “We won!”

“We did!” he said. “Callisto becomes a normal mariner community!”

“It does!”

9.

## Future Plans

November 2075

“The money will keep rolling in,” said Hun-jai Park to Jacquie Collins and her cabinet. “This is a different sort of depression than the economic slowdowns before the war. Unemployment is up and may never drop because of robotization. The poor are poorer, but the rich aren’t poorer, so they have just as much money to invest as before. They are taking vacations in low Earth orbit just as much as they were last year; demand for LEO hotel rooms hasn’t dropped, so our first corvet is still scheduled to become a hotel next year. People are investing in gold and platinum, so those prices are up, and they may not drop much if the economy improves because the demand for gold jewelry and electronics will surge. PGM prices have dropped to a third of what they were at peak a few years ago, but those are still profitable prices for us, and demand for PGMs is higher at that price. Finally, our new, more accommodating policies about investment and repatriating profits back to Earth have made us a huge investment magnet. Everyone wants to invest in our gold production and in Uzboi, Parenago, and Ceres. We’re making money predictably when no one else is! If anything, we have to watch out for a ‘Mars bubble’; too much money chasing too few investments, driving up prices, precipitating a crash.”

“How do we avoid that?” asked Jacquie.

“Cut back Commonwealth investments in gold and PGM production; that will signal our concern and increase the exposure of the investors, so they will be more cautious. It will reduce our future income, of course, but our yield will still be sufficient, thanks to taxation. Fund as much of the galleon heading to Ceres next year via private investment as possible. We need to consider sending a galleon from here in 2077, raising Ceres to three galleons and its population

to 500. It has enormous potential for water exports to the entire inner solar system, nickel steel to Phobos and the outer solar system, and PGMs to Earth. Its extraction facilities need to expand to recover copper and many other crucial metals. They won't be cheap enough for export to Earth, but they'll be the cheapest source for everyone else."

"Except us," added Érico.

"Correct; Mars has its own sources of copper and such. Ceres can export to Callisto, Titan, Uranus, and Neptune, and they'll grow in size over time. The population of the outer solar system is already 700 and will be 1,000 in two years. Let a terrestrial corporation invest in production of these other metals. Let them invest in automated fabrication facilities."

"We need to spin off Ceres Fabrication as a semi-public company," said Henry Smith.

"I agree," said Jacquie. "Henry, is this the time to encourage our construction companies—we now have four of them—to become joint stock companies? Demand for housing and work space is growing fast and very predictably, since we subsidize immigration. There are guaranteed profits, so terrestrial investments should be possible."

"Definitely," agreed Henry. "Marcomm, Margen, Marfab, and Marcraft have all been doing very well with investors. We could even sell government shares if we wanted more cash."

"We don't need more cash," replied Jacquie. "I wish we could push up immigration, but we can't strain everyone too much!"

"We need to send more migrants to the outer solar system via Earth," said Hun-jai.

"They'll still be Mariners and look to Mars. They'll move here after 10 years elsewhere."

"That's true," agreed Jacquie. "Phobos can produce two caravels, two galleons, and two corvets per year, right?"

“Max,” replied Érico. “Caravels cost half a billion redbucks each, galleons a billion, corvets a billion and a half. But currently Phobos can only turn out 2.5 billion redbucks of space vehicles per year. It has 800 vehicle technicians and Marfab and Marcraft together have 800 more here at Aurorae. If we want to grow production to 4 billion—two corvets and a galleon, or a corvet, 2 galleons, and a caravel—we need to increase Phobos to 1,200, Aurorae to 1,200, we’ll need five billion redbucks of equipment and robots, and 2 billion redbucks for a ‘corvet hab’ to house the additional workers and to build additional work space. It won’t be cheap.”

“But if the Commonwealth puts in some of the money, private investment will put in the rest,” said Hun-jai. “No question, if the sales are there.”

“The sales,” said Jacquie. “We’ll need one corvet per year just to expand immigration. That doesn’t leave any production for the outer solar system or Venus. Two corvets per year would free up galleons currently moving immigrants to Mars to travel to the outer solar system.”

“That gets to the question of the size of our commitment to the outer solar system,” said Alexandra. “Ceres will move toward economic parity in the next five years. Titan and Uranus will move toward economic parity in the 2080s as Helium-3 production begins, though they may never get there. Neptune: who knows. Callisto has no possibility of economic parity: Jupiter’s helium-3 is inaccessible at the bottom of a deep gravity well and it has no PGMs or gold. We can’t support growth just for the sake of growth. For science, yes, but how much science do they need? For balanced community, yes, but what size is adequate?”

“And what can we afford?” agreed Jacquie. “What should we afford?”

There was silence for a moment as everyone contemplated the question. “I’d start with the science; that’s how they determined the size of the Uranus mission,” said Érico. “Uranus needs 25 scientists to study the planet and will initially have 50 for the moons, the five larger

ones being fairly similar. That's fifteen percent of the total, which has to include fabrication specialists, construction specialists, ecological specialists, communications and artificial intelligence specialists, administrators, medical and educational specialists, artists, and business people. That's why they're aiming for 500 adults. Saturn could use 25 scientists to study the planet, 25 to study Titan, and at least 50 to study the other moons. They have 60 now out of 375 adults and already need 400 because they have 125 children. If they expand the scientific staff to 100, their adult population needs to grow to close to 600 and their total population to about 800. Jupiter needs 25 to study the planet, 25 to study Callisto, 25 to study Europe and Ganymede together—because they're similar—25 to study Io, and another 25 to study the other, smaller moons. That's 125, so they need closer to 800 adults and over a thousand total.”

“That's a useful rule of thumb,” said Jacquie. “But even those numbers are somewhat arbitrary. Just 25 to study Jupiter or Saturn? They're big, dynamic, complex places.”

“Then we'd ask for a clear justification, and once we're satisfied, we'd schedule the addition of another galleon or corvet,” said Érico.

“All the planets need long term plans,” said Hun-jai. “And it makes sense for the residents to make the plans, not the Commissions. The Commissions need to be a vehicle for funding.”

“Except we're the primary funder, now,” said Jacquie. “We need Earth to provide the technology because we can't make the satellites, probes, and androids the residents need.”

“But that's ending, too,” said Hun-jai. “In ten years, each place will be able to make their own with 100 additional fabrication experts and a billion redbacks of equipment.”

“Then we need to aim for a minimum roughly equal to the numbers Érico suggested,” said Jacquie. “After that, we could aim to add one galleon every four or five years to each

outpost. Then we could switch to corvets and add one corvet every year to either Ceres, Callisto, Titan, Uranus, or Neptune. That would be a steady, predictable growth rate and a steady commitment of about 1 to 2 billion redbacks per year—for the vehicle, residents, and equipment—by us, supplemented by terrestrial contributions.”

“We could afford that,” said Hun-jai Park. “It guarantees Phobos a vehicle market and Martech steady work.”

“Let’s write that up as official policy,” said Jacquie. “We’ll share it unofficially for a month or so to get comments and refine it. It’ll make a good addition to my State of Mars speech in January.”

“Keep it fairly secret for now,” suggested Hun-jai. “The ‘Future of Callisto’ forum is coming up next week and we don’t want the Chinese to think we’re making plans to expand Callisto in order to bribe its residents.”

“Yes, we need to keep this confidential until after that forum,” agreed Jacquie.

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“Good afternoon, everyone. As most of you know, I am Martha Vickers.” She paused to let the crowd quiet; the Atrium was packed. “I volunteered to chair the Future of Callisto Forum because my husband and I are leaving on the *Gan De* on December 26, bound for Earth. Consequently, there is no reason to vote for me; I’m leaving! We don’t want the vote influenced by who is chairing. Most of you have lived on Mars and are familiar with the Future of Mars Forums. They are not places where people campaign or ask for votes. They are places where we deliberate together about the future of the world we live on. They are opportunities to hear our neighbors speak, to ask each other questions informally, to chat about the future, and to ask ourselves: who among us has the experience, the good character, the virtues, the skills to provide

us collective leadership? That is a private meditation that each of us has with ourselves; ideally, we shouldn't even speak to a spouse, partner, or close friend about it.

“So, that's what the Future of Callisto Forum is. I hope we can focus on quality of life issues, because this is not the place to debate whether to import three aerostats or two for exploring the jovian atmosphere. We need to offer recommendations for the next galleon, but this is not the place for specifics; only general principles. Remember that people can speak in English or Chinese, so you may wish to set your ear pieces to translate, or watch for the written translation on the bottom of our view screens. Who wishes to speak?”

A dozen hands immediately shot up. Martha looked over the crowd in front of her and at large screens that projected the atrium over her head. She pointed to Beverly Lowell, who rose.

“You probably can't tell from looking at me, but I am three months pregnant,” she began. “As I said at our previous gathering back in August, my husband and I are settlers. We plan to have two children and remain until both are ready for university, then we'll head to Mars. Many of our friends have the same plans. So we are relieved that we'll be electing a council and chief executive. My question is: when will we move in the direction of Titan, with large underground caverns? When will we have the sort of space that children really need?”

Martha looked around to see who to ask to reply. “Pierre, do you want to take a shot at that?” she said to the head of construction.

Pierre rose. “You ask a very difficult question, but I take it what you are saying is ‘how many of us want a big bioarchive space’? I suspect most of us want to have lots of space. Enclosure 1 is on schedule. The entire surface area has 1 meter of ice, which is plenty of shielding for pregnant women and babies for about a day of visit a week. We will have three meters of ice installed over the front half by January, when the store and cafeteria moves there.

We will have a meter of ice installed over all of Enclosure 2 by June, which will make both volumes fully usable. We won't have the buildings finished until the summer of 2077, of course.

“That's the entire duration of the current mission. We aren't fully equipped to excavate caverns, but when Jupiter 4 arrives in the fall of 2077, they'll probably come with more equipment and personnel. Caverns are harder to excavate here than on Titan because of the vacuum. They'll have to be buried at least thirty meters underground so that the overburden exceeds the air pressure and fifty meters would be safer. Titan's caverns are enclosed by double nickel-steel shells with insulation blown into the space between. When Jupiter 4 arrives, we'll have a comparable population and a similar project may be possible. Shall I make a recommendation about this?”

“Yes,” said several people, and most nodded.

“We don't have the species or the experts to install bioarchive right now,” exclaimed Lai Zicheng, an environmental engineer, speaking without raising his hand. “Do we have any commitment that this place will grow after Jupiter 4?”

“I am not aware of any commitments,” replied Chen Wei. He looked at Cai Xiaopeng, who nodded in agreement.

“But that doesn't mean there won't be such commitments in the future,” exclaimed Firuz. He rose. “Mars has dedicated about ten percent of its GDP to exploration beyond Mars. A lot of that commitment is to the Phobos Vehicle Manufacturing Facility. If they dedicate a galleon every year or so to expansion of the off-Mars population, that means we'd gain a galleon and 150 people every five to ten years. That's not fast growth, but it's steady and would bring Callisto up to a thousand people in 15 to 30 years; before Beverly's kids are grown up.”

“The growth of this place must be predicated on the science it does,” noted Chen Wei.

“But there’s an infinite amount of science to do,” replied Jean Paul, rising. “The support we get is conditioned on politics. That’s why I think we need to move as close to Mars as possible; their commitment to space is solid.”

“Borough status?” asked someone.

“Yes,” said Jean Paul.

Chen Wei jumped up, upset. “This system has and should retain a Chinese character. We were the first ones here. China’s commitment is solid, too.”

“Then why did they cancel Jupiter 4?” asked Jean Paul.

“They’ve restored it,” replied Chen Wei. “And Mars has agreed to the Chinese character of this system.”

That caused startled silence. “Will my children have to speak Chinese?” asked someone.

“Could we please raise our hands?” demanded Martha, increasingly upset.

Chen rose to answer the question and Martha nodded, so he said, “Not everyone on Mars speaks English. The schools teach mostly in English, but they teach in other languages as well. Callisto will be bilingual, I think.”

“I don’t want my kids to learn in Chinese,” said someone else.

“Why not?” said Sirikit loudly, then she covered her mouth, embarrassed she hadn’t asked Martha’s permission.

Martha turned to Chen Wei. “Commander, what’s your vision for the future of Callisto, where sovereign authority is concerned?”

Chen Wei rose slowly, put on the spot. “This really is not part of my job description,” he replied in Chinese. “And I can’t say that I have thought about the matter. I suppose if Callisto has tens of thousands of people—hundreds of thousands of people—someday, it will seek the status

of an independent nation. Considering our lack of resources—other than some of the most exciting science in the solar system, with volcanoes, cryovolcanoes, bionts, a huge weather and climate system, fascinating geophysics and planetary magnetism, and a large collection of captured asteroids to study—that day will not come in a few decades. We are not another Mars. Until then, we are a ‘Commission territory’ as our legal status is described. I’d favor becoming a special economic zone of China—a sort of overseas province—before considering borough status. We aren’t on or part of Mars.”

“We aren’t on or part of China, either,” replied Jean Paul, causing Martha to scowl at him.

“Then we are a Commission territory.”

“Do you really think China can continue a commitment to us? And do you think that commitment will primarily be for our benefit, and not China’s?” asked Jean Paul.

“Do you think Mars’s commitment is wholly altruistic? We are buying Marsian goods, after all, and our galleons and caravels support their industry.”

“I concede that,” replied Jean Paul. “But Mars is a democracy; China not so much. And note that China’s commitment to Jupiter 4 involves a Marsian galleon, which will leave Mars with some of the settlers, go to Earth to get more—not all Chinese—then head here. Do we know how large the Chinese financial commitment is? No; the arrangements are surprisingly secret, don’t you think? It makes me wonder whether Mars paid for the bulk of Jupiter 4 in return for giving us an elected civil authority.” Jean Paul stared at Chen Wei rather fiercely for a minute, then sat.

“Time will tell,” replied Chen Wei replied, sitting.

Sirikit raised her hand as an uncomfortable silence gripped the atrium. Martha nodded, so Sirikit rose. “There is a third option, one that has occasionally been the subject of op-ed pieces on *Mars This Sol* and of blogs: some sort of Mariner League. The Commonwealth isn’t going to become the Mariner Commonwealth. Its identity was fought for; it was formed by a revolution. Some sort of consultative body for all the settlements throughout the solar system is warranted. It could help coordinate resources and share experience. That may be a subject for the Council to discuss, after it is elected.”

“That’s a good idea,” said Hong Cixi, and several others nodded.

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“You have a visitor,” said Goldi.

“Now?” said Holly. It was close to sunset; they had just finished supper. “Goldi, project an image here.” She pointed to a screen.

“A ranger towing a gold extraction system? Must be a newbie,” said Giovanni. “We don’t know anyone with just that combo. Goldi. Can you send an identity request on the common frequency?”

“I’m doing it right now.” A moment later, the computer said, “The automated reply is Hal McCord. No human intervention was produced.”

“Huh. I wonder if this guy knows what he’s doing.” Giovanni rose and picked up his communicator. He stepped through the airlock and into their B-75 where he had a good view. The ranger had stopped a dozen meters away; he couldn’t see anyone inside, looking through the windshield. But a light was on inside the cab, so someone was there, presumably. Most likely, the person was in the airlock.

Sure enough, a minute later someone stepped out the rear airlock. Giovanni waved; the man waved back and walked over. He entered the airlock attached to the B-75, so Giovanni walked to the Conestoga's airlock and waited there for the man to emerge.

Three minutes later, the inner airlock door opened and the man stepped into the suit donning area. He slowly—awkwardly—pulled off his helmet.

“Welcome. I’m Giovanni DePonte. And you’re . . . Hal McCord?”

“That’s right, how did you know?”

“My computer queried your id over the common frequency.”

“Oh, of course. I’m a new neighbor; I’ve just taken a claim twenty-four kilometers southeast of here.”

“Welcome.” Giovanni walked over and extended his hand; they shook.

“Thank you. You’ve been here the longest, right?”

“That’s right, just over a year now. It’s hard work, but we’ve done alright.”

“And with the price of gold going through the roof, we should all do pretty well! I start tomorrow!”

“My wife’s inside with coffee; come visit with us for a while.”

“Glad to.” Hal unzipped his pressure suit and peeled it off. He was wearing standard cotton clothes underneath. Giovanni pointed to a rack where the suit could be stood up and led Hal inside the Conestoga.

“I’m Holly DePonte,” Holly said to Hal as they entered. “Come sit and have a cup of coffee.” She handed him a cup across the table. “What brings you here?”

“I’ve bought a gold claim 24 clicks southeast of here. I drove up and took a look, then decided to come down this way to meet neighbors.” He took a sip and nodded complementarily about the coffee. “Where can I get oxygen and methane; Erstad?”

“That’s right,” said Giovanni. “It’s another fifteen kilometers down the road. Did you bring any solar panels?”

“No, just a ranger, a gold extractor, and two weeks of food.”

“You’re in a ranger?” said Holly. “That’s not much space, and you really should have two pressurized compartments, for safety!”

“I have two; the cab and the airlock! I always leave my pressure suit in the airlock so I don’t get dust in the cab, but I keep a spare suit in the cab as well. It’s tight, but it should be sufficient for a month or two.”

“And you’re by yourself?” That surprised Giovanni.

“Yes. My wife and I divorced about a year ago. She has my ten year old son and my seven year old daughter. They’re in Aurorae; that’s where I lived last. I was a software engineer.”

“How much time outside have you spent?”

Hal smiled. “Just a dozen hours! But it’ll be fine. Exploring’s in my blood. My grandfather was Jerry McCord, Commander of Northstar 2—the second flight to the moon after Apollo—and Commander of the Columbus 3 flight to Mars.”

“That won’t keep you alive.”

“I hope it brings me some luck; caution will keep me alive.”

“I’d be very careful, too, a dozen kilometers from the nearest human being, operating expensive and complicated equipment with only a dozen hours of outside time!” exclaimed Giovanni.

“I bet you had a dozen hours of outside time by the time you were fifteen,” Holly said to Giovanni.

Giovanni laughed. “By the time I was 14! By then, I had more time than my dad, that’s for sure!”

Hal didn’t get the reference. “I am a bit worried about how to use the gold extractor.”

“It takes some time.” Giovanni sighed. “I’ll show you, tomorrow.”

“Will you? Thanks!”

“We can set it up here on my land; you can keep anything you get. Then if you want more time, I’ll set up on your land and keep anything I get. We can alternate.”

“That’d be really helpful! Thanks a lot!”

“It’s nothing,” replied Giovanni. “So, how many people do we have here, I wonder.”

“I saw Will Eliot himself last week when I finalized the contract for my land. He said they would be bringing ten more radiation shelters in the next few weeks and that ten plots were sold, with five more sales pending.”

“Wow! He wouldn’t be including us, either,” said Giovanni.

“So, that’s eleven properties now and sixteen soon,” said Holly. “That’s incredible.”

“It’s a mini gold rush, thanks to the high price,” said Hal. “I made a special order for my radiation shelter and Eliot agreed to it for an extra two thousand redbacks. I ordered a nickel steel floor and two end walls with airlocks. So my radiation shelter can be welded closed and converted into pressurized housing.”

“That’s a good idea,” said Giovanni. “It’d be small, but a lot bigger than our Conestoga!”

“I’m still hoping my wife will come back to me. But I suppose it’s crazy to take a 10 year old and a 7 year old to a pressurized radiation shelter in the middle of nowhere.”

“It ain’t going to happen,” said Holly.

“I suppose not.”

“So, what brought you here, to homestead?” asked Giovanni.

Hal thought a moment. “Adventure. Exploring. Having my own land. Sitting at a desk all day, every sol, under three meters of reg for radiation protection, then having a brief experience of ‘outdoors’ walking home at night, then back under three meters of reg for the evening; I felt like a cave dweller. I didn’t come to Mars to live underground.”

“Here, here,” said Holly. “I love being outside, even if too much of it isn’t good for me.”

“Have you had any supper?” asked Giovanni.

“No; I’ve been driving all day, except when I walked my property.”

“I’ll get you something,” said Holly. “We don’t get visitors very often.” She rose and walked to the refrigerator. “Leftover spaghetti?”

“Sure, that’d be great. Thanks.”

Giovanni grabbed his tablet and pulled up the land claims website. “Yup, fifteen completed claims already,” he said. “They’re all couples except you, Hal.”

“So, our population is—or soon will be—29,” said Holly.

“Kalgoorlie will have to make us a special district,” said Hal.

“Kalgoorlie? No, we’re not in their borough. We’re off in our own,” replied Giovanni. He looked at Holly. “It sounds like we’re getting close to the point where we need to organize.”

“Organize what?” asked Hal.

“A new borough! The procedure’s simple: we get everyone together, elect officers, and petition the Mars Council. They recognize boroughs.”

“So, I’ve traveled six thousand kilometers and I might have to attend town meetings?” asked Hal. “Some things don’t change!”

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“How could they do this?” asked Sirikit. She stared at the screen of Charlie’s tablet, where they had popped up the just-released results of the Council election.

“You probably shouldn’t have said anything about the idea of a Mariner League,” said Charlie. “In *both* Future of Callisto Forums. Maybe that got people’s attention. And you are the store keeper. More people know you than anyone else except Cai and Chen.”

“I suppose.” She looked at him. “I came in sixth out of seven, too. Not seventh; sixth.”

“Not bad, my dear.” Charlie kissed her. “Of course, you don’t have a mandate to do anything. That’s the way our elections work: if you don’t run, you don’t stand for anything, so you don’t actually have to do anything.”

“True, but if people voted for me because they liked the idea of a League, I suppose I should pursue it.”

“It is a good idea.”

Sirikit looked at her husband. “How will I do this? I have too much to do already. And you’re going away in two days! I need you, Charlie!”

“I need you too, Sirikit. But we have our duties, so we’ll do them.” He kissed her again. “You’ll do fine. Just think: you’re the youngest member of the Council. You’re the voice of youth.”

She chuckled at that. “I guess so. Martha’s on the Council, even though she said she was leaving. Once she’s gone, who came in number 8?” She turned to the screen. “Beverly Lowell, so she’ll be on the Council instead. Good, she’s a good choice.”

“Cai Xiaopeng will be Chief Minister, and Wang Chenguang, and Jean Paul will be on the Council. But *not* Chen Wei; that’s a slap in the face.”

“Plus Phan Quang Ty and Pierre Archambault; interesting that the one person on the Council from the *Tienan* is Vietnamese. It’s a shame another Chinese person wasn’t elected, like Hong Cixi.”

“She’d be good, and she came in next in the voting.” He looked at the screen. “So, did we have a revolution, like the Cinnamon Revolution?”

Sirikit shrugged. “I don’t know. The Cinnamon Revolution was much tenser; I was young, but I remember. I’ve heard this called the ‘Pastel Revolution’ after Jupiter’s colors, but I think I prefer ‘Unrevolution’!”

Charlie laughed. “Yes, that’s about right. I’m sorry I’m leaving, in a way; the next few months will be formative.”

“It’s a shame they can’t postpone the flight, but they’ve postponed it several times already.”

”The launch parameters aren’t so favorable for several months, too. We have to launch when we can do a gravity assist to put us into a very elliptical orbit that comes very close to Jupiter, then another gravity assist that tilts the inclination of the orbit enough to equal Himalia’s. We’ll spend almost as much time huddled in radiation shelters, passing through Jupiter’s radiation belts, as we will flying outward to Himalia.”

Just then a note flashed on the bottom of the screen. “Message from Chen Wei?” said Charlie. He pushed on the message to open it.

“Wow, he’s heading back to Earth!” said Sirikit.

“The last few months have proved unmanageable for him, if not humiliating,” said Charlie. “Some people will cheer.”

“I’m just relieved that the trouble wasn’t worse. Now, maybe we can try out the new system with full support by everyone.”

10.

Elliott

December 2075

“Is someone there?”

“Hello?” Will Elliott leaned sideways at his desk so that he could see out the office door.

Two women stood there.

“I’m sorry, Chief Minister Will; or former Chief Minister Will; or Dr. Will,” stammered one woman.

“Just Will. You are at an advantage, you know who I am and I don’t know who you are. Please come in.”

“Thank you.” The women walked in. “This is the Homestead Company, right? We didn’t think we’d find anyone here.”

“Lately, so many people have wanted information and to sign agreements, we’ve had to open every sol. And you are . . .?”

“Morgan Leong,” one woman replied, who looked to be of mixed Chinese and European background. “And this is Tammy Sarracino.”

“Pleased to meet you, Dr. Will,” she offered her hand. “I just read your paper on paleomagnetism in Noachis. Fascinating stuff.”

“Thank you.” They shook hands. “Please sit down. My son in law was the primary author of that paper, though. So, you are a geologist?”

Tammy nodded. “A field geologist specializing in ores. Morgan’s a mechanical engineer. We represent a group of five of us here at Aurorae. We want to get a very large property claim in the homesteading area and operate it together.”

“Hum . . . I suppose that’s possible. We have a policy not to sell any of our land to companies. But I suppose if five people signed the deed together, that would work. We already have allowed two people buy land together even though they weren’t married.”

“We figure, five of us could probably work more efficiently together than two people could,” explained Morgan. “I can do repair work quite well; Tammy can find the gold deposits. We have three friends who can operate equipment, maintain life support, etc. We can also split housing costs more effectively.”

“The recent article the Homestead Company published about the income the homesteaders have made per month is rather sobering,” said Tammy. “They are not getting rich.”

“No, but they have the satisfaction of owning their own land and making their own living,” said Will. “And with the higher gold prices, they aren’t doing badly.”

“And they appear to be getting more efficient every month,” added Morgan. “Their monthly gold production is going up.”

“Yes, that’s true.”

“If we purchase five gold extractors, we’ll need a lot of solar power,” said Morgan. “We’d rather purchase power from your company rather than purchasing arrays; there’s less up front cost. But can your company produce enough for all the homesteaders?”

“That is rapidly becoming a problem. We are dealing with a gold rush and a land rush. But we have applied to the Commonwealth for an interest-free small business loan and we are confident we’ll get it. We have twelve thousand installed kilowatt hours per sol of capacity and demand is already nearing supply. In four or five weeks, we’ll install twelve thousand more. We’re also drilling three more wells.”

“What about a nuke? Can we get one of them for the dust storm season?” asked Morgan.

“We’re looking into the possibility, but it’ll have to be a gift from the Commonwealth, because its power costs a lot more.”

“How many people have bought land?” asked Tammy.

“I think we’ve sold twenty-one lots to forty-one people, but so far only eight are occupied. In the next month ten more will be; most people are using Christmas and New Years as a time to move. We’ve had over one hundred inquiries and a third of them were very serious. That’s why we have a real office with real office hours. Interest is intense.”

“We were looking at your website,” said Morgan. “We see you will provide enclosed radiation shelters, as well as open ones. We’d like to buy two of them and weld them together into one residence. Would that be possible?”

Will nodded. “It should be easy, but you’ll have to do the welding yourselves.”

“And we see several of the types of gold mining units are no longer available,” said Morgan. “Are they sold out?”

“They are indeed, but we still have six units available. We hope Martech can make a dozen more starting next month, but it’ll three or four months before they’re available. If you want five, you’d better sign a contract this sol!”

Morgan looked at Tammy nervously, who nodded. “If you’re going to drill two more wells and install more arrays, any possibility some of them can be near our homestead?” asked Tammy.

“Perhaps. You’ll be getting lots as far from Erstad crater as anyone has gone, so far, and we want to spread out the infrastructure. But we’re also looking into running a power cable to connect everyone together. Otherwise, everyone has to haul methane and oxygen back to their homesteads.”

“And how much profit is the company making?” asked Morgan.

“We’re aiming at ten percent only. We may lose money; we are assuming the risks of expansion.”

“That sounds rather generous of you,” said Tammy.

“Frankly, it is. I’m not being paid to sit here and answer questions; I’m a volunteer. We want to see homesteading succeed.”

“We appreciate that,” said Morgan. “Can we come back morrowsol with our partners to complete the paperwork?”

“Yes; I can hold the five gold mining units for you. I’ll be here by 9.”

“Then we’ll be here then,” said Morgan. She extended her hand. “Thank you, Dr. Elliott.”

“It is my pleasure. My best wishes go out to all five of you.” He shook hands with both of them, then they headed out the door. He watched them go, pleased that the gold mining units were nearly used up. That was a milestone, all by itself.

He turned back to his computer and noted he had received a videomail from Sirikit Thanarat-Langlais. He hadn’t heard from her in months, so he pushed the play icon with some pleasure.

Sirikit’s face appeared on the screen. “Good sol, Dr. Will. As you may know, when we held our Council election here on Callisto last month, I was elected to it. I was shocked; I still find it hard to believe. One of the subjects I mentioned several times in the Future of Callisto forums was the possibility of forming a Mariner League of some sort. The idea seems particularly popular up here, perhaps because people don’t trust the Chinese government, either to maintain a decent level of financial support or to keep its hands off of our internal matters. Have you any ideas about what such a league would entail or what it would do? There has been

some speculation about the idea, but nothing I have seen was very concrete. I want to present some ideas to the Council when it meets next week. I would very much appreciate your advice. Thank you. Goodbye.”

Will thought about the matter a split second, then hit reply. “It’s so nice to hear from you, Sirikit! Congratulations on being elected. It reflects a high level of trust and confidence that the residents of Callisto have in you. It’s a great compliment, really, but as you know, it carries a heavy burden of responsibility.

“I watched the videotape of the Future of Callisto Forums; both of them. I was intrigued by your comments about a Mariner League. Frankly, they are the most concrete comments I have seen anywhere. Presumably such a League consists of representatives appointed by the various Councils. That would exclude the earth’s moon; the various stations there have transient populations and therefore no real councils. I am not sure whether one would include Phobos and Ceres; maybe Ceres but not Phobos, as it is deep in the Martian gravity well and has many transient residents. If that is correct and if one included Uranus and Mars, that’d be seven places with representatives.

“The biggest question is what such a League would do. It seems to me you mentioned two possibilities in your various remarks: it could serve as a medium for sharing experience and a forum for consulting about exploration priorities and therefore about funding. I think that’s right. No doubt other possibilities can be developed as well. Once such an organization comes into existence, it will want to expand and thus will naturally find other functions.

“I’m not sure that’s very helpful, because I am repeating ideas you already expressed! But the basic idea is simple, and maybe it should start that way. I hope that helps. Bye.”

He hit send and turned back to his work. The answerbot had taken two telephone calls the night before; he reviewed a transcript of the conversation and edited it, which wouldn't change the conversations that had already occurred, but would improve the bot's future responses. One question really had not been adequately answered—there had been no drafted response to it—so he wrote one. He checked inventories to make sure he answered questions right and made a note that 5 of the 6 gold mining units were on hold. Pretty soon they'd need to start a waiting list for equipment. They'd definitely need a big solar power array; he updated the projected power demand.

Then Sirikit's response arrived; an hour and twenty minutes had elapsed. "Thank you so much, Dr. Will, for your quick answer. You've given me confidence! I agree, neither the Earth's moon, nor Mars's moons, should be able to join. The Earth isn't 'mariner' and it can't select a representative anyway, so it can't join, but perhaps the various space powers should? And how will this organization interface with the commissions for each place? I said the Councils should appoint representatives, but what about the commissions? I'm worried that this introduces another layer of bureaucracy. Bye."

Will smiled and hit reply. "You were right the first time, I believe: the elected Councils choose representatives. Ideally, they should be persons able to attend the meeting in person, presumably here on Mars, but a sol-long rambling video meeting of the Councils themselves would be a good addition. The Earth: let the various space powers send observers. They can talk to everyone during the coffee break and draft statements, and that will be useful. Commissions: This may prove to be the first nail in the coffin where the commissions are concerned. The commissions are big bureaucratic structures driven by politics. They are important currently; don't get me wrong. But the Jupiter Commission does not need its own set of space physicians

and engineers to support its equipment. The Saturn Commission here in Aurorae and is streamlined; it doesn't have its own set of physicians and engineers, it just uses Mars's health ministry and Martech's engineers. The Uranus Commission will be the same. Mars provides all the backup for both, and since the equipment is basically the same as ours, it's the cheapest arrangement. There's talk that once Uranus has an elected Council and Executive, they'll run the Commission; that's a whole new arrangement, both administratively speaking and legally speaking, because it means the Uranus community will essentially *own* everything within the Uranus's Hill sphere, its gravity well as it were. Legally speaking, we would be sending out a sovereign community. But that's the only way to do it, really, because with extremely fast ships it'll take three years for people to get to Uranus, and cargo presumably will take at least five. Neptune will be even more remote and cut off.

“So I wouldn't worry about the Commissions right now. They could send observers as well. If you have other questions, don't hesitate to call me. This is the sort of subject that fascinates me. I'll be glad to brainstorm with you. Bye.”

He sent the message and turned back to his work, but now it was difficult to focus; the idea of a Mariner League had seized his imagination. After twenty minutes of looking at screens absent-mindedly, he put up a sign that said “be back at 11:30 am” and went for a walk. He descended the ramp to the first floor of the Emporium, Aurorae's mall, which was now way too small for the city; they had added a basement level and two upper levels and it was still inadequate. The stores were glittering and stuffed with a dazzling variety of consumer goods. It was as varied as terrestrial malls had been on Earth forty years earlier, though terrestrial consumer culture had become much more sumptuous since when prosperity was possible. It

made him uncomfortable; the mariners, at the scattered outposts across the solar system, were the ones who were sacrificing.

He went outside and walked westward through their ever-larger enclosures. Caspian was now open—1,000 meters long and 700 meters wide, though divided in half by a pressure barrier for safety purposes—and Will climbed the northern hillside to take a look. It was 100% agricultural and probably would remain that way; the terraced hillside was set up to resemble Iran's Caspian seacoast region, with high rainfall. The lush greenness was quite attractive, even though the enclosure was new. He could understand why the residents of Titan and Callisto yearned for large, verdant spaces. To the west of Caspian was East Atlantic and West Atlantic, two 1,500 meter long, 700 meter wide enclosures that were being worked on simultaneously. The barrier between them had satisfied the safety regulations, so they would have a very long sight line. East and West Pacific would be even bigger, whenever they were built; each "Atlantic" would have slightly more than a square kilometer of polder, able to feed five to ten thousand people, and thus able to accommodate Aurorae's growing population for quite some time.

He walked back across Aurorae's lengthy enclosed spaces, mediating on community; the mariners needed community and 500 really was a minimum number. Aurorae's industrial areas extended southward from the original western nucleus of the city, and additional housing was now being contemplated farther west, to reduce the strain on Aurorae's transportation system. He passed through several buried metal cylinders, now stuffed with housing with brightly illuminated park areas to give a sense of space. Uzboi metal carbonyls could now come down the Uzboi Highway, a thousand tonnes at a time, and Aurorae's manufacturing capacity was expanding accordingly. Future housing cylinders would be far larger than anything that Uzboi could make and export down a roadway.

When Will got back to the Homestead Company's office, it was 12 noon and Ethel was waiting. "It's not like you, to go for a walk and leave your post!" she said.

"No, but I was thinking. He looked at the wall screen, which was blank. "Looks like no one stopped by, anyway, and we only have one mining unit left, anyway."

"Really? You had six yestersol! Congratulations!"

"A team of five want to homestead together and need five. Before we go to lunch, let me see whether Sirikit has responded." He turned to his tablet; sure enough, she had. He pushed play.

"Thank you again for your generosity, Dr. Will. I think we need to refine the goals of a Mariner League. Sharing experience and coordinating resources are the two most important ones; I've started a draft and have put them down. But it seems to me the league could also identify areas of needed technological innovation, encourage exchange of personnel, foster cultural and artistic expressions, and much more. I'm going to add things like that to the draft right now. What suggestions do you have? Bye."

"She's so smart," said Will to Ethel. He hit reply. "Thanks, Sirikit, for involving me in this process, which is dear to my heart. You don't know how dear it is to my heart! Thanks to the creation of the Marsian Commonwealth, humanity is now a type 2 civilization; in other words, a civilization that is located on more than one planet in a solar system. A type 3 civilization is located on more than one solar system. I think the central purpose of the Mariner League is to move humanity from 'civilization 2.0' to 'civilization 2.5,' in other words, to a civilization that is very widely spread out across its solar system. This is a key step toward becoming a 'civilization 3.0,' because any settlement planted in another solar system will require a voyage of many years to get there. Uranus and Neptune are important 'practice runs' for such a voyage; even the long

communications time is a good practice run. That's the purpose of the Mariner League: creating civilization 2.5. Of course it has to include culture and art; that's what civilization is! I suggest you put that in the preamble. I'll be glad to look it over as much as you want. I'll even be glad to be your coauthor, if you want." He hit send.

"Co-author?" said Ethel. "That's quite an offer! Anything with your name will carry a lot of weight!"

"And if she's primary author, she'll get the recognition she deserves. But this is very important. I want to see a Mariner League happen."

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"They barely limped to orbit," said Mikhail Shtockman. He shook his head. "If a third engine had gone out, we would have been looking at an emergency landing with 150 passengers on board."

"I'm glad we didn't have to try that," said Jacquie. "And what are the chances of losing two first stage engines?"

"Based on current use, the chance of losing one is one in two hundred," replied Alexandra. "I asked the engineers in Moscow about this quite pointedly. They insisted that the data is thorough and reliable; these are good engines, quite advanced but also quite safe. The chance of losing two, therefore, is one in two hundred squared; 1 in 40,000."

"Then why did the Prometheus have two engines fail?"

"Sloppy maintenance. We'll be sure of it in another two or three days; the Prometheus Company is fly experts down to the spaceport to check all maintenance records. But there has been a lot of unrest in India lately, disruption of consumer goods and the electrical supply, and some of the technicians at Sriharikota have left to see how their families are doing."

“They shouldn’t have flown at all,” agreed Mikhail. “I’ve talked to people at Sriharikota and they say the same thing. They are very apologetic and don’t want us to take away our launch contract.”

“So, how long will we suspend launches?” asked Jacquie.

“I hope, three days,” replied Alexandra. “But we do need to reconsider the odds of a two-engine failure. The Kevlar shields aren’t guaranteed to protect one engine from the explosion of another. I think a two-engine failure is more common than the engineers estimate.”

“If we suspend launches from Sriharikota for a month or so, what will that do to our schedule?” asked Jacquie.

Mikhail looked at Alexandra, as if they two of them were thinking together about the problem. “Sriharikota is supposed to be launching two passenger flights a week for us, so that’d be 8 passenger flights and 1,200 people; over half the remaining passenger manifest,” Mikhail replied. “That’s a lot of airplane tickets and hotels to reschedule.”

“If we can resume launches in three or four days, I’d move half to Kennedy and half to Wenchang,” said Jacquie. “We need to send them more business; they’ll charge us, but we’ll build better relations. Can Sriharikota launch cargo instead?”

“Yes, but not liquid hydrogen,” said Mikhail. “Kennedy, Wenchang, and Kourou are best for hydrogen. We can figure something out.”

“Good. Henry, how does it look here?”

“We’re ready for the first arrivals next month. The food supply is good, housing is ready—most arrivals have selected their apartments already—Phobos temporary accommodations are ready, the spaceports are ready; everything is ready.”

“Fantastic, so in spite of a series of setbacks, we’ll manage,” said Jacquie. “Let me know as soon as we have a report about the cause of the problem. Anything else?”

“Yes,” said Mikhail. “Alexandra and I have another matter to bring up.”

“Alright, go ahead,” said Jacquie.

“We want to spend about 2 billion redbacks of our gold surplus on Earth,” said Alexandra. “The nuclear propulsion department has designed the ‘Olympus’ bimodal solid core nuclear engine. The thrust is fifty tonnes. Its specific impulse is 1050 seconds, the maximum achievable and over twice as good as hydrogen/oxygen chemical propulsion. It’ll be good for at least 25 hours of operation. They have no people to spare to make them and don’t want to import 2 or 3 billion redbacks of equipment from Earth to manufacture Olympus engines, starting in six years.”

“We want to sign contracts to manufacture twelve of them in the next two years,” said Mikhail. “There are Russian, Chinese, and American companies that can make the engines without the uranium cores; we can fill the cores with uranium in orbit. With a switchover from caravels to galleons, and eventually to corvets, the larger passenger capacity makes it economic to utilize a 150-million redback nuclear engine for transportation between Mars and Earth. We don’t need them for standard six-month trajectories, but we are using more and more non-standard trajectories. If we fly toward the sun and then out to Mars, we can spread out the arrivals over a year or more and still keep the trip time under ten months.”

“We’re using solar thermal engines to do that now,” noted Jacquie.

“Yes, but they suffer from serious gravity losses at the beginning of the flight and require quite long burn times, especially to decelerate before Mars arrival. An Olympus engine could do all the propulsion in less than two hours, so it should be good for at least 10 uses. If we fly two

galleons together, each with an Olympus, there will be backup capacity. A larger fraction of our vehicles can make two round trips per columbiad, increasing the number of passengers each can carry.”

“What about liquid oxygen augmentation?”

Mikhail nodded. “Yes, they’ll have that capacity as well, with higher thrust but lower specific impulse.”

“Why don’t we switch to gaseous core engines?”

“They’re not ready,” replied Alexandra. “They still cost a half billion redbacks each, so they’re best used for the outer solar system where higher velocities are needed.”

“I see.” Jacquie considered. “How much more per passenger?”

“Assuming we increase the number of passengers each vehicle can carry in its lifetime by fifty percent and the engine is good for ten flights, the cost per passenger actually drops, because the cost of the vehicle is amortized over more passengers.”

“Oh.” Jacquie was impressed. “And what about hydrogen consumption?”

“It is increased per passenger because we are flying more high-delta-v trajectories. But the Prometheus can launch it from Earth,” said Mikhail.

Jacquie nodded. “Then we’ll do it. But the choice of companies we will give contracts to is not just an economic decision; it’s also a political decision. We can buy good will. So get me a list of possibilities. Can we split the contract?”

“We could give two contracts out instead of one, for some increase in cost,” said Alexandra.

“It may be worth it. Get me the details as soon as possible.”

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“So, we’re agreed to adopt Titan’s entire education code?” Cai Xiaopeng asked the other Council members. They had been discussing and debating various points in the twenty-page document for 90 minutes.

“I vote yes,” said Jean Paul, and Ty nodded in agreement.

“It looks good to me,” agreed Sirikit.

“I vote yes,” added Pierre Archamabult.

“Me too,” said Wang Chenguang.

“Me, too,” said Martha Vickers. “I’m glad I won’t be here to do the rest of the code we have to adopt!”

“We’ll miss you so much though, Martha!” said Sirikit, sadly.

“I hate to leave now, also,” replied Martha. “But Charles and I have planned to go in the *Gan De* for some time, and he wants to finish his assignment here and get on with life. I wish I could stay and help get this Council functioning, but it was quite a privilege to serve on the council for its first three meetings!”

“It sounds like the *Gan De* will be less crowded than anticipated, too,” said Jean Paul.

Martha nodded. “Only thirty-four are leaving; several reconsidered after the election. It’ll be a fast flight; slightly less than a year to Earth. We’ll take a nice, 12-month vacation, then catch the first flight to Mars in late 2077.”

“Sounds lovely,” said Pierre.

“Anyway, we’re done with the education section,” said Cai Xiaopeng. “Next week, we’ll tackle the licensing and inspecting section. It’s huge; it’ll take you several hours just to read, and your head will be swimming at the end. I’ll do my best to translate it into plain language.”

“Your summary of the education section really helped,” said Sirikit.

“You should have been a lawyer!” joked Ty, and they all laughed.

“Are we going to discuss Sirikit’s item at all?” asked Martha. She looked at Sirikit, who was anxious, and who had been hopeful but distracted during the entire meeting.

“I’m not sure we really can,” said Cai.

“I’d appreciate it if we can talk even a few minutes,” said Sirikit.

“How many times did you and Will Elliott talk about it?” asked Jean Paul.

“Maybe fifteen or twenty times over two weeks. We discussed the issues a lot.”

“How much of it did you write?” asked Pierre.

“I wrote the whole thing. Dr. Will proposed the wording of the preamble and offered scattered words, phrases, and a sentences. Our process was to discuss the matter at the level of principle and then I made a draft.”

“You’re blessed, Sirikit,” said Martha. “It’s a remarkable document. And with Will Elliott’s endorsement, it carries a lot of weight. Not many twenty-somethings get to coauthor with a Nobel Peace Prize recipient.”

“Yes, it was a rather challenging and daunting thing! I called him on a lark and he was very generous with his time.”

“I can see why; this is the sort of subject he loves. It’s a ‘vision thing’ situation.”

“It is,” agreed Sirikit. “But is this something we can approve?”

“The short answer of that is no,” replied Cai, curtly. “Drafting this proposal is step 1. Our approval is step 3 or step 4. Step 2 is missing.”

“What’s that?” asked Sirikit, disappointed.

“I agree, we can’t vote on it,” said Wang Chenguang. “Our relations with China will collapse, and we can’t afford that right now.”

“Someone else needs to accept it first, and maybe modify it,” agreed Ty.

“Mars?” asked Jean Paul.

Ty shook his head. “Then this looks like a Marsian plot.”

“I think the first step is building popular opinion,” replied Cai Xiaopeng. “That’s what I was referring to. But I agree, we shouldn’t be the first or even the second council to endorse it.”

“We could put it up on our website with a note that we were impressed by it,” said Martha.

“*After* Chen Wei leaves on the *Gan De* in two days,” said Cai. “I wouldn’t endorse it at all. It’s premature.”

“*Mars This Sol*,” suggested Martha. “That’s where it should go. Everyone in space will know about it right away and that will start a discussion, especially if Will Elliott’s name is on it as well.”

“Alright, I’ll submit it to *Mars This Sol*,” said Sirikit, disappointed.

“Good,” said Xiaopeng. “Then we’re done. Thank you, everyone.” He rose from the table and turned to Sirikit. “Don’t worry,” he added, then exited from the room.

Everyone headed out. Martha put her hand on Sirikit’s shoulder. “This is best. We’re a brand new Council; we’re busy settling basic regulations and laws. That’ll take six months to a year. We can’t launch ourselves into foreign relations; we aren’t even sovereign.”

“I understand. That makes sense. But this proposal makes a lot of sense, too!”

“I agree; I think it makes a lot of sense, too. Once we’re on the *Gan De*, I’ll say so, and I’m sure Charles will as well. But even good ideas don’t always happen, and if they do, they can take a long time. There are a lot of people to inform and a lot of egos to deal with.”

“That’s true.”

“Do your best with it. I’ll stop by at the store tomorrow before we get on board the *Gan De*. Good night.”

“Good night. Thanks, Martha.” Sirikit watched her go, then headed out of the meeting room and down to her quarters. There, she plopped down on the queen bed—looking at Charlie’s side sadly—and wallowed in self pity for a minute. Then she called Charlie. He was 5 million kilometers away that day; 17 light seconds away, so pauses between conversations lasted about half a minute.

“Ah, there you are!” he said, as his face popped onto the screen. “I figured you’d call me pretty soon. How did the meeting go? What did they think? I hope it went well.”

“Thanks, hon. No, it didn’t go so well; or not as well as I had thought. I think everyone liked the ‘Mariner League Resolution.’ But they felt that the Callisto Council couldn’t take it up now. We need to focus on domestic matters first. The Titan Council has 1,000 pages of regulations and policies and we’re wading through them, 20 pages at a time, so it’ll take the entire year to read and approve them, even longer if we want to modify them. This time, Cai said he’d find a lawyer in Beijing to read them, change ‘Titan’ to ‘Callisto’ and ‘Saturn’ to ‘Jupiter,’ make any other obviously necessary changes, and comment on places where changes are needed to make them compatible with Chinese law, which will be numerous I’m sure. So the rest of my time here—two years—will be tied up with that! At least everyone thought the resolution was worthwhile. They said I should get it up on Mars This Sol to get discussion started on it, and that public support was necessary anyway.”

She stopped, paused, glanced at the chronometer on the bottom of the screen, and waited. He was patiently waiting as well.

“Oh, I’m sorry, hon. I’m glad you’ve been elected to the Council and not me! I’m definitely not interested in bureaucracy of that sort. But their advice does sound good to me. If the Callisto Council had passed the Mariner League Resolution, China would have been furious. Cai would have been under pressure. Mars would have been under pressure. If you publish the resolution, everyone will be talking about it. There will be buzz. And people will say ‘who is this author, who has Will Elliott as coauthor?’ That’s pretty amazing, if you ask me! That’ll move it forward.”

“I don’t care what it does about me; that’s not important. What worries me is that it’ll be a flash in the pan; there will be buzz for a month, then it’ll drop off the radar screens and the idea will be dead. That’s what happens to most of the op-ed pieces and articles on *Mars This Sol*. And . . . well, I’m not sure I want to run a store for two more years! I’m scheduled to take two graduate seminars next semester, and how will I do that, serve on the Council, and run the store, let alone try to keep the Mariner League idea alive! It’s . . . overwhelming!” Tears came to her eyes.

It was a long wait for Charlie’s reply. “I’m sorry I’m not there to give you a hug! But I think you are worrying too much. You did two graduate seminars every semester on the flight out and ran the store. The Council won’t take that much time; there may even be a way to get credit for some of the work, if you plan it right. And the Mariner League idea will happen if it is meant to be. It is needed; people have buzzed about it for a few years. The kids at Martech will be in favor. Titan will, and I bet Mercury will; they almost held a vote about becoming a borough of Mars. This isn’t something you can lobby for, anyway. Aren’t you Bahá’is supposed to practice detachment? Maybe this is a good time for that.”

She smiled at that. “You’re right, I should be more detached! I guess I’m letting one setback make me question everything. We’ll submit it to *Mars This Sol* and see what happens. At least when the semester starts, I’ll be moved into the new store; tomorrow’s the last day it’s open, then the hours are curtailed for a week while we shift the inventory to the new space. So the workload shouldn’t be too bad. Maybe there will be things I can do to keep it alive; I’ll have to talk to Dr. Will. I hope he doesn’t mind hearing from me more! I’ll call him as soon as I feel able to! Anyway, how was your day today?”

“It was alright,” he replied, after thirty-four seconds. “Someone quipped we just started ‘phase 3’ of the flight. In phase 1, the thirty-four of us were huddled together in the control area for sixteen days, shielded from Jupiter’s radiation belts by eighty-six tonnes of supplies and equipment, with just twelve hours of freedom on day eight while we were out of the radiation belts during our gravity assist past Callisto, so we could plunge even deeper into them! I feel bad for the folks on the *Gan De*. Then phase two, two weeks of shifting eighty-six tonnes of stuff back to where they belong! But we now have the aquaponics set up, the consumables stored, the equipment back in the labs, and now phase 3 starts: boredom! I suppose it won’t be that bad, though. We’re going to be doing seminars on Himalia every afternoon and reviewing exploration plans every morning. So, are you feeling better?”

“Yes, a bit better, though I wish I had your ‘boredom.’ You’re right, I’m too wrapped up in my desires and plans. These things will happen or not; I need to do my best and let go! Dr. Park needs my help writing a report about unemployment and inflation in Europe; they have incredible, seemingly uncurable stagflation. So I guess I should watch a little tv, go to bed, and tomorrow more, turn to my list of tasks.” She shrugged. “So, I guess that’s it from here. Bye, bye. Sleep well, my love.”

“Relax and rest, dear. Bye.”

“Bye,” she said one more time, and closed the line.

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“If anyone had told me a year ago I’d be spending New Years Sol picnicking in a bubble, looking out on Martian range, I would have said they were crazy,” said Morgan Leong to Giovanni DiPonte.

Giovanni laughed. “Holly and I spent last New Year’s eating lunch here in our B-75, looking at our land, looking at the barrenness of the bubble—it had a little pile of dirt in it then and nothing else—and wondering whether we’d still be here, a year later!”

“A little pile of dirt?” Morgan looked around. The 75 meter by 35 meter transparent cylinder was now full, with a flat floor and two terraces running its length. Most of it was covered by corn and vegetables, except for a “lawn” fifteen meters square closest to the airlock, followed by a ten by fifteen meter fish pond. The homesteaders—all forty-eight of them—were scattered about the lawn eating their lunches. Many had brought chairs; Morgan and her group had brought a table as well. “You’ve really set this place up, in the last year!”

“Thanks. We did a lot of the work during the dust storm season, and finished it up four months ago right after we hit a big gold deposit. It was sort of a vacation. The terraces are flat nickel steel plates bolted to a frame curved to fit the bubble’s shape. You can buy them over the web; they’re standard equipment for Agmar. There’s an additional, higher set of terraces we can add, but they’re high and steep and don’t add that much more land to the bubble. They’re covered by 12 centimeters of dirt; we made it ourselves, the formula’s on the web. The pond is unmortared stone on top of a heavy tarp—to protect the bubble and provide insulation—covered by a heavy plastic liner. I made it myself. I’m glad we had the picnic here, because we are in

danger of being buried by corn! Don't plant 500 square meters of it; you'll get more than the five of you can eat in a year!"

"So, how much food does this make for you?"

"More than we need! The B-75 was given to us; we didn't buy it. We didn't mean to become farmers. This set-up provides 2,250 square meters of flat space, which actually could feed all 48 of us, if set up very efficiently with the genetically modified crops—'frankenplants,' some people on Earth call them!—that we usually use on Mars. The Commonwealth standard is 200 square meters per person, so this is big enough for 11 people by that rule. It has a water circulation system that irrigates the land with water from the farmland, excess of which drips back into the pond; the terraces have very slight slopes. That also removes the salt from the soil. One thing we want to do is sell surplus to everyone. We hope everyone takes a dozen ears of corn home with them tonight!"

"It's really good," said Morgan. "What's under the terraces?"

"It's all open space. It has ten tonnes of rocks down there, which were left over from our first attempt to make terraces the old fashioned way. I don't recommend it! During the day it can get pretty hot in here. The excess heat is put into the pond via the bubbler and is stored in the air space under the terraces, which is pretty cold otherwise. At night, the heat is pulled out of both. We don't usually cover the enclosure with insulation, we need the heat to escape." He pointed to an insulation blanket along the eastern length of the bubble. "We put that up until 11 am to keep it cool in here, so it wouldn't be too hot and humid for the picnic, and we've turned the bubbler up to high to keep the heat down. It can be 32 or 33 Celsius in here in late afternoon otherwise!"

"I bet it's fun to swim through the bubbles."

“It is; a sort of hot tub. Holly and I love to skinny dip in here at night! We swim with the fishes.”

“Sounds like fun. Have you harvested any of the fish?”

“I’ve tried catching them with an improvised fishing pole; that didn’t work very well! We need to get a big net and call in some neighbors to help catch them. We’ll sell them, too. I think a robot can be programmed to clean them!”

“Let me know when; the five of us can come over some Sunsol and help catch them. We’re going to want a B-75.”

“So, are the five of you . . . a commune or something?”

“No, we’re a cooperative, I guess you could say. We’ll have our own personal property and we can have private businesses on the side. Two of the five plan to get married in a few months; that’ll be the first marriage here in the borough. The company owns the land, but we could all have our own houses. I suppose eventually we’ll be a hamlet; assuming the company doesn’t collapse over disagreements! That’s always a challenge.”

“I bet. It’s hard enough to make cooperative arrangements with neighbors. Working with the same people sol after sol . . . that could be a real challenge.”

“We need some standard understandings. Someone needs to serve as a storekeeper for the area, where we can buy and sell stuff; it should be on a website so we can all see what’s there and how much it is. We need a cooperative agreement about movement; most people have one vehicle and need it for gold mining, so if someone is driving to the store, they should let people know and give people a ride. We need some standards about helping each other, too; a place where people can keep track of how many hours they’ve given each other, and an agreement that time is worth 100 redbacks per hour.”

“A website.”

“Basically. Stores run themselves with robots, now. Someone should get a three-d printer, too. We could print most of the spare parts we need. I suppose the five of us should do that, because we have the most resources.”

Giovanni pointed to the Mobilhab. “No one else has a mobilhab! That’s quite an impressive vehicle!”

“It’s really old; it’s the second or third one Mars got! It has all new fuel cells, electric motors, and life support systems, though.”

“Celeste Petersen plans to start a store morrowsol. They’re struggling financially; so far, they’ve had the least luck with gold. And she’s pregnant.”

“Pregnant? That’s crazy.”

“It may be unintentional. But she’s under 3 meters of radiation shielding and doesn’t go out; except this sol, of course.” Giovanni looked around. “People are done eating, so I had better getting the formal meeting started. Lars said, since I was host, I should chair it.” Giovanni stood up and clapped his hands to get everyone’s attention. “Happy New Years, everyone! Happy 2076! When Lars and Celeste Petersen suggested this meeting, I volunteered to host it, because I have the only lawn in the borough, and besides, I had a couple thousand ears of corn to harvest and get rid of. I hope you enjoyed it and will take the rest home with you! They said, in return, I should serve as the master of ceremonies for our brief borough meeting.

“It seems there are several matters we can discuss. Celeste has said that she will start a store for all of us to use. Celeste, do you want to give some details?”

“Sure.” The Rwandan woman rose. “As some of you have heard, Lars and I are now expecting our first child, so I am staying inside to minimize my radiation count; this is my first

excursion outside for two weeks, so I was really relieved to come here! To keep myself busy, I plan to set up a store. We have a B-75 also, just like this one, but not set up very much, yet. We have a garden covering the floor of half of it, raised off the bubble by sheet metal and plastic on top of rocks. Much more primitive than this place! But we have a lot of room, so we want to use it once a week—every Sunsol afternoon—for a community gathering. Bring things to sell yourself or sell them to me and I'll sell them next week. We can set up a table to play chess, we can play horseshoes—we can make a place between the crops for it—people can bring food, and we'll have a little party, once a week, starting next Sunsol. If that works out, we propose to get a set up in our B-75 like this one, but rather than having two terraces, we'll have one, 15 meters off the floor. It'll be a bit higher than the terraces here.” Celeste pointed to the higher level of Giovanni and Holly's terrace. “It'll be simpler and give us almost 2,500 square meters of farmland, which we will use to raise items for the store. We'll take orders ahead of time, of course. Well put at least a meter of dirt down, saturated with water, so that we have pretty good radiation shielding underneath. We could add some water storage as well. The area below the dirt could hold five stories and have over 10,000 square meters of floor space; plenty for a borough hall, school, a store, a few businesses, etc. Business and government loans over time can fill the lower area.”

“You'll need exterior steel reinforcements,” said Morgan. “The bubble isn't designed to hold that much weight.”

“We understand that exterior steel pillars can be installed,” said Celeste. “Anyway, that's what we want to propose.”

“That's great,” exclaimed Thorvald, and several others nodded.

Morgan raised her hand to get attention. “I think one thing the five of us will do is seek a small business loan to purchase a three-d printer. We need a repair service down here.”

“That’d be very helpful; I’ve had to drive to Kalgoorlie three times in the last month to get parts!” exclaimed Hal McCord.

“So, are we going to declare a borough or not?” asked Rajesh Patel. “It’s just a petition, right?”

“Yes, just a petition,” said Giovanni. “We’ve drafted something: ‘we the inhabitants of the quadrangle bounded by zero longitude east, 15 longitude west, the equator on the north, and 15 south latitude, do hereby petition the Mars Council for status as the borough of Airy.’ If everyone agrees, we’ll even make it ‘unanimously petition.’”

“What about officers?” asked Muhammad Rahman.

“We elect them after we are recognized as a borough.”

“What about regulations? The Callisto Council is bogged down approving thousands of pages of them,” asked Julia Rahman.

Giovanni shook his head. “We’re a borough; our authority is defined in regulations passed by the Mars Council. It’s much easier for us. And once we are recognized as a borough, we’ll get the taxes we’re already paying that are being kept for borough services.”

“We badly need a volunteer emergency response team,” said Thorvald. “That’s one thing the money can go toward.”

Everyone nodded. “That’s one thing every borough must maintain,” agreed Celeste.

“Didn’t the Homestead Company say they’d give us the company once we had fifty residents?” asked someone.

“Yes, but they have to recoup their investments,” replied Giovanni. “And we don’t need to wait until we have fifty to petition for borough status. Aurorae had less than twenty when it became a borough!”

“I have no problem with the petition,” said Morgan. “It’s short and to the point. But why ‘Airy’? The crater is only partly in our borough. The rest is in the other three boroughs!”

“Airy was a 19<sup>th</sup> century British astronomer,” said Tammy.

“That reinforces my point. Why name a borough for him?”

“We’ve been using it because there’s an old shelter at Airy Crater,” replied Lars. “We didn’t use it much, but it was a geographical landmark. This borough is not known for many landmarks.”

“The sunwing crash occurred here,” noted Giovanni. “We could name the place ‘van der Velde’ after the pilot who died.”

There was silence after that. No one was opposed, but there was no enthusiasm, either.

“Did Opportunity land in this borough?” asked Tammy.

Giovanni shook his head. “No, it’s just east of here, across the border in Meridiani borough.”

“You can’t name a borough ‘Opportunity’ anyway,” said Lars.

“Why not?” replied Celeste, disagreeing with her husband. “We’re here for opportunity!”

“Wrong borough, though,” replied Giovanni. Then his eyes lit up. “How about ‘Elliott’? Named for Mars’s First Minister, one of the first arrivals, and the head of the Homestead Company!”

“Yes, *very* appropriate,” agreed Lars.

Giovanni looked around; people were nodding. “So, can we make that a decision? All those in favor of petitioning to become the borough Elliott, please raise your hands?”

He raised his; Lars and Morgan immediately followed; then others raised their hands, until after several seconds, everyone had their hands up. “It’s unanimous!” said Giovanni. “We are Elliott borough!”

11.

## Milestones

January, 2076

“Isn’t it amazing how much Aurorae has grown?” Rajesh Pradhan turned to see his friend, Gandhimohan Ramanujan, through the helmets’ visors. Gandhimohan didn’t look too impressed.

“It is amazing how much range you’ve converted to polder. What’s the total?”

“When I took over construction here in 2063, Aurorae had 30 enclosures with 360,000 square meters. Now it has 41 enclosures and 2.1 million square meters. It’s grown from a third of a square kilometer of pressurized land to 2 square kilometers; a six fold increase. Aurorae is now almost 4 kilometers long, west to east! Its population has grown from 1,800 to almost 11,000.”

“Also six fold. I’m surprised you haven’t taken me to Layercake Mesa to see the new enclosures, though I have walked through them already, and I was suitably impressed.”

“Thank you.” Ramesh pointed west. “From here, atop Boat Rock, you can barely see Caspian and Mediterranean because they’re so far away. But I wanted to point you east, south, and north instead.” He turned east. “Aurorae starts rather abruptly at Face Rock with a bunch of small enclosures, which are replaced by bigger and bigger bubbles as you walk west. East of here is empty range; who not expand in that direction as well? Furthermore, Aurorae is now so long, it’s almost an hour to walk end to end. Andalus was supposed to be roughly in the middle, but it’s only half a kilometer from the east end, and the public transportation system is getting more and more stretched to move people from their housing in the west to their work and shopping in the east and southeast. So the solution is to expand eastward. In June we start work on ‘Australia,’ an enclosure 1,200 meters long and 700 meters wide, surrounded by buried housing, with housing inside the dome as well. Agriculture will continue to expand westward, with East

Atlantic, West Atlantic, East Pacific, and West Pacific. I hope when we build West Pacific, it'll be 1,500 meters wide and 3,000 meters long and feed 20,000 people! It'll have 250 kilograms of air above every square meter. Australia will be designed for beauty but high density living and should accommodate up to 10,000 people, including the buried cylinders along its edge. And when it's too small, we'll build Europe, South America, North America, Africa, and Asia as well, each larger and larger. Some of them may go here." Ramesh turned south and pointed to the range on the other side of Boat Rock.

"You'll build on both sides of Boat Rock?" Gandhimohan was surprised.

"Definitely; the goal is to keep Andalus more or less in the middle, though by then it'll be too small to serve as our commercial and government center. I suspect in 10 or 20 years, we'll put a dome right over Boat Rock and incorporate it into the city!"

"How big can you make an enclosure?"

Ramesh shrugged. "There is no limit. We need cable anchors at least every 250 meters; that's based on the strengths of the materials we are using. At that spacing, the anchors must be designed to handle 75,000 tonnes of upward force each!"

"Very impressive. We can do so many impressive feats, now; the trans-Himalayan tunnel, the Korea-Japan bridge tunnel complex, the Uranus mission . . ."

"Uranus?" Ramesh laughed. "I guess it is pretty complex and impressive, actually. Three galleons, 2 caravels, 500 people, 4 gaseous core engines, 4 power reactors, 3,000 tonnes of consumables people and equipment, 8,000 tonnes of liquid hydrogen . . . it's a lot more expensive than any of my enclosures. But Uranus? Gandhimohan, why do you want to go? I really wish you'd stay here, become a part of the Indian community, get involved in Mars administration . . . how old will you be when you get back?"

Gandhimohan laughed. “Ramesh, you are so predictable. You immediately latched onto the material facts of the mission, while I was actually referring to the human social and cultural complexity, perhaps the most socially and cultural complex project humans have ever undertaken! And you even managed to make it about *you!*”

“No, I was worried about you and your age!”

“Ramesh, you want me here to maybe get another Indian on the Mars Council or higher. I want to be involved in the greatest social and cultural experiment in human history, and I may not come back at all, Ramesh. I may lay my bones up there, somewhere.” He shook his head.

Ramesh said nothing. So Gandhimohan continued. “It may not be 500 people; it may be as many as 600. We’re still not sure. With the zero-g spaces added to the top of the galleons to increase our volume, we could accommodate more. We’ll be flying between 120 and 200 engineers and technicians to build the helium-3 retrieval system: the aerostat for the Uranian atmosphere and the nuclear shuttle to take supplies down and bring helium-3 back up. A team of 400 people are developing the aerostat and nuclear shuttle already, including 120 from our mission and 80 from the galleon that will fly to Saturn at the same time. Over half the development team is flying to the places where the systems will be deployed! They will be putting the final touches on the equipment during the flight; we’ll be modifying our equipment based on the experience gathered in the Saturn system. And we’ll be improving it continuously afterwards. Our community will come together this summer for the first time; 18 months we will be a community together before we depart. We’ll have ‘shore leave,’ we’ll be able to see relatives and friends, but we will be cloistered, sometimes here, sometimes on our galleons in orbit. We may elect our commander and council in a year or so; we won’t wait until we reach Uranus. When we reach Uranus, we will have already been a community—a sovereign

community—for five years. About 2/3 of our crew is of reproductive age and is planning to start a family after the launch or after arrival, so in ten years we'll have about 200 or 250 children. We're not coming back, most of us; it's too far and it takes too long. Elliott was right when he said it was like a starship to Alpha Centauri. And one more thing: we'll be financially self-sufficient, because once the Helium-3 starts flowing back to Earth, the Uranian settlement will have a steady income. We will be unique."

"You'll still have a Uranus Commission."

Gandhimohan shook his head. "Not exactly. They'll serve us; they won't tell us what to do. The people going to Uranus will be forming their own nation, quite self-consciously. As soon as the trans-Uranus injection burn is complete, we will be an independent nation."

"Do people know that?"

"It has occurred to some of them. As soon as we come together as a community, it will become clear pretty quickly. Mars is running the project and Mars is not doing this for the glory of Mars. Or maybe I should say, it will be for the glory of Mars, the least they try to make it so! No one can rescue us or help us; we'll be two and a half light hours away, so no one can even advise us if we have trouble. We have to be independent. That's true of Saturn, too, but right now they are financially dependent. Helium-3 will cut the last umbilical cord."

Ramesh looked at Gandhimohan. "I . . . had no idea. I can see why you want to go. I will say, better you than me! The best I could do there is build a gigantic enclosure for you."

"Well, we may want one of those some day, too. But you build your ever larger enclosures, Ramesh. I'll build communities."

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The prophet looked old. Anand hadn't seen him in twenty-one years; he was now almost bald, with just a fringe of shockingly white hair left on his head. He looked frail and awkward, floating in Phobosian gravity, gazing out the window of the observation deck. Anand hesitated to enter, wondering whether Tree Rivers was meditating. The top of Mars poked above the horizon, half full and blindingly bright in contrast to Phobos's dark, dusty terrain. But Tree, perhaps seeing Anand reflected in the window, turned.

“Can I help you?”

“Greetings, Dr. Rivers. I'm John Anand Tian.”

“Pleased to meet you, Dr. Anand.” Tree turned, then awkwardly floated over, prompting Anand to float toward him as well. They met in the middle and shook hands, Anand's magnetic shoes giving them an anchor. Tree looked at Anand, trying to remember whether he had met this man with English and Indian first names but a Chinese last name. “Ah . . . I was just looking out into space, praying for the safe journey of my caravel, the *Patares*, to Themis. My niece and her baby were on it.”

“Yes, I heard a four-month old was on the departure roster. I hope the baby has handled zero-g adequately?”

“Fortunately, yes, though he cried constantly when I was with him. He didn't vomit, which is the big danger, and they kept the caravel in a rotating configuration during the burn. He won't experience weightlessness again unless there's an emergency.”

“He should be pretty safe from radiation, too, with a 700-tonne dome secured to the dorsum and 400 tonnes of liquid hydrogen in tanks secured to the ventrum.”

“The ship has magnetic shielding as well.” Tree looked around, wondering why Tian had walked into the observation deck. “I am continually amazed by Phobos. What’s the population? 900?”

No, we’re at 1032, including 200 children. At the end of this month we’ll receive over a thousand migrants, who will be accommodated in the new corvets while awaiting their flights to the Martian surface. Phobos could have as many as 2,500 in a few months, then we’ll drop down to about 1,300, which will be our new population for this columbiad.”

“This place is so busy; how many launches do you have coming up?”

“Next week, the *Herschel* heads to Earth and from there to Ceres. At the end of January, two galleons loaded with migrants will arrive, drop off their passengers, and head back to Earth for another load. Then in March—just before the peak season of arrivals from Earth—three caravels with 150 people head for Saturn. In May and June, one corvet and four galleons head to Earth via Venus or Mercury, depending on the flight plan. Later in the summer, a caravel and 15 crew set out for two nearby asteroids. . . . the flight roster gets a bit lighter after that, but of course we’re constantly dealing with arriving and departing solar sailers as well. We have a weekly round trip passenger flight to Deimos, two passenger/cargo flights to Aurorae per week, and one liquid hydrogen cargo flight from Aurorae per week.”

“That is impressive.” Tree frowned. “Have I met you before, Dr. Anand?”

Anand smiled. “We have indeed, but it was twenty-one years ago.”

“Oh?” Tree considered, then nodded. “Yes, of course, we both arrived here on Columbus 10! But you were much younger!”

“So were you! I was 28. I’m now 49.”

“And I’m 75. Columbus 10 had 196 arrivals; Mars had about 500 residents. Columbus 20 arrives with 6,000. Such huge changes.”

“Indeed. Phobos now has twice the population that Mars had then. I’ll be heading to Uranus in two years, and the Uranus community will be larger than Mars was, then.”

“So, you’re going to Uranus? With your family?”

“Indeed, my wife is a physician and she’s part of the medical team, and my 16-year old daughter’s coming as well. She plans to become a psychologist and we’ll have the capacity to train her.”

“Marvelous. You’ll have to tell me what the spirit of Uranus feels like.”

Anand carefully suppressed his reaction and smiled. “We won’t be going to the planet itself; we won’t go within several hundred thousand kilometers, in fact. So we may not feel anything.”

“Possibly. What moon will you set up your outpost on?”

“We haven’t decided yet. The six larger inner moons all are about equal in their advantages and disadvantages. We’ll probably hold a hearing and ask the community to decide.”

“That’s very inclusive. So: what has prompted a 49 year old rocket engineer—if I remember your profession correctly—to pick up everything and move to Uranus for at least a decade or two?”

“In a way, you helped inspire me. That’s why, when I heard you were up here, I thought I’d come find you. We never spoke directly on our flight to Mars, twenty-one years ago, but I overheard a long conversation you had with someone about the excitement—the thrill—of setting up an independent autonomous, community. That stuck with me. In 2054 that meant going out into the Martian range and setting up an outpost. Now we have homesteaders setting

up their own borough. In the 2060s and 2070s, autonomous communities are being set up in the outer solar system. Uranus will be way out—at least a three year voyage to get there, with the latest propulsion technology—we’ll be staying a long time, and with Helium-3, we may even be able to pay for ourselves. We aren’t going as a mission; we’re going as a community. The entire Uranus system will be ours.”

“Will you claim it?”

“I don’t know.”

Tree scrutinized the face of the man standing in front of him, then said quite matter-of-factly. “You’re going to be Chief Executive of the Uranus system.”

That startled Anand. “I don’t know about that. I am on the three-person coordinating committee that is planning the expedition and community, sol to sol. I’ve been working on it for three years, now.”

“I’m sure. I can see the experience, the dedication, the vision. You may enjoy seeing what we are doing with Themis.”

“I looked at the website and asked Marbuild about the dome specifications. It isn’t my sort of project, I suppose one could say. But I was impressed by the vision.”

Tree smiled. “Thank you.” He pointed out the window at the ruddy sphere in front of them. “Father Mars was my principal inspiration. I suppose that sounds strange to you, but it’s the best explanation I can offer.”

Anand nodded. “I can accept that explanation at a symbolic level.”

“Good! I appreciate your capacities, Anand. I wish you and your family every blessing with all your endeavors.”

“Thank you . . . prophet. I appreciate that. Best wishes with all your efforts as well. I’m glad we had a chance to meet again, after all these years.”

“So am I.” Tree extended his hand and they shook. Then Anand turned and floated out of the room, wondering what to make of his meeting.

Tree turned back to the window of the observation. “Ah, Father Mars, Father Mars . . .” he mumbled, thinking about the surprising encounter. He wished he could see the caravel on its way to Themis; the engine had shut down half an hour earlier and it had been a good burn, so the ship was on a very precise trajectory. There was much to be grateful for. Themis already had 36 inhabitants, the caravel was carrying 30 more, and another caravel had just arrived from Earth with 100 more. The little rock would have a community with air, water, and life in no time. He could see it.

He sighed and floated to the door, then down the corridor. He was tired; the launch had been rough on his heart, and he was not looking forward to the return to the Martian surface in two sols. The switch from Martian gravity to 3 gees in launch and then to zero gee had worn him out. He headed to his room in the Phobos Marriott, a segment of Beta module, thinking about a message that was forming as an inspiration in his mind. When he got to his room, he turned to his tablet and pulled up the email address of Bill Hollingworth on Themis.

“Hello Bill,” he began. “As I am sure you have heard, the caravel *Patares* has completed its burn and is on its way to Themis. Suzanne and Jeremy are on their way to you. I thank you for your patience with me when I encouraged Suzanne to stay in Aram and have a baby. I really wanted to be an uncle. As you know, I never had children of my own; Suzanne was as close to a daughter as I have had, and you are as close to a son as I have had. Now I have reunited your family, with great gratitude that I played any role in it at all. I hope I will be able to come to

Themis some day and join all of you—the four of you, for I feel you will have a daughter at some point—there.

“You are special to me, Bill. I have admitted to you things I have never admitted before. You will be the leader of a remarkable little world with its own community. You won’t be the only asteroid community, either. In the future, Themis will be one sovereignty out of many in a solar system filled with civilizations. You and Themis are in my prayers. You will always be in my prayers. Best wishes.”

Tree Rivers played it back and listened carefully. He never knew how the inspiration would flow; he was surprised to hear what he had said. Satisfied, he hit send. Then he turned to his bed and laid down to take a nap.

He never woke up.

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Jacque Collins felt outnumbered. It helped that Alexandra Lescov, Yevgeny Lescov, and Mikhail Shtockman had come with her, but it was still her against four ambassadors: Arthur Danforth of the United States, Zhao Tao of China, Mariella Fsadni of the European Union, and Shiva Ramnath of India.

“We thought we would come to you together because we share a common concern and we don’t want to be played off against each other,” said Ambassador Arthur, who was hosting the gathering in the U.S. embassy. “I mean no offense, Chief Minister Jacque.”

“None taken. But let me be clear that contracts for space vehicles and related hardware or software can only go to qualified contractors, and all of you have very qualified contractors. That said, every government uses its financial resources as instruments of foreign policy. We are very grateful for the high quality American and Chinese nuclear thermal engines we are contracting

for, the Prometheus rockets made in Russia, the satellites and probes made in India, the materials research and medical science done by the Europeans, the solar thermal rockets continuously improved by the Japanese. All of you are integral partners in our exploration of the solar system. We look forward to very specific national expeditions and contributions.”

“You are very kind and inclusive, as always,” replied Ambassador Tao. “But our concern will not go away. This idea of a Mariner League threatens to upset everything. It jeopardizes all our support.”

“What do you want me to say?” asked Jacquie. “The Mariner League has never been Marsian government policy. We have made no official statements about it. I have never even said anything informally about it. The idea came from Saturn and from our Martech students. You know university students; they are always coming up with new and exciting ideals. And who plans to ask Will Elliott to stop writing about it? He’s the father of his country and a Nobel Peace Prize laureate. I invite all of you to talk to him, individually or collectively.”

“What is your government policy about it?” asked Ambassador Arthur.

“We have no government policy. How could we? This is just an idea on a website.”

“If I may add, as Minister of Space Exploration,” said Mikhail. “I am in contact with all the outposts, stations, and expeditions all across the solar system. The issue of the Mariner League has never even come up in my emails and videomails. I deal with very formal matters: how their equipment is working, what they need, what national commitments have been made, what commercial commitments are possible. We are pushing the development of commercial ties very strongly, now. We have put aside ten billion redbacks *on Earth* to make loans and back up loan guarantees or support public-private partnerships to support commercial development of

translunar space. We have even extended some loans to commercial operations on the moon. Those are our priorities.”

“And we have put a lot of resources into terrestrial projects,” said Alexandra. “We are not moving forward on our own.”

“I hope my administration’s commitment to partnerships is absolutely clear,” concluded Jacquie. “We have developed approaches to leveraging our resources that we had not used previously, and these leverages have benefitted everyone.”

“We want to see that continue,” said Ambassador Arthur. “I think all of us have appreciated your resource influxes, too; you have helped us make our own efforts more coherent and fend off lobbyists. But the Commissions have become a very effective mechanism for coordinating support, and this Mariner League undermines that mechanism.”

“Does it?” asked Jacquie. “I don’t know. What if the various Councils hold a series of joint video meetings and develop a coordinated wish list, which they take back to the Commissions? Wouldn’t that be helpful?”

“That’s not a League,” replied Tao.

“Are we sure? We don’t know what a ‘League’ is, so we also don’t know what it isn’t,” said Jacquie. “Let me ask you this: in ten years, let us say, Mercury has a thousand people, Mars has fifty thousand, Ceres has a thousand, Callisto, Titan, Uranus all have a thousand, Neptune and Venus both have at least 500. Don’t you think that the four thousand people in the outer solar system should consult with each other about common commitments to studying ice moons, the atmospheres of their giant mother worlds, Helium 3 production, and research on the solar wind and the iceteroids in their vicinity? Should not Mercury set its priorities of exploration and mineral exports? Shouldn’t the personnel in Venus orbit set their priorities and consult with

others? We all have a lot of adjusting to do, where thinking about space exploration is concerned. I can see a role for Commissions, for various sovereignties, and for Commissions.”

“There is no longer a Mars Commission,” noted Ambassador Shiva.

“It was abolished when Mars had some ten thousand people. None of these other worlds will hit a number like that soon,” said Alexandra.

“Look, all of this is a question of resource coordination,” exclaimed Mikhail. “The Jupiter Commission provides medical support for its personnel on Callisto. Mars just sent a galleon there with two caravels and tripled the population, and we provide medical support for the people we sent. Now, the physicians on Callisto who were there before our galleon arrived want affiliation with Mariner Hospital as well, and the Jupiter Commission has agreed to let patients there get their support from Mariner Hospital or from the facilities in Beijing. Isn’t that wise and helpful? Our physicians here understand low-g problems, low atmospheric pressure problems, psychological problems resulting from tight quarters, etc.”

“Let us be specific, then,” said Arthur. “We don’t want a League headquartered on Mars replacing the Commissions.”

“Alright,” said Jacquie. “But we have no government policy about the League, and our policy will be shaped heavily by public opinion. What do you want us to do if four outposts, outside our gravity well, petition to create a Mariner League, and our public wants it, too?”

“You can say yes, but everyone will lose our financial support, including Mars,” replied Tao, point blank.

Jacquie looked at the four ambassadors. They were determined, but she doubted their governments could manage the future that successfully. “In that case, Mars and everyone else up here will have to weigh their options. We’re not crazy. We want and need terrestrial resources.

We want partnerships. Any League would be proof of that, and Earth needs to be involved in the partnerships necessary to explore this solar system of ours.”

“Humanity’s solar system,” emphasized Mariella.

“Humanity’s solar system,” agreed Jacquie. “Just like the Pacific Ocean, which is the common heritage of mankind. But the Pacific is dotted by islands and archipelagos, and all of them have people on them, and they all have sovereign states with borders and their own priorities. In the next century, this solar system will be like that. Keep that in mind.”

“And no one gets upset that there is an organization of Pacific Island nations,” added Mikhail. “Don’t you think that some sort of common discussion about our future off Earth is inevitable?”

“That gets back to the definition of League,” said Arthur.

“We’re going round and round,” observed Jacquie.

“We are,” said Arthur. “We have made our position clear, and I think you have made yours clear as well; that you have no position, that is. With your help, we won’t need to do anything more. This tendency will be suppressed.”

“Time will tell,” said Mikhail. Jacquie looked at him, but said nothing.

The Marsians rose, thanked the ambassadors, shook hands warmly, and headed out onto Andalus Square. They said nothing until they had entered the Commonwealth Building. “That went about as well as it could,” said Jacquie.

“I hope my comments struck the right level of ambiguity,” said Mikhail.

“I think so. We don’t have an official position and we really can’t; this initiative has to come from the settlements,” said Jacquie. “If they’re in favor, we have to be.” She shook her head. “Who do they think they are? These earth countries are treating us like colonies!”

“All these settlements will be sovereign some sol,” said Mikhail, with a tone of inevitability.

“Exactly,” agreed Jacquie. “Every one of them; well, possibly with the exception of Venus, of course. But all the others, definitely.”

They walked up the stairs and into the executive wing. Jacquie’s communicator began to vibrate with an urgent message, so she pulled it out and looked at the screen. “Wow. Tree Rivers was just found dead in his hotel room on Phobos. He was scheduled to get on a shuttle and fly back to Aurorae, and missed the flight. They think he’s been dead two sols.”

“Two sols! That’s a long time for him to be missing!” said Alexandra, surprised.

“Who’s taking over?” asked Mikhail.

“Who knows?” replied Jacquie. “He was the Prophet, for them. Victor MacLeod and Victorino Alves were his assistants; Victor came to Aurorae and did External Affairs, and Victorino helped out with domestic administration. But neither can replace a prophet. You can’t replace a prophet.”

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“Is it true?” demanded Cynthia, as soon as Bill entered the crowded cafeteria of the *Inspiration*. The caravel, which had reached Themis from Earth just five days earlier, had a cafeteria able to hold 50 at the most. Normally the 100 passengers on the *Inspiration* ate in staggered shifts. Bill had called everyone together, so it was packed, standing room only, with 136 people; the total population of the *Inspiration* and of his own caravel, the *Materra*.

Bill nodded ever so slightly. “How did you hear?”

“Captain Shepherd told some people.”

Bill nodded, wondering how many people received the notice from Victor MacLeod. Now that the *Inspiration* was landed on Themis, it was no longer an independent entity, but part of his operation, so the Captain should not have received a notice. “He probably shouldn’t have. I’ll make the announcement now.” Bill raised his hands so people could see him, then he commandeered a chair and stood on it. “Attention, everyone!” he shouted. It was hard to hear himself, above the din of conversation. The air in the cafeteria was getting hot and stuffy as well.

“This is a very fast meeting. The rumor some of you have heard is true.” He paused because one woman nearby emitted a loud cry and fainted. “Tree Rivers, our prophet, the Voice of Father Mars and Mother Earth, has died in his sleep. He went to Phobos three sols ago. After the *Patares* completed its burn to come here, he called me and the captain of the *Patares*—so the captain later mentioned to me—about the successful beginning of the caravel’s voyage. Then he laid down to go to sleep, and he never woke up.”

He paused for the explosion of emotion. Men and women alike were wailing, crying, even screaming; it was so loud that his ears rang from it. He bowed his head as tears came to his eyes. At first, he decided to let the emotion run its course, but when it didn’t diminish, it occurred to him that as leader, he had to cut it short. “We need to rest and reflect, the rest of the day,” he continued, raising his voice. He repeated the sentence two more times until people stopped wailing. “Victor’s email said the funeral would be scheduled in three sols. He has gone to Phobos to retrieve the prophet’s body while Victorino plans the details. Many officials are expected to attend. We will plan our own service to follow the program at Aram.

“Ladies and gentlemen, Themis was one of the prophet’s prized projects. We were the object of much of his affection and a considerable portion of the resources he commanded. Themis as a green, living world is one of his legacies. It is the legacy we can create for his

memory. Therefore, I call on everyone to redouble their effort, after we complete our period of mourning. It is our gift to him.”

Bill looked out at the crowd and then added, “That’s the end of this meeting. Thanks, everyone.”

He stepped down off the chair; the wailing and crying resumed. He watched his crew—the residents of Themis—and tears came to his eyes as well. In spite of his ambivalence about Tree Rivers’ prophetic powers, he was fascinated by the man’s genius and compassion.

“So, what will we do?” asked Cynthia, interrupting his thoughts.

“I haven’t thought about that, yet. I’m still numb.”

“What will the spirit of Themis tell you?”

“I don’t know, Cynthia. If she speaks to you, please tell me what she advises, and we can compare notes.”

“Alright.” She looked at him suspiciously, or perhaps it was jealousy; he couldn’t tell. Then she walked out of the cafeteria.

People gradually dispersed; the cafeteria was way too crowded and stuffy to stay in. Captain Tom Shepherd came up to him. At age 52, he was exactly twice as old as Bill, and not a follower. “I’d recommend some sort of service right away, and maybe people should be go to work. It’d be a good distraction.”

“Too many people have to work outside in space suits and with delicate equipment. As for a service of some sort . . . that’s tricky right now because the prophet never appointed anyone here to serve as a sort of priest, so it isn’t clear who would run a service or how he or she would perform it. The Green World Community stresses personal communion with the spirits of the

worlds. We have twenty-two people here who have experienced the spirit of Themis, for example.”

“Spirit of Themis.” Tom Shepherd shook his head sadly. “I’ll be heading on to Mars, as you know, once the launch window opens in six months.”

“Understandable, Captain. Meanwhile, please be sympathetic. A remarkable man has died.”

“Is that what he is to you?”

“At very minimum, yes.”

“I see. Alright, I can do that.”

12

## Expressions of Beauty

Mid-late January 2076

*It's like watching ice melt*, Irina Mukhamadova thought, as the twenty-meter asteroid, a chunk of grayish carbonaceous chondrite, approached Magellan Station's docking apparatus. She floated in the docking control area, a small room near the apex of "the pyramid," the zero-g cone attached to the top of the galleon that provided most of the Venus crew its housing and work space. The view out the expanse of windows was spectacular: the asteroid was directly overhead, a dark mass approaching them at less than a centimeter per second, with enormous solar panels and an ion engine attached to its far end; the sun blazed to the right, mostly obscured behind the station's solar panels; Venus glowed painfully bright to the left, a swirl of yellowish clouds, a poisonous hell a thousand kilometers below them. To Irina, Venus was an ambivalent presence; it was their *raison d'être* for being there, but it was forbidding and fatally inaccessible.

"Here we go," said Patrice, pointing to a television screen in front of him. The docking apparatuses were about to join together. Irina leaned over and a second later they could hear a faint clank and feel a slight shake as vehicle and worldlet were conjoined.

Irina clicked on the intercom. "We have docking," she said with great satisfaction. "Venus now has a beautiful little moon." She closed the intercom.

"It's not much of a moon!" exclaimed Patrice.

"It's the beginning," she replied. "And EVA's scheduled for tonight?"

"That's right, for a preliminary exploration and examination of the propulsion system; after tonight's celebratory dinner."

"It's something to celebrate." Irina offered her hand; they shook. "Good job, Patrice."

“Thanks, Commissioner.”

She turned and floated out of the docking control room. She entered the shaft leading down twenty meters—seven floors—to the rotating section of the station. Most of the floors were hydroponics or storage, except the bottom level, which had a large bay for receiving and launching satellites and small rockets bound for Venus. After thirty years of nearly continuous human presence in Venus orbit, they had gotten pretty good at operating robotic vehicles and automated science labs on the surface, and the equipment had been improved so that it could survive the hadean conditions for more than a year.

Below the service bay was a hatch taking her into the main, rotating part of the station. She transferred to the rotating part and took an elevator down to the atrium, where the celebratory dinner was being prepared.

“People are already celebrating,” Pauline Augustine said to her as Irina walked by. Pauline was sitting at a table with Harold Laan, a fellow member of the Magellan Council; both were geologists studying Venusian volcanoes. Irina stopped and looked around the atrium. “Looks like a lot of people came here to watch the docking.”

“It was a pretty good show,” said Harold. “We all cheered when you announced the docking.”

“I wanted to cheer, myself. It’s a big step.”

“Such a small object, a mere twenty meters across,” noted Pauline. “But it has 8,000 tonnes of mass, and several hundred tonnes of that is water and volatiles.”

“A good ‘anchor’ for Magellan,” added Harold.

“Except it won’t serve as an ‘anchor’; two or three years from now, it’ll have been cut apart, the volatiles extracted, and the rock will be in bags surrounding the galleon, giving us

fantastic radiation shielding. The nickel-iron body we get next year will be even smaller and it'll serve a resource as well. None of the four asteroids we're scheduled to get over the next four years will be left intact."

"I understand that," replied Harold. "And we geologists are looking forward to cutting them apart as well. But even as debris they'll provide us an anchor of sorts up here; Magellan Station will mass thousands of tonnes instead of hundreds. Don't you think a worldlet like Themis would be a valuable resource, all by itself? We could use a real moon, here; some pretty place we could go where we could actually walk around!"

"I do agree, but the Commission doesn't have the resources to give Venus a moon; not yet, anyway. But in a decade or two, that may be possible. We need to discuss whether something like that should be part of the long-term plan. There are alternatives, too, such as a rotating hollow cylinder where the air and water and people are on the inside. We'd get a much larger living space for less mass."

"I suppose that's not too much beyond our current capabilities, also," said Pauline. "If the dome being built around Themis were heavier and stronger, it could be rotated and Themis could be broken up and the pieces put against the inside. The cylinder you're talking about could be made pretty easily."

"Something like that," agreed Irina. "Of course, the community on Themis is facing a social crisis right now, and that can defeat any engineering plan."

"Yes, it'll be interesting to see how that plays out," said Harold.

"Why don't you sit down for a moment," suggested Pauline, gesturing to a chair at their table. "Because Harold and I were just talking about the implications of this milestone for our community."

“What implications do you have in mind?” asked Irina, sitting. Pauline and Harold were two of the most active thinkers on the Council.

“Long term relations with Mars and with the nations supporting the Commission. We have good, solid support from France, the rest of Europe, India, and Kazakhstan. Mars has been fantastic, too, and their commitment can only grow. We especially need their engineering expertise if we’re going to develop a nexus here, or whatever we call the combination of vehicles and processed asteroidal debris that is accumulating! We were wondering whether the Mariner League idea is something the Council should explore.”

“The Mariner League.” Irina repeated the term with some dread in her voice, because as Commissioner it was not clear what the league would do to existing relationships. “I have no idea, but right now we’re doing fine, don’t you think? The pledges are for two billion a year and they are solid. Only during the war when terrestrial orbital facilities were destroyed, did that commitment waver. Half that commitment is into engineering on improving our surface facilities, and the research into materials that can handle 750 Celsius and 100 atmospheres of CO<sub>2</sub> pressure is yielding valuable spinoffs, too, so Europe’s commitment seems solid. Mars has no interest or need to research high temperature and pressure materials.”

“I’m not so sure; the work they’re doing on nuclear reactors is pretty impressive,” replied Harold. “They’re funding two billion redbacks of research into cold and ultra-cold materials engineering. Some of those folks could cross-fertilize our work.”

“Certainly, the geological collaboration runs deep,” agreed Pauline.

“That’s true of collaboration with terrestrial geologists, too,” noted Irina.

“Let me put it to you this way, Irina,” said Pauline. “You’ll be going back to Earth in a few months and will run things from the commission end, so you are uniquely informed about

what is happening here as well as the politics going on there. No other Commissioner does that. Mercury seems to badly need a visit from its Commissioner; from what I hear, they're getting fed up by what they perceive as lack of respect. But we know you and you're here half the time. If the Venus Council passed a resolution supporting the formation of a Mariner League, what would be the fallout? What would be the harm?"

"Hum." Irina stopped to think about that question a moment. "It's hard to be sure. The French would be hurt and might withdraw some of their support. I think I'd have a lot of sleepless nights trying to soothe their feelings."

"Fair enough," said Harold. "But what if the resolution made it clear that we wanted the Commission to continue its vital work, and the League's purpose was to coordinate priorities, share information, and solve common problems, not replace the Commission. How would that go over?"

"Better. People would still be hurt, and would worry that Venus will want to become a borough next."

Pauline shook her head vehemently. "No, we're not going to become a borough of Mars. We really appreciate their support during the war, but Venus is Venus and Mars is Mars. Simple as that."

"What we need from Mars—or with Mars—is more collaboration over spacecraft and space flights," said Harold. "Everyone off Earth—even Mercury and some of the moon bases—use life support equipment designed by Marsians, and often manufactured there. It keeps them alive, too; they're the experts. We need a better mechanism for sharing problems with them and proposing improvements. Right now, our inputs go to the Commission, which takes them to their national space programs, not to Mars. If we want more small asteroids added to Magellan

Station, we need to work with Mars. They're manufacturing all sorts of engines now; ion engines, solar thermal engines, even magnetohydrodynamic engines. We need to tell them what we need and they need to tell us what they have and can develop."

"Right now, the discussion occurs with Mars via the national space agencies, and Mars often pays them, or private contractors, to develop certain items. But you are right, the expertise here and on Mercury is largely cut out of the loop, and that's inefficient." Irina nodded reluctantly.

"These are our concerns," concluded Pauline. "We think the Mariner League potentially could give us the best of both worlds."

"And play the Commission off against the League," suggested Irina.

"Your words, not ours!" said Harold. "But the potential competition for our 'affection' could be good for Venus, too."

"I understand, and you may be right," conceded Irina. "The Venus Council should discuss the matter."

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"Rather lukewarm comments," complained Cynthia to Bill. On the big screen in the *Inspiration's* cafeteria, they could see Jacquie Collins walking from the podium back to her seat next to Will Elliott, who had just spoken about Tree Rivers as well.

"What do you expect?" whispered Bill in return. "That they'd call him a 'prophet'? They can't call him a 'genius,' it'd be insulting."

"Sure would be! Why can't they understand him as a prophet? It's obvious, isn't it? Are they idiots or something?"

“Cynthia, what is obvious to us is not obvious to everyone else. Then everyone in the world would have accepted him. That’s not how prophets work; consider how few people accepted Jesus in his day.”

“Well, Tree Rivers was a lot more powerful a prophet than Jesus,” she whispered back.

That started Bill; he privately leaned toward that politically incorrect word of ‘genius,’ having seen in more detail than most how the Prophet worked. But he wasn’t going to argue with Cynthia. Victor and Victorino now stood and walked to the open casket of the prophet, who looked beatific in death. Four men joined them and the six of them lifted the casket and bore it on their shoulders, followed by the entire large and impressive crowd.

That was Bill’s cue. He rose and walked to the front of the room, where he began to sing “The Prophet’s Song,” perhaps the most popular hymn in the Green World Community, sang to the tune of “Amazing Grace.” The seventy people squeezed into the cafeteria rose and joined him, and a screen that showed the other seventy residents of Themis in the cafeteria of the *Materra* revealed that they rose to sing along as well. When they finished the Prophet’s Song, they sang a hymn to Mother Earth and Father Mars, then a hymn to the spirit of greenery and another one to the life power of water. The Green World community had developed a rich heritage of songs, and they sang them all that day.

The funeral procession had a long way to go, starting on the floor of Genesis Crater and proceeding through a long tunnel to Enclosure 1, northward along the Gihon River, through enclosure after enclosure, until it finally reached the last enclosure, which was the biggest and tallest one of all, 150 meters wide, 500 long, and 75 high. The ground was bare, undeveloped range; in the middle of the enclosure was a huge funeral pyre. The pall bearers brought Tree Rivers to the pyre and placed him on it, then Victor and Victorino, both dressed in red as Father

Mars—usually Rivers dressed as Father Mars and both of them were clad in the green of Mother Earth—blessed the remains and praised their prophet one last time. Then they lit the pile of wood and the fire quickly became an impressive blaze. The crowd stood and watched by the air inlet to the dome, where the smoke blew away from them and where a trickle of water splashing against the dome far overhead did not fall on them.

Bill started to sing “The Prophet’s Song” again. The crying and sniffing in the cafeteria was replaced by wobbly voices. When they finished, he said, “Our Prophet is now returning to Father Mars and Mother Earth; his terrestrial and Martian atoms are mingling with the ecosystem of Aram, with its Martian ground and terrestrial life and his spirit is joining the spirits of the worlds and beings that have gone before. No doubt he will continue to speak to us, through a glass darkly rather than face to face, but we can be sure of his guidance. We have started on this favorite project of his: the greening of Themis. When we complete this effort, we will have created an entire beautiful living world, shielded from radiation and clad in verdure, a world where we can thrive and can serve as stewards. The Prophet wanted this; it was practically his last wish. When he last spoke to me, probably hours before he died, he said ‘In the future, Themis will be one sovereignty out of many in a solar system filled with civilizations. You and Themis are in my prayers. You will always be in my prayers.’ This was his vision for us: a little sovereignty, a little civilization, and a contribution to human civilization. It was also his promise to us; he will always be praying for us, and hence we can be assured of his guidance. The rest is up to us, my friends. I’m giving everyone tomorrow off, so we can finish grieving, and then it’s the weekend, when we’ll just turn to essential tasks. But Monday we will rededicate ourselves to the greening of Themis.”

“He has indeed been speaking!” exclaimed Cynthia, suddenly. Bill, startled, turned to see what his director of construction was saying. She had an ecstatic look on her face. “He has spoken to me, and says we must complete the dome as absolutely quickly as possible! He said we should do that even if it means lowering its pressure rating and making it thinner! It’s urgent to finish the dome!”

Bill’s face turned from surprise to anger, then to a blank disguise of his feelings. She had been pressuring him about the dome for weeks. Rivers had videomailed him and said not to cut corners. “We’ll consider the revelation later,” he said. “I have felt his spirit and the spirit of Themis as well, lately. Today and tomorrow, we grieve, collectively and privately, in our own way. We’ll make decisions on Monday.”

Cynthia stared at him, disguising her anger or jealousy. He gazed back, trying not to show anger in return. She said nothing more.

They went back to watching the funeral pyre. But after a minute, Bill decided he would go to the *Materra’s* cafeteria instead to get away from Cynthia and the incident. He told Captain Shepherd where he was going and headed out of the ship and to the tunnel connecting the *Illumination* to the *Materra*.

Cynthia came right out after him. “Bill, we have to get the first dome finished as soon as possible. We’re 136 people crushed into two ships; we’re vastly overcrowded. Our consumables will last only so long. We need breathing space and farmland.”

He turned to Cynthia. “The Prophet was very clear that we shouldn’t cut corners. We won’t be able to go outside without a suit for several years. Making the dome thinner is a huge risk; the current dome is rated for only a third of an atmosphere of pressure, which means we can’t pressurize it over 1/6 of an atmosphere in order to preserve a safety margin. We can’t make

a pure oxygen atmosphere of that pressure in six months, anyway; it'll take years to extract that much oxygen. Themis may outgas methane, ammonia, carbon dioxide, and carbon monoxide for some time; the atmosphere won't be breathable, it might even be flammable. We need to shift some people to the *Materra*, inflate the two greenhouse bubbles the *Illumination* brought, and make some additional bubbles, so we have agricultural and "outside" space."

Cynthia shook her head. "Even a tenth of an atmosphere of oxygen is sufficient, and with a breather we can be sure the air won't harm us, and that'd be sufficient for agriculture. I think we could do that in six months if we shifted resources."

Bill shook his head. "That'd be a stretch. It'd take a year to make that much O<sub>2</sub>. The bubbles get us space and food right away and don't delay the rest of our schedule. And I received very clear instructions from the Prophet."

"Well, I can get revelations from him, too." It sounded like a threat.

Bill was startled by that. "That contradict his living words? I doubt in death he'd change his mind."

"Maybe in death he has access to truth he could see only dimly while alive."

"Well, I have verifiable instructions."

"Then you had better provide them, and they had better be unambiguous."

"Alright, I will." He looked at her defiantly; he could make that videomail available to everyone. It even made him the Prophet's "steward" for Themis.

He turned and walked away from her. But as he thought about the videomail, it suddenly occurred to him that it was also the message where the Prophet had confessed that he often used Mother Earth and Father Mars as metaphors for his own ideas. He couldn't release that part of the videomail. Suddenly, his plan had gotten much more complicated.

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“Welcome to the Council,” Sirikit said to Hong Cixi. She extended her hand, but then changed her mind and hugged the woman.

“Thanks, Sirikit,” replied Cixi, hugging her back. “I’m sorry Beverly resigned, but I understand.”

“Four months pregnant and a lot of research; it’s understandable. But I’m so glad we have a Chinese person on the Council who *isn’t* a ship commander. That’s important.”

“It’s a big responsibility. I don’t know how you do it, running the store, the cultural activities, and take economics courses!”

Sirikit shrugged. “I have to get it done, so I do! It helps to have Charlie away right now. I have more time. My Martech economics courses are very demanding at the moment; we’re following the situation on Earth closely.”

“And what’s going to happen?”

Sirikit shook her head sadly. “Who knows. In the past, you could say ‘cool heads will prevail’ or ‘people will do the right thing in the end’ but you can’t say that any more. The U.S. situation is particularly dangerous. I doubt the opposition will accept the economic plan President Casselberry has proposed to pull the economy out of recession. They would have eventually accepted the plan if it had come from President Mennea; he couldn’t run for reelection, he had public support, and he knew how to deal with Congress. But Casselberry is running for election and she’s vulnerable. The opposition would rather bring down the American economy and blame it on her. They can count on the media that supports them to lie to the public, and that will fool enough people to keep them in power.”

Cixi shook her head. “Disgusting. But I gather Casselberry hasn’t managed relations with Congress very well, either. I can’t say that China’s doing any better. It is so focused on destabilizing the Tibetan Republic and Uyghurstan, politically and economically, that it is severely damaging its own economic standing.”

“Neither the US nor China will be able to pull the world economy out of depression; and it probably will be a depression. But demand for gold will definitely remain strong or even get stronger as people seek shelter in it. PGM demand is up permanently at an acceptable price, so the space economy is alright. By summer, Mars will have a population of 25,000! Investors can see that it will continue to grow fast and that it has achieved political and economic stability, so investment money is practically pouring in. It’s a problem; it could cause inflation and all sorts of investment bubbles. The economics team on Mars is going crazy, managing the situation. I’m glad I’m a lowly student and on Callisto!”

Cixi laughed. She gestured at the new space where the store had been relocated. In front of them was a rectangular space thirty meters wide and long, defined by new buildings on three sides with wide, verdant balconies that climbed all the way to the enclosure’s ceiling thirty-five meters overhead. “Callisto Square is quite nice.”

“Yes, it’s pretty! And the view down the length of the enclosure will be quite attractive, once the construction’s finished and the noise ends. It’s a shame Callistan gravity is a bit too low for permanent human habitation. Otherwise, I’d love to live here.”

“I gather we’ll have big apartments here, and retain our small condos on the ships.”

“Yes, Charlie and I will have one over the store, so I can get here easily. The cafeteria area is nice, also. This place is going to be very lively, once it’s completed.”

“I see you already have signage up in Mandarin, with English underneath.”

“Yes, the Council decided that Callisto is primarily Chinese in language, so signs should have Chinese on top, in larger letters, with English underneath in smaller print. So far, people have taken it just fine.”

“Good. I was just talking to Executive Cai about the question of Chinese culture and he said the Council was quite committed. I think that’s very important and hope we can offer more Chinese cultural events.”

“I’m planning 2/3 of the cultural events around Chinese themes. The remaining 1/3 are not all English, either.”

“What about more focus on Confucian ideas? I have been fascinated by the two Confucian conferences you organized. They brought my thinking around quite sharply. I think we need to work on a ‘Mariner Confucianism.’ It’s humanistic and rational; it’s not like religion.”

“I . . . agree that it potentially provides a neutral ethical platform,” said Sirikit. “I’m not sure it’s adequate; how will we decide on the proper role of women, for example? Will we redefine all four hierarchical relations in Confucianism to be forms of the ‘friend/friend’ relationship?”

“I don’t know. Obviously, ‘true humanity’ involves treating women as equal partners and not as subordinates. I was hoping you would collaborate with me. You are always talking about virtues.”

“Virtues.” Sirikit nodded. “Yes, that is the way to go; define ‘true humanity’ via the virtues she and he must exemplify. And the scriptures of the world’s religions have a lot to say about that.”

“I suppose that’s true, but as a physician trained in psychology, I have a lot of thoughts about it as well. So does Martha Vickers; before she left, we had a lunch and talked about virtues. Over the next month or two, she’s not so far away that we can’t consult with her as well by videomail.”

“That’s true.” Sirikit nodded. “Sure, let’s do that, as long as you don’t mind my referring to scriptures.”

“I don’t mind that at all, as long as we balance them with our current experience.”

“Let’s see what we can do,” agreed Sirikit. “Our definition of the spiritual side of life very much overlaps with what many call ‘human values.’”

“Alright; good. The Bahá’í religion has always struck me as quite practical in some ways. Now, what’s the Council going to do, where the Mariner League is concerned?”

Sirikit shook her head. “Nothing right now; we don’t want to disturb our relationship with China. I’m rather disappointed.”

“I can understand that. That’s probably wise, but I agree with you: we need a formal relationship with Mars and with the other settlements across the solar system.” She pointed to the enclosure around them. “Because this is just the beginning. In spite of the mess on Earth, we’re riding a revolution. How much does it cost to send a galleon full of people here? Let’s be generous and say two billion redbacks, assuming the galleon stays here permanently. That’s 15 million redbacks per person. Fifty years ago, they couldn’t have put a person in low Earth orbit for that price! And now we can put a settlement on a moon of Uranus or Neptune for that price! If there were a thousand people here on Callisto, we’d be a permanent human community, not many people would feel the need to leave, and we’d do incredible science. China isn’t prepared to support that. Mars is.”

“Mars can’t afford two billion, either.”

“Not per year! But if it produces one galleon a year for Ceres through Neptune—five worlds—that’s two per decade for each one, and 300 to 400 people per world per decade. If it can get Earth to match that expenditure of money for equipment, we’d get 150 people every five years. We’d constantly grow. Mars will do that because it knows the people will come and go from Mars, the equipment and vehicles will be Marsian, they’ll be at the center, and they’re fundamentally like us.”

“They are, because . . . they’re Mariners too.”

Cixi nodded. “Yes, I guess that’s right. So we need a Mariner League.”

“Well, you’re on the Council now, so you say that, not me! But I do think we should go slow for a few more months. We’ve waded through, modified, and approved less than half of Ceres’s legal code. We have months of work to do before Callisto has a complete and functioning legal system. That should be our priority.”

“Yes, I agree. Well, I had better go; you have your economics work, and I have to go look at the new medical facility being built down on level 2. We’re putting it deep so that if there’s a breach, the air pressure will hold up a long time, and we’re surrounding it with greenery. That should make it pretty attractive.”

“I’m surprised it doesn’t need to be in higher gee.”

Cixi shook her head. “We’ll have a clinic on the galleon, too. But one eighth gee is fine for a week or so for an adult. If someone exercises an hour a day in half a gee, they can spend the rest of their time in Callistan gravity. We knew this from medical research on the moon, but now it has been confirmed on Titan as well, where the gravity is basically the same as here. Children need to spend more time in at least half a gee, though, so we need to keep the school in the

galleon. With two galleons, we could probably accommodate a thousand people here.” She waved. “Got to go.”

“Bye.” Sirikit waved and watched Cixi leave the store. She was glad the Chinese physician was now on the Council, and even happier she’d be an ally where the league was concerned. The possibility of stressing virtues was also exciting; it was a way to spiritualize the place without introducing God, an idea that did not sit well with some people. Sirikit doubted that virtues ultimately were adequate without a God and a divine revelation to make them work, but as a stopgap, they’d help.

She wished she could call Charlie and share her excitement. But it was a bad time; they had talked earlier and she knew he was outside at that time, doing geology. In fact, Charlie was taking a short break from geology at that very moment. The *Barnard* had arrived on Himalia two days earlier and they had started their second EVA shortly after the sun had risen. Now that the sun was overhead, Charlie decided to look around, so he carefully walked to the edge of Perrine Chasma—Himalia’s gravity was one 160<sup>th</sup> that of Earth, so he had to be very careful and slow—and surveyed the vast canyon before him. It took his breath away.

“Look at the chasma!” he exclaimed over the common radio frequency. They had landed several hundred meters from the edge of an enormous crack in the moon’s surface, five kilometers wide and three kilometers deep, and now that the sun was overhead, the opposite walls was brilliantly illuminated.

“It’s incredibly beautiful, isn’t it?” agreed Firuz Moulin, who jetted over to stand with Charlie.

“There must have been a recent meteor strike somewhere nearby that released a lot of water vapor, because the entire surface is covered with fresh ice.”

“Yes; it’s all glitter.” Firuz sighed. “Deeper than the Grand Canyon on Earth. Just about as deep as Valles Marineris at Tithonium.”

“I’ve never been there. This is certainly higher than the escarpment near Aurorae. And so much more beautiful! The deep blue of the ice; I had no idea you could see it in the dim sunlight out here! And the old, exposed surfaces are reddish or pinkish in places! Then add the fresh frost and make the entire thing sparkling . . . it’s amazing!”

“Red and blue make purple, too. I don’t think I’ve ever seen lavender rocks, before.” Firuz paused to say a prayer silently to himself, then recited aloud, “Whatever is in the heavens and whatever is on the earth is a direct evidence of the revelation within it of the attributes and names of God, inasmuch as within every atom are enshrined the signs that bear eloquent testimony to the revelation of that Most Great Light. . . . all things, in their inmost reality, testify to the revelation of the names and attributes of God within them. Each according to its capacity, indicateth, and is expressive of, the knowledge of God.”

Charlie turned to Firuz, puzzled. “So . . . this is a testimony to God?”

“I believe so. That is what Bahá'u'lláh is saying: that every created thing reflects a quality or attribute of God. And of all the attributes I see out here, on Mars, in the asteroid belt, in the jovian system, the one I see most often reflected is God’s beauty. The physical universe is a reflection of God. And we live in a beautiful universe.”

Charlie nodded slightly. “I see.”

He stood there, staring at the chasma in front of him, struck by the idea that he was, in a sense, looking at God.

The rest of the EVA was rather mechanical. Charlie walked the outcrops on the edge of the chasma, chipped off samples, described them, and noted layers and folding and fracture

patterns. The geologists would gather after dinner to review the day's work, give each other reports, and offer reconstructions of the geological history of the chasma, which no doubt stemmed from a particular impact that had split the moon and cast off fragments that had become some of the other moons of the Himalia group. But his mind was only half engaged in his work. A deeper realization had dawned in him; one he couldn't quite understand.

After they returned to the *Barnard*, he peeled off his suit and went to his room for a few minutes of peace and quiet before dinner. He called Sirikit, who was 30 light seconds away. "Hi Siri! How are you? We had quite an EVA today; our second. Yesterday we explored Kunlun Crater, where the Chinese impactor had landed, in order to gather ground truth. But today we went to Perrine Chasma, a huge canyon that splits Himalia. I can't describe it to you, it's just so beautiful. It's vast, a tumble of angular cliffs with heaps of boulders and debris, but the colors: the ice is a deep glacial blue where the light shines through it, many surfaces have a patina of red from radiation damage to the crystal structure, and other surfaces have been refreshed by frost deposits. The result is a combination of blues, reds, lavenders, purples, and sparkling white that I can't describe . . . it's absolutely sublime." He paused, surprised by that adjective, which he had never used before. "I suppose the media people will post pictures to our website, but I'm sure they won't do the scene justice. Firuz quoted Bahá'u'lláh about every created thing reflecting an attribute, a quality of God, and it suddenly struck me that I was looking at God, in a way! It was most amazing. I don't know what else to say. . . ." Tears came to his eyes and he stopped.

He used the 30 seconds to regain his composure. He had not expected to cry; he hadn't cried in years, and never because of beauty. He watched Sirikit's face as she listened to him.

“Charlie, that’s so amazing! I don’t know what to say. What you’ve had is a very rare and special experience, and I love you all the more for it! Now maybe you can appreciate how I feel, sometimes. It must have been quite a canyon, I’ll have to take a look!”

“I didn’t say I believe in Bahá'u'lláh, Sirikit, but I guess I do believe in God. I’m not sure why; it’s just something you assume or trust in. It’s a funny thing, like flipping a switch in the brain or something. Maybe it’s a switch flipped in the soul, I don’t know! All that talk, on the trip out, about virtues and qualities of God, all those devotional programs I helped put together, but it was abstract then; the canyon’s beauty somehow made it concrete. These are qualities of God all around us and in us.”

“Yes, exactly. And I’m excited for a similar reason, because I talked to Hong Cixi a few hours ago—she’s now on the Council, replacing Beverly, who has resigned—and she said she wanted more conferences and activities to talk about a Mariner form of Confucianism, in order to ground Callisto’s values in something solid that was also Chinese. I asked how that was possible and she talked about grounding Mariner Confucianism in virtues! So she and I are going to work on that, consulting with Martha Vickers by videomail. That’s the inner beauty, Charlie. God doesn’t talk to us directly in revelations, or not very often, anyway. Most of the time people think they’re having revelations, at best it’s their unconscious speaking to them. And sometimes it’s not even that, I’m afraid. But virtues; those are qualities of our soul. We develop them in this life, we express them in our relations with others, and they are what we take with us to the next world. It’s thrilling to build huge, beautiful enclosures, but that’s a material expression of our capacities only. The virtues are our real capacity, our real beauty.”

Charlie was struck by that and didn't say anything for a moment. "Yes, I think that's true. Our inner beauty; what a fascinating idea. And it reflects God, too, as it is developed and refined especially. That's . . . a beautiful thought."

13.

## Revelations

Feb. 2076

“Bill, what’s going on at Aram?” Bill’s mother looked very worried on the grainy videomail. “I suppose you don’t know much, but is the fighting effecting you at all? What’s the situation on Themis? Did you see the interview with Captain Shepherd on *Mars this Sol*? It sounds like he’ll give you trouble! I’d be careful about being drawn into the conflict at Aram, it could get ugly. I hope you’re alright, dear! Let me know if I can help in any way. Bye.”

Her face faded from the screen. It gave Bill a lump in his throat and made him feel very lonely. He really could use his mother’s help. He glanced at the chronometer; he had to run a staff meeting in ten minutes. Not much time to reply. But he hit reply anyway.

“Hi, mom. Thanks for calling; I really don’t know who to talk to, right now, and you have a lot more experience dealing with people than I do. First, Shepherd: so far he isn’t my problem because he isn’t a believer, so he doesn’t have any following here. He is stuck here until the launch window opens to Mars in June, which is also the time the *Patares* arrives from Mars. I don’t know what we’ll do when the *Illumination* leaves because we have 136 people here now and the caravels really shouldn’t hold more than 50 each. The *Patares* arrives with 30 more! Maybe some people will leave then as well. I hate to say it, but I hope a lot of people do. The Prophet planned this situation in an insane way. As you know, he has cut corners on safety several times in the past. The *Illumination* is leased; we don’t own it.

“As for my problems here: I don’t have time to go into it now. I face a dilemma: solving one problem by disclosing information may cause another big problem. I’m not sure what to ask you about that one, so I’ll get back to you later.

“Aram: I’ve been following *Mars This Sol* pretty closely, but I’m not confident they have the entire story, either. A few fist fights and a lot of shouting over who will succeed Tree Rivers is not necessarily a crisis. On the other hand, I can’t imagine how the issue can be settled rationally. Victorino Alves emailed me first, saying he was the successor of the prophet and asking to send him a public statement declaring my loyalty to him. There seemed to be an implied threat he’d ‘fire’ me otherwise. Then Victor MacLeod videomailed, telling me to send all reports due to Rivers to him from now on. He complained that Victorino was claiming daily ‘guidance revelations’ from Rivers and that Victorino had insisted that he’d be Father Mars while Victor dressed as Mother Earth! I think neither of them appreciated that role. Victor seems to be avoiding claims to revelation, which I appreciate; I have someone here making such claims and it complicates everything. What do you think I should do about Victor and Victorino? Any wrong move will cause problems. Frankly, I have no idea who else I can ask. If I videomail or email anyone—even Suzanne—there’s no guarantee my communication won’t be intercepted. So, mom, please advise me! Thanks! Bye.” He hit send; no time to review his message. Now he had to hurry to the staff meeting.

Once again, they were split between two cafeterias, with a big screen showing the other space. Putting 136 people on caravels designed for 50 or, at best, 60 each long term, was the height of insanity, and thinking about it put him in a foul mood when he entered the *Matera’s* cafeteria.

“Good morning everyone,” he began. “I hope the few days to mourn and reflect have been helpful and will empower us to move forward with our principal task, which is enclosing and terraforming Themis. I have talked to several of you informally about our plans for the next few months. I have also reviewed the guidance I received from the Prophet, because on one

occasion we talked specifically about accelerating the completion of Dome 1, and he said no. Here are his exact words.” Bill pushed an icon on his communicator and pointed it at the wall screen. A minute later, a recording of Tree Rivers appeared. “Thanks, Bill, for the message. I’m glad to hear that the dome is going a bit better. We won’t stop the dome and make an enclosure yet. The caravel coming from Earth has two bubbles, and the two vehicles together have a lot of hallways and other underutilized space that could be used briefly for ecological purposes. So for now, we’ll pursue that strategy.”

The recording ended. “That was back in mid July when the dome was going very slowly. Since then, we have solved many of the problems and it has been moving faster. So the need to make the dome thinner to complete it faster is even less urgent than it was. I see no reason to depart from the clear guidance we have. Consequently, my plan is to put every spare person into the dome work, in order to complete the first bubble as fast as possible. We will also inflate the two bubbles the *Illumination* brought from Earth and set them up right away, so we can start to grow more food. We’ll also complete the work necessary to shift 30 people from the *Illumination* to the *Materra*, to alleviate crowding. Those are our priorities. They were before last week and they will be afterward.

I should add that Themis’s atmosphere requires 75,000 tonnes of oxygen and it’ll take plants several years to produce that much. There is no significant advantage to rushing dome 1 by making it thin and weak. It’d still take us three months to complete it, so it would save only three months. But we’d have to worry about various processes—degassing as the interior of Themis heats up, for example—pushing the pressure too high, and either rupturing the dome or forcing us to vent the excess gas into space, thereby losing it. So the prophet’s advice was sound. We will pursue the completion of dome 1 as planned.”

“Commander, how can we ecologists help accelerate the dome construction? We’re not engineers!” asked someone.

“Some of you have mechanical experience and can indeed help. You can assist the experts and gradually learn to do some tasks on your own.”

“Commander, I’m not satisfied with the excerpt you just played,” exclaimed Cynthia. She stood up. “I know my revelation and have no doubt about it. I think you owe it to us to play the entire conversation.”

“I’ll tell you why I don’t want to, then. Part of the conversation after this excerpt is very personal. My wife, remember, is the prophet’s niece. He made some family comments that really are not appropriate to share with others.”

“Then perhaps you should let a few of us see it and vouch for your statement.”

Bill stared at Cynthia, at wit’s end. “No, I won’t drag family stuff through a public screening.”

“Then I see no reason to reject the revelation I received from the Prophet on Thursday, during the funeral; and since, I should add! As you said, we have 250 tonnes of oxygen. If we can finish the dome in three months, we’ll have 400 tonnes by then, enough to pressurize the dome to 0.13 atmospheres. We only need to pressurize it to 0.1 atmospheres pure oxygen; that’s enough for breathing and to suppress transpiration from plants. Three months is a lot of time to save, where terraforming this world is concerned.”

“So is a year, if the dome bursts because of an explosive release of gas or a fire. In six months we’ll have three domes, one inside the other, the pressure can go much higher, and we’ll have redundancy.”

“Bill, when I receive a revelation like this, it is proof against accidents. That’s how revelations work.”

“Cynthia, a simple review of the history of Aram shows that revelations have not always been proof against accidents. Consider the loss of enclosures 1 and 2 and the space between them, and the partial depressurization of Genesis Dome, which resulted in several deaths.”

“How dare you question the Prophet’s wisdom!”

“Cynthia, I repeat: there is no guarantee in this world for anything. The best guarantee is caution and care. We are not cutting back on the dome’s strength. We are not cutting corners on safety. We are a small community in the middle of nowhere with no possibility of rescue. We have to take care of ourselves. That means being careful.”

“Then you’ll proceed without my directorship or the work of a big chunk of my team, because we’re going to cut the dome back to 0.2 atmospheres.”

Bill turned red from anger, but he held his tongue at first. “I . . . warn you not to pursue this course of action. It will hurt the entire community.”

“Then relieve me of my directorship, Bill, because you don’t have credibility. I don’t know that anyone believes you.”

He looked at her sadly. He probably could have handled the situation better, but he didn’t know how to. Now he was boxed in. “Very well,” he said. He picked up his tablet, scrolled through the videomails, and played his message asking why the Prophet had said he received a revelation to do something that he didn’t do until five days later. Then he played Rivers’ response: that sometimes he felt promptings and sometimes not, but either way, he attributed it to Father Mars and Mother Earth. When he said that, several people gasped; others mumbled

surprised comments. Captain Shepherd said, rather loudly, “So, the old boy is a liar.” That prompted someone near him to confront him.

“Take that back!”

Shepherd laughed, so the man swung his fist and hit Shepherd in the face, knocking him against the wall. Shepherd bounced back up and knocked the man flat with a punch to the gut.

“Stop!” shouted Bill, dashing over to intervene. He got between the two men and kept them apart with his hands. “No violence, and no comments!”

“You doctored this recording!” exclaimed Cynthia.

“No I did not! We can run it past all the experts you want; I don’t care. I didn’t want to play this tape, you forced me to do it, Cynthia! I didn’t want to shake anyone’s faith. But several things are clear from this message. One: Tree Rivers is a profound and rare genius, one who probably does occasionally receive revelation. Two: He does not want us to cut corners with the dome. Three: He has appointed me the leader of and his chief steward on Themis. Four: he promises that we will go down in history. He even has said how we will go down in history. So we have had our staff meeting and we know what to do. If anyone on the dome team doesn’t want to continue work on the dome we have been told to make, they can stay inside. But we will program the airlocks not to open for you if you decide you want to go outside for any reason. I will be outside in an hour to coordinate the dome machinery myself. Irene Langlois is the day officer, like every other day, and she is in charge of things while I am outside. Let’s get to work.” Bill nodded to everyone and headed for the door. Everyone else did the same.

Bill headed to the control area across the hall. He waited for Irene and her crew to enter.

“You heard what I said about the airlocks?”

Irene nodded. “Yes. Good idea.” She looked at him respectfully. “You handled that pretty well.”

“Well? I just shattered peoples’ faith!”

“Some people. Some of us have suspected all along that he was making it up.”

“Genius,” replied Bill, tapping his head. “He was an extraordinary man.”

“True. But this will get back to Aram and it will cause huge controversy there. And in the Green World communities on Earth; I bet some will disintegrate.”

“I didn’t want to release it, but it was that or lose my command; you heard Cynthia. She was insisting on revelation herself. Maybe she won’t be able to try that trick anymore.”

And maybe Victorino, too!”

“Yes, exactly. Irene, I want a copy of the audio and video of the entire staff meeting, including the recordings of Rivers, emailed to *Mars This Sol*. Let them put it on their website. Like you said, rumors will get out. For all we know, some people may have been recording the meeting. Let’s just get the recording out and let the chips fall where they may.”

Irene raised any eyebrow. “Alright, Commander. I’ll copy you when I send it.”

“Good. If you have anything else, let me know. I’m going outside to see what sort of dome team we’ll have.”

Irene nodded; Bill headed out of the control room, feeling a bit better. As he walked to the suit donning area, his communicator beeped. His mother had replied. He detoured to his office and pushed the play button.

“I’m not sure what to advise, Bill,” she said. “When I was mayor of Aurorae I had to deal with some pretty strange characters and strong egos, but I never had to deal with a power struggle between two people who both could claim to receive revelations! I’m afraid that’s

completely outside my expertise. I suggest you stay neutral. If either of them could fire you, be careful!”

He hit reply. “Thanks, mom. I suppose your experience in politics is pretty different! I think I just did intervene in their fight, in a way. Tune into *Mars This Sol* in a few hours and you’ll see what I mean. We’re sending them video of this morning’s staff meeting.”

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Marshall Elliott was surprised to get a videomail from Magellan Station, Venus. He had never heard from there before; he didn’t think he even knew anyone orbiting Earth’s sister world. But he had no time to stop and look at it at that moment. He had just finished a very full day of work, first teaching an online class on Titanian geology for M.I.T and Martech—his students were one and a half light hours away that day—then doing administrative work for Martech-Titan, then doing preparatory work for the Saturn Council meeting coming up in two nights. He had exactly an hour before he had to pick up Willie and Millie at after care, so he dashed back to their apartment on court 5 of the *Von Braun*, changed into his jogging clothes, and headed out. First, he made several laps around the rim of the spinning *Von Braun*, augmenting its  $\frac{3}{4}$  of a terrestrial gee by running with the rotation, which pushed his apparent weight up close to what it would be on Earth. It made him pant; it wasn’t easy, but that was the point.

After fifteen minutes of that, he took an elevator to the hub, descended to the Titanian surface, and jogged down the wide ramp tunnel leading down into the underground part of the outpost. A hundred meters down he turned right and entered their bioarchive, a spiral of five pairs of 50 by 100 meter enclosures, each with a cooler and wetter climate as one descended. He followed the “even” numbered enclosures, jogging along the babbling brook that started in B-2 and descended with him, for each enclosure had a slanted floor. When he got to B-10, he paused

to rest by the pond, but it was cold in that enclosure, so he didn't remain. Then he headed to the spiral stair that served as an extra entrance or exit from the lowermost enclosure and jogged up the steep 75-meter ramp, which was quite tiring, even in Titanian gravity. At the end of the routine he had burned close to 500 calories.

He headed to aftercare on the *Korolev*. It was located where the kids were in at least half a gee all day; good for their bones and muscles. Willie, age 6, was bubbling over with stories from first grade. Millie just wanted her daddy to carry her; she was tired. Marshall brought them to the atrium on the *Von Braun* to eat supper, and Amy joined them.

"Any progress on the super-enclosure?" Marshall asked her, once the kids were settled down.

"You always ask about that, don't you! Yuri's made it his last big project. The debate isn't over how big we can make it theoretically; it is clear we can make it very, very big if we want. The question is, how big do we want it to be. Right now, Yuri's leaning toward a width of 200 meters and a height of 100 meters. The remaining question is length, but we could start with 200 meters and add to it later."

"Two hundred by two hundred." Marshall contemplated that while he chewed his rice, tilapia, and vegetables. He nodded. "That would be nice. It would take a long time to melt that much ice, though, and it'd take a lot of power to light it; 20 megawatts. We could be ready to tackle it in a year or two."

"Sooner. Yuri thinks we should start right after the *Ptolemy* arrives and the people get settled down. A big tunnel will take a lot of planning time as well. We don't have much time before the arrival of a third galleon and the beginning of the helium-3 project. Why are you so keen on it?"

“I think we need a really big space. Two hundred by four hundred: that’s sort of the size I was hoping for. I’d like to see an enclosure 500 meters by 1,000 meters and 250 meters high. I think we need a really big open space. Now that we can make wind turbines and geothermal wells, we can get as much power as we need, so we should plan big and plan ahead.”

“The survey last month bears you out; 80% wanted a really big enclosure. But the volume you’re talking about would need 250 megawatts for illumination, and it may be that the surface area is insufficient for the heat to escape. Yuri was talking about adding wells to the enclosure he was proposing, so the extra heat of the enclosure can be injected into the subsurface. There’s also the problem of getting enough nickel-iron. We’re already mining lag deposits forty kilometers away.”

“We need to get nickel iron from Ceres. They’re exporting it anywhere. They could send it to Jupiter, a gravity assist would fling it to Saturn, and Titan’s atmosphere would slow it enough for a crash landing, which would be sufficient.”

“Well, I’m not worrying about a big enclosure right now. Ecology is busy preparing for the arrival of the *Ptolemy*. It’s bringing a thousand more species and we’re determining when to add each one to the biomes. I’d rather clear another ten enclosures and double the area of each ecology.”

“Maybe we can do that, in another five years.” Marshall turned to Millie, who was having trouble eating her peas; at ten months, she was doing a pretty good job, but needed some help. Willie had finished his supper fast and asked whether he could dash off and play for a few minutes, which his parents agreed to. But in another twenty minutes Millie had finished eating and Marshall and Amy had finished their coffee, so the family headed down the elevator to their

condo facing courtyard 5. At that point, Marshall remembered the videomail from Venus. He sat on the couch and played it.

“Good day, Dr. Elliott. My name is Dr. Pauline Augustine. You probably don’t remember me; I was in the Martech Department of Volcanology in 2064-67, right before you headed for Saturn. I left for Earth in 2068 then came to Venus in 2073. I am a member of the Venus Council. As you probably know, Magellan Station expanded from 50 to 200 with the arrival of a galleon two months ago, and a few weeks ago we got our first asteroid, a little chondrite body 20 meters in diameter. So technically, we are now a moon, not just a station.

“I’m calling because I wanted to ask about two or three matters. First, I am wondering whether the Saturn Council is considering the idea of a Mariner League. We think it’s a very useful idea, but we’re not inclined to jump and be first. Second, we’re thinking of setting up a formal campus of Martech. Most of us here have faculty affiliations at various terrestrial universities, though they are pretty informal, and many of us have collaborated with people at Martech or have worked there. So those are my main questions. My third question is purely informal: have you any suggestions for how we can grow Magellan further? Two hundred is a fairly substantive community, but we’d like to get up to 500, which seems to be the recommendation of sociologists. We may not have any exports, but we’re also the closest community to Earth, and therefore the cheapest one to support.

“I appreciate any ideas you have on these three matters. The development of Titan remains a fascinating topic and I’m sure you are all eagerly awaiting the arrival of the *Ptolemy*. Bye.”

“Interesting questions,” said Amy, who had been listening from the bathroom, where she was helping Millie.

“Yes, but there’s isn’t much I can offer,” replied Marshall. He thought a moment, then hit reply. “Thank you for your call, Dr. Augustine. I’m glad to hear the Venus Council is interested in the idea of a Mariner League. I’m afraid we’re not going to do anything for a few months because the *Ptolemy* arrives in less than two weeks. It’s bringing 200 and will be departing for Mars with 85 in March. In between, we’re having a new election and the new Council will have considerable turnover, so it’ll need a few months to get organized.

“As for Martech, all you need is organize the potential faculty into departments of a Magellan Campus and choose a Chancellor. I’ll send you the relevant documents we drew up, here on Titan. I can’t imagine Martech would turn you away. If they did, you could affiliate with another university, anyway.

“As for growing, the lack of an export is a limitation, but your proximity to Earth helps a lot. The main difference between Magellan and Titan, I suspect, has to do with the fact that we have natural resources and you don’t; or didn’t until recently. As a result, we have a permanent construction and fabrication crew equal to one third of our adult population. That pushes our population up enough so that we need more support services, and all our enclosures mean we need more ecological specialists than you. Basically, Magellan and Titan both have a galleon full of scientists, but Titan also has a galleon full of construction, fabrication, and ecology specialists. We also have a lot more children than you. Now that you have access to natural resources, I’d argue that Magellan now needs construction and fabrication. Once you have them, you might not even need more galleons, because unlike Titan, you can build your own rotating housing from nickel iron and chondrite. Ceres could fabricate huge cylinders for you and you could set up housing and work areas on their inside surfaces. All you need is a permanent construction and fabrication crew of sufficient size. That’d be my recommendation.

“Good to speak to you. Best wishes with your research; Venus is a fascinating place to study volcanism. Bye.”

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“I assume you didn’t invite me to your office to talk about Columbiad 20,” Will Elliott said to Jacquie Collins.

“No; that’s going pretty well. We’ve got 2,000 arrivals on Phobos, shifted into the new corvet there, and they’ve started down on the new Prometheus passenger liners. Another 2,000 have made it to low Earth orbit or the moon and will be on the way shortly, and the remaining 2,000 are on schedule to be transported to LEO over the next two months. Housing is done here, and I think just about everyone has a job! It’s amazingly smooth, this time, in spite of the huge size. No, I need your help with Aram.”

Will sighed. “I was afraid you’d say that!” He nodded. “I’ve been following the developments on Mars This Sol. I can’t say I know Victorino practically at all; he’d come to the Mars Council votes and then leave. Victor handled the external affairs, so I know him a bit more. Both of them struck me as yes men; or maybe I should say, good, reliable, loyal assistants. Neither has ever had an original idea.”

“Well, they both have decided to make up for lost time. I met Victor a few times and shook Victorino’s hand once. Maybe that’s not much less than you. But they strike me as less likely to work for women, and I’d rather not show up with a squad of rangers. You are respected by them; you’ve visited Aram a lot more than I have. And you have a Nobel Peace Prize.”

“So, what’s the mission?”

“They have to have the rule of law. That means an election to choose an Executive who will have the authority to run the borough. Charismatic authority is not sufficient. This is the twenty-first century, not the first century.”

Will nodded. “That makes sense. Otherwise, we’ll take control over Aram’s life support.”

“At minimum. If we need to send in a squad of rangers to provide peace keeping, we’ll do that. We’ll take control of anything that we need to take control over. We’ll prosecute violators in Aurorae if necessary. They are a borough, not a sovereignty. Do you want a dramatic arrival—via suborbital hop—or the quiet arrival via surface vehicle?”

“I’ll drive down. I need to bring a few others along, too. Geezers, I think. They respect the elderly.”

Jacque chuckled. “That’s my feeling, too.”

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“Are we ready?” asked Érico, watching the door of Genesis Crater’s large vehicle airlock open for them.

“I think so,” said Will. He was lost in thought, running through things he could say.

“As ready as we can be,” agreed John Hunter, still uncertain why Will had invited him to come along.

“Okay,” said Érico. He engaged the ranger’s airlock sequence and the vehicle moved itself slowly and precisely into the metal cubicle. The outer door closed behind them and air rushed in. A minute later the inner airlock door opened and the ranger moved into the garage.

Érico deactivated the airlock sequence and powered down the vehicle. The three of them rose and walked to the ranger’s rear airlock, which opened automatically to let them out. “No one can enter without our permission,” Will reminded the ranger as they stepped into the garage.

“Welcome to Aram,” exclaimed a young woman to them, a moment later. “I’m Nicole Ravier, the Superintendent of Schools for the Borough.”

“And a member of the Mars Council,” said Will, offering his hand. “It’s good to see you again, Nicole.”

“Thank you, Dr. Elliott. It’s good to see you again. I’m sorry for the sad circumstances.”

“Me, too.” They shook hands. Nicole turned to Érico. “Dr. Lopes, thank you for coming as well.”

“I hope we can be of assistance.” They shook hands as well.

She turned to the third visitor. “I’m sorry, I don’t know you. Nicole Ravier.”

“John Hunter; I’m a geochemist and arrived on Columbus 5 in 2044.” He offered his hand and they shook; he had an intentionally weak grip. She glanced at his long braids of gray hair.

“You are very welcome. You are . . . Indian?”

“Lakota. Since you are an educator, you may have met my wife, Vanessa Smith.”

“Oh yes, of course!” Smith was a Nobel Prize winner in biology and President of Martech. “It’s very good to meet you as well.”

“Thank you.”

“Gentlemen, this way. Victorino Alves, as you may recall, was the Prophet’s personal assistant for Aram. He was de facto the borough manager. He asked to come down to meet you and escort you to his office.”

“Ms. Ravier, we aren’t here to take sides,” said Will. “We are here to help mediate what is clearly a conflict. Rather than meet with Victorino, we’d prefer to meet with him and with

Victor MacLeod at once, preferably with a ground of other managers of the borough's agencies such as yourself.”

“I see,” replied Nicole. She stopped walking forward and considered the situation. “I can take you to the guest house in Genesis Crater; it's a beautiful, comfortable place. Would you prefer that everyone come there to meet you?”

“Yes, definitely. We mean no offence to Victorino, who understandably has invited us to his office. That is the proper, hospitable, thing to do. But considering the nature of the conflict here, we'd prefer to meet everyone in a neutral place.”

“I understand; the Guest House. That makes sense.”

“What has it been like here?” asked Érico.

“Ah; very tense. Victorino is in charge sol to sol because most all the managers had always reported to him anyway. The exceptions were exports and enclosure construction, which was oriented around exports anyway. Those departments reported to Victor, who handled external affairs. He also handled the department of revenue; still does.”

“That's a pretty important division of responsibilities,” said Érico.

“It is. Their clash has precipitated a serious crisis. This way.” Nicole pointed, then started forward.

Genesis Crater had been the scene of Rivers' funeral a week earlier and the vegetation still looked trampled. She led the three men to the Guest House, then headed out to convey their message to the other department heads.

John looked around the beautiful main room of the guest house, then settled into a chair facing the fireplace. “This is beautiful. And they actually use the fireplace?”

“They do,” said Will. “I’ve seen it with a fire in it. Aram is so big, the smoke really isn’t a problem.”

“It has ashes in it,” said Érico, pointing. “So, how many adults live here now? Four hundred?”

“A bit less; with children, Aram has 450 people,” replied Will. “One hundred fifty more are on their way from Earth, too. It has 320 hectares of enclosure, scheduled to almost double in the next two years. That’s why they can burn wood; they have real forests. It’s a paradise of sorts, and now it’s in jeopardy.”

They contemplated that as they waited. Will opened some cabinets and found coffee and tea and a kettle; he made a pot of both, anticipating they’d need it. Gradually, the five principals of the borough came in: Nicole Ravier, head of the school; Anselm Michelson, head of construction; Patrick Stern, head of ecology; Victor MacLeod; and finally Victorino Alves, who was noticeably angry that the guests hadn’t come to his office. The others had introduced themselves and had offered a few tense, formal comments, but Victorino’s “So, why have the three of you come? Are you planning to interfere in internal matters?” immediately chilled the atmosphere.

“We are here because there is conflict here, people have been injured, construction has stalled, and the future of Aram is in jeopardy,” replied Will. “You have heard the reports from Earth: Flora Rivers has claimed her brother’s prophetic mantle; Greenley Rivers has rejected her claim, asserted continuity with his brother’s philosophy, and grabbed control over the community’s financial assets; two communities have pulled out entirely; dozens of members have resigned. On Themis, there was a claim to revelation as well, and then Bill Hollingworth

put it down in a contentious staff meeting that included release of a videomail where Rivers admitted to making up some revelations.”

“The videomail must be a forgery,” asserted Victorino. “I’ve been with the prophet when he received revelations. They were all genuine.”

Will opened his mouth to reply, but Victor spoke up instead. “No, it is genuine, Victorino! We’ve already had this conversation. He said the same thing to me on two occasions.”

“You’re saying that because you can’t have revelations!”

“Neither can you!” Victor snorted back.

“I know what I feel and see! You aren’t being faithful to the Prophet’s vision! You should resign and leave the community.”

“Don’t *you* wish.”

“There is clearly conflict here,” said Will. “You have proved it. Did Rivers leave a will or other written instructions about leadership?”

“No,” said Victor.

“He left me plenty of oral instructions,” replied Victorino.

“Perhaps he did,” said Will. “But I asked for written instructions, which are the only kind that will hold up, in these circumstances.”

“If I may add,” said John Hunter, quietly. He paused to make sure everyone was listening. “I have felt the spirit of Mars on several occasions. I will not deny the truth of that spirit. I have felt many other spirits here as well. So the existence of the spirits is not the question. The question is how we will, as a community, function together. Aram is a community, isn’t it? Are we not all a community?”

The others looked at each other. “We are a community following the vision of the prophet,” replied Victorino a moment later.

“We are a community that includes the four legged and the winged ones,” persisted John. “How will they be included?”

“We do need to protect our ecology,” agreed Patrick Stern, which produced a hot glance from Victorino.

“What do you want?” asked Victorino. “What threats have you brought?”

“No threats,” replied Will. “Jacquie Collins and I said nothing about threats. Nothing at all. We never talked about taking things away. But all of us in this room know how dependent Aram is on the rest of Mars. Construction need nickel steel and plastic. Ecology sells us food and materials that we could do without if we had to. And the Commonwealth subsidizes borough governments. It gives them the right to oversee their own environment, and it has already taken that right away from Aram once. I’m repeating things we know. I’m not issuing them as a threat.”

There was silence in the room for a moment. Then Érico said, “Look, we don’t need to take a poll to know that some people support Victorino and some support Victor. There are probably some who are fed up with both of you, too. How do we resolve this problem, on Mars? We don’t use fist fights or arguments. We can debate, yes. We can talk, yes. But in the end, what do we do?”

There was more silence. Then finally, Nicole said, “Vote.”

“Exactly,” said Will. “The alternative is to look more and more like Earth, and it isn’t pretty down there right now.”

“Except here at Aram, we really haven’t had votes,” said Victorino. “We have always done what the Prophet recommended.”

“That’s fine,” said Will. “Victorino, you can’t force people to believe you are receiving revelations. I’m not saying you aren’t; I’m just saying, you can’t force belief. If the vast majority of people here become convinced that you are receiving revelations, they can vote to stop holding elections. Otherwise, if you prevail, you will be in charge of a shrinking borough. People will vote with their feet.”

“That’s true,” agreed Patrick Stern. “Prophets don’t always run boroughs, either. Tree Rivers didn’t.”

“I’ll agree to an election,” said Victor. “I think right now, after the videomail Bill released, most of the people here don’t believe in revelation.”

“We need an election,” agreed Anselm Michelson, quietly.

“Alright,” said Victorino. “When?”

“We brought our luggage,” said Will. “We can stay several sols.”

14.

## Leadership

late January 2076

Helmut Langlais popped up the blueprint of the new addition of Ceres borough onto the wall screen near his desk. The *Herschel* wouldn't arrive for over a year, but the underground complex connecting the two galleons and the two caravels together was already designed and excavations had begun. A metal cylinder fifty meters in diameter and one hundred meters long was the centerpiece and would provide a large interior space called "the mall"; the top half would be open for flying while the bottom half would have several high ceilinged floors for trees, orchards, and other greenery. Cererean gravity was too low for shops, restaurants, and other public social spaces; it was a "mall" in the sense of an open space, not a shopping center. They'd have to wait for the arrival of a corvet for that, if they could get one. Helmut was hopeful.

While he studied the plans for level one—which would have all the machinery, pumps, and storage, and therefore was the most complex level—he noticed that a videomail had arrived from Magellan Station, Venus, of all places. He didn't know anyone there except for Irina Mukhamadova, whom he had emailed two or three times. But this wasn't from her. He pressed play, curious.

"Good sol, Dr. Langlais. I am Mike Hall, a fabrication engineer here at Magellan Station, two thousand kilometers above Venus. My wife, Pauline Augustine, is on the Venus Council, and wonders whether Ceres would support a Mariner League, if Venus initiated a resolution. That's her personal question to you. I have a different question, though: as you know, we just received our first asteroid recently, a small chondritic body 20 meters across. We have a larger body about to enter high orbit around Venus and it will settle into our orbit in about a year. A third body does

a near encounter later this year and that will put it into a shadowing orbit; it'll arrive in about 2 ½ years. A fourth object is currently undergoing orbit modification so that a close encounter with the moon next year will move it into a Venus-intercepting orbit, where some gravity assists will bring it in about 2079. We may go after additional objects as well if we can get the funding.

“I’m calling because we have been reviewing the new capacities described on your website. The byproduct of 100 tonnes of PGM production is staggering! You can’t even export the thousand tonnes of cobalt and the hundred thousand tonnes of nickel byproduct; you can’t even use the two hundred thousand tonnes of waste iron. No one can, even Uzboi, which produces a million tonnes of ‘waste’ metal per year, in spite of the metal roads and metal habitation cylinders and thousand-tonne tankers of metal carbonyl now being shipped to Aurorae. We see you can produce nickel-steel sheets ten meters wide, up to 6 centimeters thick, and fifty meters long, and you’re just stacking them as waste.

“I want to explore the possibility of Ceres producing a cylindrical habitation for Magellan. This is purely exploratory and informal; we want a preliminary proposal to submit to the Council, which will take it to the Commission. What we have in mind involves four nested cylinders. The innermost cylinder would be 100 meters in diameter and 100 meters wide. The outermost cylinder would be 106 meters in diameter and 106 meters long. The cylinder closest to the outermost would be separated from it by a ten centimeters space, a space that would be filled with cooling water to radiate away waste heat. The innermost and next innermost cylinder would be separated by one meter and that volume would also be filled with water, for radiation shielding. The remaining 1.9 meter volume would be filled with waste rock from our asteroid processing to provide radiation and micrometeoroid shielding. The entire cylinder would be rotated 4 revolutions per minute to produce 0.88 artificial gravity on the inside surface of the

cylinder. The end caps would have LED lights designed to illumine the cylinder wall uniformly. We figure the habitat can easily accommodate 500 to 1,000 people. The metal structure would mass about 25,000 tonnes. You already produce the materials; they'd just have to be welded together. The interior could be used to store the hydrogen and oxygen fuel necessary to propel the structure to Venus and put it into orbit.

“We don't have more specifications than that, so far, but we thought they were enough to get the discussion started. We suspect you have more capability to build the habitat than Phobos because Phobos doesn't have access to the metal. Bye.”

Helmut watched Hall's image fade and contemplated the request. It was true they produced 10 by 50 meter nickel steel sheeting. They could robotically weld them into longer strips as they came out of the facility, so strips 314 meters long were possible. Bending the strips and welding them into rings was possible. Stacking the rings so that a 100-meter cylinder could be welded together was harder, but there were plans to do that as well; Martech had developed a system for manufacturing their 50 by 100 meter mall, whose blueprints he had just been examining. It would consist of nested cylinders as well, two of them three meters apart to accommodate water for radiation shielding. The idea of LEDs on the end caps was interesting; they weren't doing that.

He hit reply. “It's good to hear from you, Dr. Michael. We can indeed produce four nested cylinders 106 meters outer diameter and 106 meters long. We have plans for a 56-meter outer diameter cylinder with a 50-meter inner diameter cylinder with water in between to make ‘the mall,’ our main space in Central Outpost. We've even started on plans to mass produce cylinders 50 by 100 meters, filled with water, hydrogen, and oxygen. They'd be our main ‘tanker’ for moving water anywhere it's needed in the solar system. We might even consider upsizing to the

dimensions you are proposing; Earth orbit uses a lot of water. So the cylinders aren't difficult or expensive. The pipes, pumps, wires, and sensors to convert one into usable space are the main expense. I'm copying Jamsheed 'Jimmy' Khan at Martech because he's chief designer for our mall. I'd welcome a three-way conversation about this project. When the *Herschel* arrives next year, we will have the human resources to start on projects like this.

“As for the Mariner League: intriguing, isn't it? Our Council hasn't discussed it, but certainly we would be in favor if we did. We think we'd be invited, in spite of our borough status, but that also makes us hesitant to propose it. Boroughs don't do foreign policy, as it were.

“It's very good to hear from you and I look forward to additional conversations. Bye.”

Helmut sent the videomail with a sense of satisfaction. Jimmy Khan was a bright, young, innovative 'space structures engineer'; he didn't call himself a spacecraft designer. He had already told Helmut about the idea of hollow cylindrical colonies at the Earth's Lagrange points or cruising trans-Neptunian space self sufficiently for decades at a time, hopping from Kuiper Belt Object to Kuiper Belt Object to study their origins and utilize their resources. Perhaps his vision would come sooner than expected.

He turned back to the blueprints of the mall's lowermost basement, reviewing comments and asking questions. Suddenly, in his mind he saw the cylindrical mall turned ninety degrees—standing up on Ceres, rather than laying on its side—and rotating on a turntable to produce artificial gravity. Intrigued, he sat back at his desk to contemplate the idea. Manufacturing their own gravitied interior space on Ceres? He wondered whether they really could do that. It occurred to him that a thousand tonne structure would weigh only 28 tonnes on Ceres, and maglev trains on Earth weighed far more than that, yet never touched the tracks they hovered over. The mass of radiation shielding did not need to rotate, but could stand on its own

foundation. Mirrors could even admit sunlight from the top. He pulled up Jimmy's email again and dictated a quick voice mail to him.

Then Helmut turned to an update on the Mahuika Highway. The metal road was now adding almost a kilometer of track a day, complete with built in methane and oxygen pipelines. The Mahuika nickel-iron impactor was 400 kilometers to the northeast of Central Outpost; the highway to it would be completed in less than a year, allowing rapid and cheap movement of its nickel-iron to Central's processors. The report reviewed the proposal to extend the highway all the way around Ceres. After the *Herschel* arrived they would start building westward as well, with the goal of completing a circumferential metal highway in five years. Since the roadway was nickel steel, it was magnetic, so vehicles could ride along it very fast and use magnetic brakes to stop in the low gravity. The 3,600 kilometer highway would put the entire asteroid's surface within 700 kilometers of a fast road and would be diverted past every other known nickel-iron impactor, allowing them to exploit every one eventually. They could also set up solar panels anywhere around Ceres, convert the electricity to methane and oxygen, and ship it anywhere else. The highway took a crew of only 10, which would double to 20 after the *Herschel* arrived. It was a good use of resources. Every day they crushed a thousand tonnes of ataxite and taenite—nearly pure, hard, natural metal alloys—blasted the powder with hot carbon monoxide to convert it into metal carbonyls, then let the different metal carbonyl gasses condense as liquids at different heights and temperatures in a fractionation tower. The very rare liquids of platinum, germanium, gallium, iridium, palladium, and osmium were poured into molds and heated to break down the carbonyl, producing hot carbon monoxide gas to recycle back to a new supply of powder. The ingots were stored for export to Earth. The remaining thousand tonnes of metal was potential waste without a use. The iron carbonyl and some of the

nickel carbonyl were blended together just right with a few percent carbon dust, poured into molds of various shapes, and heated to drive off the CO, producing solid, stainless, nickel steel. The highway molds produced perfect ten by twenty meter road “panels” that a robotic truck hauled down the highway to the end, where it lowered the panel into place and robotic welders attached it to the track. It was a good use of the metal. The same system was extending metal highways all across the Martian surface.

Helmut read the report with great satisfaction, correcting grammar in a few spots and adding an occasional sentence or two. It was just what Ceres needed to secure its central place in the asteroid belt, for it would have cheap access to far more resources than any other world.

He turned to the latest monthly income and expense report, but before he had a chance to read the cover memo, his videophone icon flashed and beeped. It was Clara, and that worried him; she was taking Oskar to the sick bay. When her face appeared on the screen, she looked older than her 50 years. “Helmut, can you come down?”

“Sure. Bad news?”

“Very.”

“On my way.” Helmut closed the circuit and hurried down two levels to the medical center.

Oskar looked crestfallen as well. He had just turned 14, but had just begun his growth spurt and was still fairly short. He had been struggling with allergies for a year and in the last month he had been sick a lot of the time.

“What is it?”

Juliette Delafontaine looked at Oskar and Clara. “This time it isn’t allergies, like we thought. Oskar has leukemia.”

The word shot through Helmut like a bullet. “Leukemia?”

She nodded. “Leukemia. There’s no evidence in his DNA that it’s genetic, but Oskar has been exposed to a lot of radiation. We have chemotherapy drugs here, so we want to start him on that right away.”

“Of course. And—”

“There’s a good chance we can wipe it out, but this particular strain of leukemia is very hard to eliminate. We haven’t gotten the DNA analysis of the leukemia back yet; it’ll be a few days. But it may be best to take him back to Mars next year. They can handle anything there. Mariner Hospital is as good as any hospital on Earth, where cancer is concerned.”

“We’ll have to wait and see,” said Clara. “The launch window doesn’t open until next year, anyway.”

Helmut nodded, numb. He looked at Oskar, who looked frightened. “We’ll figure it out, don’t worry.” He walked over and embraced his son. “We’ll figure it out.”

“I don’t want to leave Ceres!” replied Oskar.

“Honey, we can always come back later, if we have to go,” replied Helmut.

“But this is your life!”

“My family is my life. Don’t worry.”

Clara looked at Helmut, uncertain what to say; she was still overwhelmed. “We’ll figure it out,” she agreed.

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“Auntie’s not budging,” Suzanne Rivers Hollingworth said to her husband, Bill. Her image flickered a bit on his screen. “I videomailed her personally because it would do dad no good to contact her. He thinks she’s crazy, to claim prophecy. He doesn’t believe a bit of it. But she won’t

budge; she wants control over the entire community's fortune 'because the Prophet had it,' after all. Actually, legally, he didn't; it was in the hands of the trustees and still is, it's just that the trustees no longer agree about how to allocate it. They always accepted the prophet's judgment, but of course they won't accept Flora's. She said she won't agree to any release of funds for emergency expenses on Themis because you released that video. But she also didn't say you should resign! I guess she hasn't gotten a prophecy about that. I'm sorry I couldn't help, honey. Can't wait to see you. We're fine, but we miss you and are counting the days—or sols, I'm not sure which we're using now—until we see you. Bye.”

Bill watched Suzanne's image fade on the screen. His hopes faded with her image. He was responsible for authorizing monthly payments for dozens of items, including the two domes on the way to Themis on the *Patares*. Now he wished Rivers had just paid the entire cost at once; he had plenty of money. But now the entire fortune was tied up in litigation, and might be for years.

He hit the reply icon and sighed. “Thanks for trying, hon. It was a long shot; it might be that the courts wouldn't have agreed to paying bills, anyway. I suppose they will authorize it eventually, though. I videomailed Victor and he's supportive; he won the election on the sixth round of voting partly because of the video, after all. It's terrible to see the community tearing itself apart this way, fighting over new revelation, over teachings, over money, over property . . . it's enough to make you want to cry! But we're here on Themis and we can't go anywhere for at least 5 months. We're stuck with each other. So we're managing as best we can. I can't wait until you and Jeremy get here. He'll just about be old enough to walk by then! I hope I get to see that. I hope I can take a bit of vacation, but I suppose that'll be impossible. Talk more later. Bye.” Bill hit send and looked around his office, which also served as his quarters; they were too crowded

for him to have a second space. He was lonely, assailed by critics, criticized, questioned every hour of every day, and tired. But it was a hell he was stuck with, for the time being.

He headed to the cafeteria for some quick supper. The food wasn't very good, either; very simple, relying on a few very productive plant species, and therefore monotonous, unless the cooks spiced it up with dried rations. It didn't help morale any.

He hoped that Captain Shepherd and Cynthia Clarke had finished eating and had left, but they were still in the cafeteria, and as soon as he sat with his supper, they pounced. "So, will Spacelift be paid?" asked Shepherd pointedly.

"They'll have to sue the Prophet's estate. Everything is tied up. Even the Marsian portion of the estate is frozen until the courts can resolve who can authorize payments. And there are jurisdictional problems; Flora Rivers is in Canada, Victor MacLeod's on Mars, and the three other trustees are in the United States and Australia. But if no one can spend a penny, I suspect they'll come to an agreement pretty quickly."

"I hope so, because Spacelift wants its monthly payment right away."

"I can't help. I'm doing everything I can. Themis has a lot of outstanding bills."

"I'm sure. I hope you'll be able to pay them."

"Thanks."

"And they're mad at *you*," said Cynthia. "I think it's time for us to hold an election here. If they can do it at Aram, we can here."

Bill looked at her, surprised. "So, the one who believes in revelation, who believes in the Prophet, wants to overthrow the Prophet's clear statement that I am his 'steward' for Themis. Very interesting."

"Bill, don't hide behind the Prophet."

“I’m not; I’m surprised you’re rejecting his word!”

She scowled at him in her anger. Shepherd intervened and said, “Look, this is the 21<sup>st</sup> century. Elections are how we resolve issues of day to day authority. If people want to claim revelations, they are free, but we are also free to reject the guidance they claim.”

“Very true.” Bill looked at Tom Shepherd, wondering what his motivation was. “Look, I’ve been appointed the leader of Themis. Everyone has heard the Prophet’s utterance. I’m not one to overthrow a pronouncement of our late leader; not yet, anyway.”

“Then you’re a fool,” said Shepherd, ominously.

“That’s my privilege. Now, please let me eat my supper.”

Tom and Cynthia nodded and walked away. Bill looked around; a dozen people had heard the entire exchange. They looked at him; some were sympathetic, others uncertain. Bill looked down at his food, trying not to look uncertain himself.

He went back to his office, laid on his cot, and wondered what to do. He was tempted to pray, but decided it was meaningless; he no longer believed in Rivers’s “metaphors” about Mother Earth and Father Mars. He got up and walked to the bridge for a while; all was well and the dome extruding system was humming along, making more dome per day than they had ever expected, slowly making up for lost time last year. That was the most unexpected and happy news of the last few weeks.

He went back to his office and laid down again, and he soon fell asleep. But half way through the night he had a vivid dream of Cynthia Clarke and Tom Shepherd arguing with each other, then walked around the two ships gossiping and backbiting against him, spreading lies, undermining his authority. They had already been doing that, but now it was dramatic and vivid.

He awoke and bolted up on his cot. Was it a revelation about the future, or his subconscious working on the data of the last few days? He knew what to do. He laid in his cot and reviewed it over and over again.

Finally at 7 a.m. he got up, showered, and went to breakfast. Irene Langlois, who had been running the bridge all night, had been relieved an hour earlier and was sitting at her usual table, eating a light breakfast and getting ready to go to bed. “They’re talking against you,” she whispered.

“I know. What are they saying?”

“You’re a dictator. You’re scared of an election. You’re an ineffective leader.”

“That’s what I thought. Then we’ll solve the problem at the staff meeting in half an hour.”

“How?”

“We’ll hold an election. They’re already electioneering, after all.”

Irene’s surprised turned to admiration. “Good point.”

Bill smiled grimly. It was a risk; but he sensed that his position could only get weaker over time, as people pressed him about an election and gossiped about it. He ate his meagre breakfast of toast with tofu cheese and washed it down with coffee, then helped move the tables out of the way so that more people could crowd in for the weekly staff meeting. At 8:30 the screen came alive with a similar scene from the cafeteria of the *Patares*. Bill rose and walked up front. “Let’s get started. We have some good news: yesterday the dome extrusion unit made 81 meters of dome. For four days, now, we have exceeded the nominal 3 meters per hour or 72 meters per day. The first dome will be finished almost on time, if we can keep this up. It has taken us almost 8 months to get the dome extrusion unit working right. Cynthia and her team did

a great job of modifying equipment. Let's give them a round of applause." He started to applaud and everyone followed, much to Cynthia's surprise.

"The work setting up the two greenhouses is also proceeding well. We have Themis on a 22 hour 33 minute rotation and we should have her adjusted to a 24 hour day in another 2 months. We have the cables strung between all four main pylons, ready to support the last loops of dome. We have 8 of our 10 planned wells drilled into the heart of Themis; once she is enclosed, we'll start pumping the heat down and driving off the gasses to make her atmosphere. In spite of the difficulties and disruptions, our work is proceeding well. We have much to be proud of." Cynthia moved to open her mouth, to object, but he raised his hand. "No, don't say anything yet, Cynthia. I'm not done. We have one area where we are still deficient: our unity as a community. That is something the Prophet always emphasized very highly. So I propose that we hold an election, right now, for our Commander."

"What?" said Cynthia. "Last night you said you were opposed to an election!"

"No I did not. I said, 'I'm not one to overthrow a pronouncement of our late leader.' And I'm not. He declared me his 'steward'; you all heard it. But his pronouncement is being overthrown by others, who are spreading gossip and are electioneering for themselves. So rather than let that continue, let's resolve the matter right now. Let's hold a vote."

"But we haven't had time to make our case!" exclaimed Shepherd.

"You mean, campaign for yourself?" asked Irene loudly and pointedly, for she was happy to help out her boss. She liked him; a lot of the crew liked him.

"No, to make our case!"

"In other words, the campaign against someone!" said Irene.

"I'm from Earth, not Mars!"

“Enough said,” replied Bill. “If people want some time to ponder and reflect, that’s fine. We can leave the voting open until noon. There’s no reason to rush people, but we do want to hold our election without campaigning. The Marsian Middle Way is to leave people free to vote according to their experience and conscience, without outside influence. Let’s respect that. Aram had so much trouble because they tried to give speeches, but without campaigning. It was rather ridiculous looking.” Bill held up his tablet and pushed an icon on it. “There; I just sent everyone a link. Click on the link and write down the name of the person you want to have as commander. The software will do the rest. If it can’t read your answer, it will ask for clarification. Okay, folks, let’s get to work.” He turned and headed for the bridge; everyone else headed out the door and went to their various tasks as well.

Irene followed him to the bridge. “Clever; but what about a Council?”

“We can resolve that later; today, we’re just laying the leadership issue to rest. Besides, Cynthia and Shepherd will probably get elected to a Council, but may not get elected as commander. We’ll see how they take the first election.”

“Good point. I’ve got to get to bed now, but I’m not sure I can sleep!”

“Rest anyway, Irene.” She nodded and headed out of the bridge. Bill sat at his usual chair there, reviewing emails while he kept an eye on systems and listened to the chatter of workers outside. It was about all he could do to pay attention; he was distracted by the situation as well. He was rather nervous when 12 noon came around and the system automatically emailed the results to everyone. Bill Hollingworth: 70. Cynthia Clarke: 30. Tom Shepherd: 15. Twenty-one other voters voted for other people or didn’t vote at all. There was scattered applause from the cafeteria when the results appeared on the screen.

Bill heard the applause in the bridge, across the hall from the cafeteria, so he headed over for lunch. Several applauded when he walked in. He nodded. “Thanks. I’m glad you have confidence in me.”

“You got more than half,” observed someone else.

Bill looked at Tom Shepherd. The Captain of the *Illumination* clearly was not happy. “You won,” he said. “That’s fine. But according to the Astrolabe celestial navigation system, a launch window to Venus opens in four weeks. The *Illumination* has the fuel for the delta-v; the trip will take 80 days. We’ll visit Magellan for a few months, then take the launch window from there to Earth.”

“You can’t do that!” protested Bill. “We have two caravels here for 136 people! They’re desperately overcrowded!”

“Maybe half the people here will come with us,” said Cynthia. “Because I’m leaving, too.”

“You can deploy the life boats,” suggested Shepherd. “They’ll give you 300 cubic meters of space each. It’ll be zero g, but better than nothing. You’ll manage until the *Patares* arrives.”

“We’ll manage in spite of anything you do,” replied Bill, his voice rising. “Because we have a mission to terraform Themis, and we will complete that mission. It was the Prophet’s last wish, expressed to me, so we will do it.”

15.

## The Best of Both Worlds

February 2076

“Honey, how are things on Themis?” asked Anne Hollingworth. “I watched the video of the staff meeting that you posted to the web. I think that’s very smart, right now. I suppose you did it to give the people on the *Patares* confidence in your leadership, but it gives me confidence as well! You seem to have pretty good instincts, Bill, especially considering you’re only 26; these things take time to mature, you know. It also helps that you have such a young crew; I wonder why Rivers sent so many of his young followers to Themis. It’s as if he saw it as a new Garden of Eden. Anyway, you’re frank and open; that’s essential up here. But try to be more focused and succinct. People’s minds wander if explanations get too long. Let them ask more questions instead, or ask if your quick answer is enough.

Have you seen the op-ed piece in *Mars This Sol* by Will Elliott and Sirikit Thanarat? It came out yesterday. It’s about ‘Mariner Leadership’ and coins a new term: ‘polisian’ a ‘person who provides servant leadership for the polis.’ In other words, it’s a new definition of a ‘politician,’ but one based on Marsian and mariner values. The ‘polisian’ leads through example, through listening, through explaining, through exchange and open consultation. He or she earns trust, but the public must be willing to extend the benefit of the doubt and not to attack or tear down anyone. The polisian does what is right for the community, not what is expedient; articulated ethical principles of governance; and sacrifices personal benefit and even material gain for the common weal. The polisian strives to exemplify ‘true humanity’ and the virtues that necessitates. In other words, the polisian is everything a politician always was supposed to be, back on old Earth, before marketing was applied to political campaigning, money came to

dominate the process, and lying became the main rhetorical mode. You should read it, if you can find the time. I suspect everyone on Themis is rather confused right now. This effort to articulate mariner values, including values of mariner governance, is very important and influential. I suspect it will provide Themis with a foundation on which to rebuild its values. Inevitably, Themis will have a variant of mariner values. That's the trend right now.

“Anyway, Bill, good luck on everything! We're so proud of you, we can't begin to express it. You are doing amazing things, son. Let us know how we can advise. There's no news at this end, since your father videomailed you this morning after our landing on Titan. We're about to go to the welcoming dinner. Bye.”

She sent the email and looked around their living room. “Sunlight” poured in through their picture windows facing N-7; beyond their patio was the rich greenery of the enclosure, with grass, flowers, and artfully arranged vegetables and herbs, with trees lining the edges, all the way across to the dachas at the other end. Cottage: it was a funny idea, that they had a cottage on Titan. It was three meters by seven on the top floor, just big enough for a small private living room; if they wanted to have over more friends, they'd open the hatch to the patio on the roof, which had walls around it for privacy. The next floor down had their master bedroom, bathroom, and kitchenette. The third level down had two private rooms they were using as offices and storage. It was compact, but much bigger than their unit on the *Ptolemy*.

She walked to the picture window and sat in a chair there, admiring the enclosure's white ceiling 30 meters overhead covered by simulated clouds, and the slanted slides of the enclosure covered by a gigantic mural of a mountain scene. At the far end of the enclosure, the side walls looked almost real. The enclosure's opposite end cap had a brilliant “spotlight” sun shining brightly at them, surrounded by a soft blue skyglow; the end cap was actually covered by

hundreds of thousands of tiny light emitting diodes, half emitting bright white light, half emitting soft blue; the former were focused on specific parts of the enclosure while the latter were unfocused. The resulting effect was of a yellow sun that followed you as you walked around the enclosure, and it always seemed to be shining in a blue sky. The end cap of the enclosure on their side did the same thing for the opposite side. The illumination system was by far the most expensive part of the enclosure, and she loved it; it gave her the impression of living inside a long cylinder with the sun shining in from the opposite end.

She heard steps on the spiral stair. She turned and saw Kurt come up from the lower floor. “Done?”

He nodded. “It’s nice to take a long shower. But the water splashes a lot in one eighth gravity.”

“That’ll take some getting used to,” Anne agreed. “But this is pretty nice.”

“It is. Hard to believe we’re living under fifty meters of cryogenic ice.”

“It is. Look at the carpeting, the quality of the furniture and its upholstery, the glass in the windows; Titan has good workmanship.”

“They do; very impressive.”

She rose and they headed to their front door. The welcoming dinner started in five minutes. They exited, followed the main corridor of Acheron Outpost, and entered the enclosure with the cafeteria and stores.

The buffet lines were already open, so they headed for the nearest one and loaded up. They were impressed not only by the range of the foods available at the dinner—which was the big banquet of the year—but also by the herbs, spices, and preparations, which were an exotic

fusion of the Earth's culinary cultures. They headed for the tables and spotted Marshall Elliott and his family.

"Can we join you?"

"Of course, Anne!" Marshall jumped up to give her and hug. "I haven't seen the two of you for almost ten years! Kurt, great to see you again!"

"Thanks, Marshall, good to see you again as well!" Marshall hugged both Hollingworths.

"Do you remember Amy?"

"Yes, vaguely," said Kurt, giving her a hug as well.

"I almost didn't recognize you, Marshall; you're so much more mature!" said Anne.

"Well, I'm 36 now. This is Willie, who's 6, and Millie, who's almost one."

"Your family is beautiful." Anne leaned over and hugged Millie, who smiled; Willie offered his hand and she shook it. They all sat down.

"I'm so glad you've arrived," said Marshall. "We're looking forward to your classes on record keeping and Marsian law; we need updating."

"We're glad to be here to do it," said Anne.

"How was the flight?" asked Amy.

"Quite comfortable. And we got here in record time; 18 months. It was a good test for the faster Uranus flight with its gaseous core engines and enhanced meteoroid protection."

"We're only staying two years," added Kurt.

"Yes, I know. We're glad to have you here to lead expeditions to the outer moons," said Marshall.

“If all goes well, we’ll sample the Inuit, Gallic, and Norse groups,” agreed Kurt. “And we need to get back to Phoebe, too, if we have time, since it’s a captured Centaur. It’s a lot closer than the regular Centaurs.”

“That’s for sure,” agreed Marshall.

“This food is absolutely incredible,” said Anne. “Better than anything on Mars!”

“We’ve made it a priority, since the opening of bioarchive,” said Amy. “The immense diversity of species we now raise in 10 different terrestrial environments and four aquatic environments—50,000 square meters of bioarchive, not to mention the 30,000 square meters of enclosures with the dachas and 30,000 square meters of farmland—gives us just about every choice anyone has on Earth. The *Ptolemy* has brought us several thousand more species, too.”

“I took a walk through the bioarchive earlier today,” said Anne. “I was *so* impressed. So many climates. Mars has more, but here they’re all in one place, within a ten minute walk. And the simulated sun and sky; after eighteen months of courtyards and cramped quarters, they’re very impressive.”

“Thanks,” said Amy. “I’m head of bioarchive. We worked very hard on the enclosures. And you’ve brought us trout, so we can stock Acheron Brook! It flows all the way from top to bottom.”

“You mean, I’ll be able to go fishing?” asked Kurt, surprised.

Amy nodded. “Just about the time you leave, we’ll be able to open the brook to fishing. You can already fish in the tropical ocean enclosure.”

“I must say, no amount of reading or virtual reality tours prepared me for this place,” continued Anne. “It’s so big and sophisticated.”

“And with the *Ptolemy*, we have a third permanent galleon,” added Amy. “With the new habitation regulations, which allow more time in Titanian gravity, we can really accommodate a thousand people if need be.”

“Or more,” said Marshall. “Adults need 6 hours a week jogging at 1 gee or 12 hours a week of moderate activity at 0.75 gee or 16 hours a week of moderate activity at 0.5 gee; twice that if it includes sleeping. Three evenings and nights a week in a galleon are sufficient.”

“We don’t have 1 gee here,” said Kurt, puzzled.

“If you jog around the rim of a galleon at the 0.75 gee level, moving in the same direction as the rotation, you experience 1 gee,” replied Marshall. “An hour of jogging a day will do it. You can work and live the rest of the week out here, if you do that.”

“We’ve been enjoying our dacha,” said Anne. “We can’t move back into the *Ptolemy* for at least a month while it is reoriented for the effect of Titanian gravity.”

“We’re moving our school and day care facility there,” said Amy. “It needs more space.”

“Yes, I saw. Titan has how many children now?”

“We have 153,” replied Amy. “For a total population of 528 before the *Ptolemy* arrived with 165 more. After the caravel *Tereshkova* departs next month with 37, we’ll have 656. And when we get the next galleon load in 2079, our population will probably be close to 900, because we can expect another 30 to 50 births in that time.”

“The *Ptolemy* brought a lot of young couples,” said Kurt.

“I like to say that we have the best of both worlds,” said Marshall. “Or maybe I should say, the best of three or four worlds. We have lots of open space with high ceilings, like the domes on Mars, and we plan to make even larger enclosures. Yet we can actually go outside; we can walk around on the surface of Titan, just like on Luna, on Mercury, on Mars, on Ceres. We

have adequate gravity in the galleons, just like on Mercury, Mars, and Earth; but we also have potentially infinite space, just like Callisto and Luna. Unlike Mars, we are in a low radiation environment; Titan's atmosphere shields cosmic and solar radiation even better than Earth's. And consider our possible destinations! We have almost 100 moons larger than a kilometer; more than Jupiter, and because of the jovian radiation belts, most of Jupiter's moons are inaccessible to humans. We have outer retrograde satellites that are captured debris from all over the solar system, just like Jupiter, and thanks to your expeditions, Kurt, we're going to visit them. We have by far the biggest and most complex ring system, and we've already visited it. We have a central planet almost as large as Jupiter, but just as complex, and even better, we'll be able to start harvesting helium-3 from its atmosphere; it's impossible to do that with Jupiter, because of its powerful gravity. That means, unlike Jupiter's settlements, Titan can be a self-sustaining community; furthermore, we'll have access to the planet's atmosphere and can retrieve samples and conduct more extensive research because of the Helium-3 aerostats we'll eventually be running. I suspect within a decade we'll have permanent scientific outposts on several of the other moons—Enceladus first—with the personnel rotating through from Titan.”

“And within a decade, it probably will be possible to get here from Mars or Earth in about a year,” added Kurt. “You won't be quite so impossibly isolated.”

“Yes, I agree,” said Marshall. “Our goal is to attract young professionals who arrive here close to age 30, have their families, then head for Mars about two decades later when their kids are college age. A lot of them will stay even longer, of course, and settle here permanently. That's what we need.”

“Yes,” said Kurt. “And Titan has the natural advantages to do it, too.”

“So, how's Bill doing?” asked Marshall, changing the subject.

“Pretty well, considering the challenges he faces,” replied Anne. “You know he’s Commander on Themis, right?”

“Yes, I was surprised to hear that. And I gather he released a videomail from Tree Rivers admitting that sometimes he basically makes up revelations.”

“That must have split the community,” said Amy.

“Yes, rather violently,” said Kurt. “There were fist fights in Aram and threats to take over key parts of the infrastructure. Jacquie Collins sent down Will Elliott, Érico Lopes, and John Hunter, and they convinced the two sides to hold and respect an election. Now they have a ‘secular’ government, but Aram is still split down the middle and is a troubled place.”

“So is Themis,” added Anne. “They also held an election and elected Bill Commander. The losers are leaving for Venus next month. The Green World Community on Earth has completely fallen apart; a minority wants to follow Rivers’s sister Flora as the prophetic successor, a larger group wants to enshrine Tree Rivers as a latter day Jesus and build a church on his revelations, and yet others want to start a secular ecological movement based on his ideas. And no one yet has control over Rivers’s fortune, estimated at 1.3 billion redbacks.”

“What does Bill think?” asked Marshall.

“I’m not sure; somewhere between the church and the secular ecological movement, I’d say,” said Anne. “He has enormous respect for Tree Rivers. He’s married into the family; his wife Suzanne is the daughter of Greenley Rivers, the one pushing the secular movement. Flora Rivers, the prophetess, is her aunt. What worries me is that Themis will be cut off from the fortune and the people there will essentially be stranded there. They have equipment to survive, but no one can survive forever without imports, and that means a source of income, which they don’t have.”

“That is worrisome,” agreed Marshall. “What will become of Aram?”

“They’ll have to become very clever with their exports of agricultural and forest products,” said Anne.

Just then Yuri walked to the front of the hall and stood at the podium. The crowd gradually quieted; Titan’s Executive waited patiently. “Thank you, everyone,” he began. “This is our second welcoming dinner. Two years ago it was the *Cassini*; now it is the *Ptolemy*. The *Cassini* left and will be back in 2079 or 2080, depending on how fast it comes. The *Ptolemy* is added to Acheron Outpost, permanently expanding our gravitied space. We welcome the addition and thank the Commonwealth of Mars for this gift.

“We look forward to the next three years. The *Ptolemy* has brought us Kurt Hollingworth, who replaces Andries Underwood as our explorer of the other moons in the Saturn system; he plans expeditions to at least two of the three outer satellite families, plus another expedition to Enceladus and one to Mimas. The *Ptolemy* also brought us sixty new engineers and three hundred tonnes of new equipment, bringing us some very important new capacities; in fact, they are in the position to begin building our first Helium-3 aerostat and parts of our Peregrine nuclear shuttle, so that when the *Cassini* arrives in 2079, the parts they bring can be fit right into place. The *Ptolemy* is also bringing several thousand species to diversify our bioarchives and twenty additional ecologists to oversee them. This should allow even further expansion of our underground enclosures. The new geothermal well that goes on line in a few months and another twenty wind turbines that will go up in the next twenty months will increase our energy supply enough to allow the melting of a cavern larger than anything we’ve tried before. Exactly how large it will be needs to be decided by the next Saturn Council, which we will elect in late March, a week before the departure of the *Tereshkova* for Mars. As most of you know, I will be on the

ship, along with Andries and Sridhar; three of the five positions on the Saturn Council will be empty. With the expansion of our adult population over the 500 mark, the Saturn Council will expand to seven positions. We can anticipate an exciting election, with so many vacancies!

“To conclude, I regret leaving at this point. We have come, we have established ourselves, we have become recognized as the largest and most successful settlement off Earth except for Mars, and we have accomplished some amazing scientific and engineering milestones. But we are not sitting on our laurels; indeed, the next five years may prove the most important ones in the history of the Saturn system, as we establish an economic basis for our financial autonomy. Should recognition as a sovereign state follow? I don’t know, and I won’t be here to debate that issue. But I look forward to following it and am confident that the residents of the Saturn system will make very momentous and crucial decisions that will move Saturn into a glorious future. I will be immensely proud of everything you accomplish. Thank you.”

Yuri stepped down from the podium, but everyone rose to their feet and began to applaud. “Yuri! Yuri!” some people began to chant, and everyone followed. Yuri smiled, nodded in thanks, and continued back to his seat.

“He’s quite popular!” exclaimed Anne, after the chanting died down.

“He’s done a great job, first as Commander and then as Executive,” replied Marshall.

“They’re big shoes to fill; a huge challenge for whoever is elected next.”

“Any thoughts who that will be?”

Marshall was started by that. “Anne, that wouldn’t be an appropriate discussion.”

“That’s right, you’re a Bahá’í. You Bahá’ís are quite fanatical about no campaigning and electioneering.”

“No, it’s not just that, Anne. I’m on the Council now; one of two people who will be left after Yuri, Andries, and Sridhar depart. It’s particularly my responsibility to respect the process!”

“I suppose. But you’re probably too young to be elected, so I thought it might be worth a conversation. But I apologize for bringing the matter up, Marshall.”

“That’s alright,” he replied, though he glanced at Amy and saw she was absolutely shocked by the comment that he was too young to be the next Executive.

The table fell into an uneasy silence. Amy turned to help Millie; Anne rose to get another cup of coffee. Marshall and Kurt struck up a conversation about the geology of the outer moons and the plans to follow up the visits with rovers, androids, and analysis of the returned samples. Anne stopped to talk to others and when she returned, people were leaving the hall, so the Underwoods and Elliotts said goodbye and parted ways. Marshall and Amy headed to their dacha in H-4, where the family planned to spend the night.

“Anne Hollingworth is surprisingly impolitic, for the former mayor of Aurorae,” said Amy.

“Yes, I’m surprised. I think she looks at me and sees the little boy who used to run around Catalina Biome. I’m now almost as old as my father was when he became Commander of Mars for the first time!”

“Of course, Mars was a much smaller place.”

“Definitely. I’m not saying I deserve to be elected Executive, or anything like that; but that Anne seems to have decided I’m not worthy, even though she doesn’t really know me. That’s strange.”

“I agree.”

They turned into N-5 and headed for their door, which opened automatically for them. Their dacha was set up like the Hollingworth's but was wider and longer, because it had to accommodate two children as well. The top 4 by 9 meter level was a living room with a kitchenette and picture windows overlooking the enclosure; the roof was a single large enclosed patio. The next level down the steep spiral ramp had the master bedroom, with windows facing the enclosure, and a bathroom. The third level down had windowless bedrooms for both kids, a second bathroom, and a storage area. As small as the space was, it was twice as large as their unit in the *von Braun*, which had a small living room where Willie slept, a master bedroom where Millie had her bed, one bathroom, and a very narrow balcony.

Willie immediately turned on the large screen in the living room to watch his favorite show and Amy took Millie down to the bathroom for her bath and bed routine. Marshall sat with Willie a few minutes, then decided to videomail his father. He sat at the dining table, faced a screen with a camera, and called up Will Elliott's email address. "Hey dad," he began. "I hope you and mom are well. We just attended the welcoming dinner for the *Ptolemy*. It was quite an uplifting banquet. Even though the *Ptolemy* was sent out before the plans for the *Peregrine* and the *Helium-3* aerostat, the engineers and equipment it brought appeared to be well suited for the task, so everyone is excited to get started on that project. The crew also provides the solution for our severe shortage of ecologists and the cargo fills holes in some of our new ecologies, thanks to the arrival of thousands of new species. So we're looking forward to growing toward 900 or so, assuming the new arrivals have an average of 1.5 children per couple in the next few years.

"Anne and Kurt Hollingworth sat with us. It was good to see them again. I can't figure Anne out. She seemed friendly, but she didn't treat me as an equal, exactly, and she actually asked me who might get elected to the Council. I was surprised by that. Kurt's going to be on

expeditions much of the next few years; he plans to head to the outer moons, which are captured asteroids and iceteroids. He and I have been emailing back and forth over the last month about his research priorities; he has some good plans. He was friendly enough.

“Anyway, I don’t know what else to say about Anne and I’m not even sure I’m asking you a question about her. I hope you and mom are well. Maybe on Saturday here and Sunsol there we can exchange some family videomails; I think our Saturday lunch coincides with your Sunsol dinner. It’d be nice to catch up again. Bye.”

Marshall hit send and the videomail headed to Acheron Outpost’s central computer, up its microwave link to Titan’s communications satellites, by microwave to one of the Saturn system’s two main communications nodes, and by laser to Mars. About the same time, Anne Hollingworth’s videomail to Bill reached him at Themis via Earth. He was in his room resting on his cot. “Thanks, mom, for the advice. I really could use it. I’ll try to be more succinct. The Prophet spoke about the virtues you called ‘true humanity’ once; I’ll look for that and put it up on our website. It may help calm things down here. The worst seems to be over; the trouble makers have decided to leave next month. It looks like 40 people will go, reducing our population here to 100, which is manageable with the two lifeboats. We deployed them today and started setting them up; we’ll rotate people through them, so everyone gets some sleep time in gravity. We’re setting up a schedule to make sure everyone gets enough ‘gee-time.’ If we don’t have an accident, we’ll be fine until the *Patares* arrives, but we’re also going on safety alert. Everyone is tense, but the work is moving along pretty well and it appears the first dome will be finished in July; just 5 or 5 weeks behind schedule.

“I’ll take a look at the article about ‘polisians.’ The term doesn’t roll off your tongue, but the ideas sound good. If we can work them into the culture and the expectations of the

population, maybe they won't become lip service, like on Earth. That's the problem. Enjoy Titan! I hope they like you and dad and elect both of you to the Council! Bye." Bill send the videomail with a smile.

The message immediately rode a laser to Deimos, where it was transferred to another laser pointed permanently at Saturn. It passed Marshall's message in the asteroid belt. Will receive the videomail from Titan while he and Ethel were on a high speed bus from Uzboi to Aurorae. Ethel squeezed close to her husband to see the message. She rolled her eyes. "Anne."

"Yes indeed," replied Will. He hit reply. "It's good to hear from you, Marshall. I'm sorry some of the difficulties between Anne and me may be rubbing off on you. She was the mayor of more than half of Mars; I was in charge of the whole thing. So we were constantly butting heads over development priorities. She was a good mayor and pushed the development of Aurorae hard. She's also a bit inaccessible; there's a remoteness to her personality. But she's sweet and it will come out. Whatever you do, don't cause a breach in your relationship, because it is very hard to recover it at that point. Try to stay warm and friendly, even if you end up disagreeing with her. She's very bright and has great vision.

"Anyway, your mom and I were just in Uzboi for a few sols and we're now on our way home. You should see this new metal highway! Sixteen hundred kilometers of perfect, shiny ten-meter roadway. It opened last month and this week the new high-speed bus service started. It averages 200 kilometers per hour! Of course, it isn't a hyperloop, but that's still a few years away, and this is quite an advance. The vehicle has rubber tires and magnetic emergency brakes. It's absolutely unbelievable; Uzboi to Aurorae, eight hours. It's comfortable, too; you sit and relax. A few minutes ago we passed a carbonyl train, a tractor towing a line of tankers filled with 1,000 tonnes of nickel and iron carbonyls. It goes just 60 kilometers per hour; at first I thought it

was going toward Uzboi before I realized that the impression was caused because we were passing it so fast! The highway has three lanes and the automated vehicles can switch among them, so passing is easy. All vehicles on the road must be under automated control; no human drivers, they're not reliable enough. There are short exits and entrances every few kilometers. Uzboi is turning out more road panels than ever—almost its entire daily production of waste metal—and they're being shipped down the highway to Aurorae. Some are being used to build the highway west to Tithonium. Some are being hauled half way to Aram so the road to the Central Highlands can be built from two locations, in order to speed it up. Jackie's smart; this is incredibly popular, so it's getting an even higher priority. The idea that all of Mars's major population centers can be tied together by efficient, low-friction metal highways—our equivalent to Earth's railroads—is very appealing. But it's the best of both worlds, you might say, because private vehicles can drive on them as well as specialized cargo and passenger vehicles.

“So we're fine. I'm glad Titan is moving forward. Good luck with Anne; she'll be fine. Bye.”

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“Sirikit must have been very unhappy,” said Firuz.

Charlie paused in his loading of samples into the x-ray diffraction instrument.

“Disappointed, yes, but not that unhappy. She was afraid this would happen. But Dr. Hong was devastated.”

“Who wouldn't, having a world-renowned Confucian expert say that your invented Confucianism has nothing from Confucius in it? And he was right. You can't take the idea of *ren* or true humanity, strip out all of Confucius's hierarchical notions and ritual, and pour in 21<sup>st</sup> century ideas instead. There's nothing left of Confucius. You have humanism.”

“Dr. Hong’s use of Confucian virtues was more sophisticated than that, though. Confucius had a lot to say that was eternally valid about compassion, reciprocity, harmony, and balance.”

Firuz considered that a moment. “Perhaps, but the ‘Confucian’ virtues she advocated really were partially Bahá’í. The Confucian expert didn’t pick up on that, but we know it’s true. Dr. Hong has been talking to Sirikit a lot, and she likes the virtues she has heard.”

“I agree, but don’t you think that making Bahá’í values ‘Mariner values’ via this Confucian route is a good thing?”

“I don’t know. It’s a step forward, I suppose. But the problem with all humanistic value systems is very simple: since they are made by human beings, other human beings feel free to pick and choose. You can’t do that with a divine revelation; you take it or leave it. I’m sure that eventually ‘mariner values’ will be questioned into a state of complete ambiguity. Selfishness and egotism will rear their ugly heads.”

“You may be right about that.” Charlie put the last sample in place and closed the machine. It would process them all night. “I think it’s a clever alternative for people who admire many Bahá’í teachings, but don’t like the fasting, prayer, and devotional aspects. That’s true of a lot of people here in the jovian system and on Mars.”

“I agree,” agreed Firuz.

“I think that’s why Sirikit’s planning the next ‘Confucius on Callisto’ conference for May. She wasn’t disappointed with the conference enough to cancel a follow-up conference.”

“I hope we’ll be on Callisto for it,” agreed Firuz, with a smile.

Finished with their work in the geology lab, Firuz and Charlie headed for the door. Charlie glanced at a large screen that served as a window. Himalia was no longer shrinking in size. “I guess they’ve frozen the image,” he said, pointing.

“Yes, we’re more than a hundred thousand kilometers away, now; it should be smaller than that. It was a good visit, wasn’t it?”

“Yes; a fascinating place. Themisto should be pretty interesting, too.”

“About the size of Deimos; a little place. Probably just another captured asteroid.”

Charlie nodded. “We’ll know in a few weeks.”

As they headed down the hall toward the cafeteria, Charlie’s communicator buzzed. It was the sound of a private message, so he pulled it out and looked. “This is from my dad, so I’ll join you in a few minutes.”

Firuz nodded and continued to the cafeteria; Charlie walked down a flight of stairs to his cabin and entered. He and his father had been exchanging videomails almost daily, lately, about Oskar’s leukemia.

“Well, Charlie, the news appears to be good,” Helmut began. “Oskar’s responding well to the chemotherapy. The blood tests are coming back positively. The disease is disappearing from his system. Juliette is consulting with experts at Mariner Hospital—they’ve dealt with three cases of childhood leukemia—and with experts in Paris and New York, so Oskar’s getting the absolute best care possible. He understands the situation and is very cooperative and grateful. He should be back in school in a few sols, though only half a day. Your mother is almost calm again; this has been really rough on her, partly because she blames herself for exposing him to so much radiation. She hasn’t been able to work at all.

“But the long-term situation does not appear to be as good. The DNA analysis of the leukemia cells suggests a high probability that some will mutate and survive the chemotherapy. We don’t have the medicine here to solve that problem. They have it at Mariner Hospital in Aurorae; in fact, they have a license to manufacture it if they need to in an emergency, and they have the capability to do it. We’ll have to wait a few more months to see what happens, but it appears very likely that we will be heading back to Mars. They can speed up the arrival of the *Herschel* and send a caravel with it; the latter can take us back to Mars before the launch window to it closes completely. There are about a dozen people who want to rotate back, so we won’t be alone.

“This is pretty hard on me; I can admit that to you. Most people know it, anyway. Ceres has been my life for a very long time; from before you were born, really. Perhaps we’ll come back some time, but once I resign as Executive and leave . . . well, someone else will be Executive and if they do a fine job, why should I want the position back? I can’t attack them or claim in public I’d do better, our election system precludes that, and wisely. But what will I do on Mars? Certainly, Ceres needs a strong voice there, and I’ll probably be elected our representative to the Mars Council, but that’s a part time job. I suppose I can go back into research, but I’ve gotten rusty. So this is a time of uncertainty for me; I suppose it’s a midlife crisis! Don’t tell that to anyone! Tell Sirikit to say some prayers for me, I think God must listen to her. I’d welcome advice, but just explaining this to you is helpful.

“I see you all left Himalia a few hours ago and you’re on your way to Themisto. I followed the Himalia expedition pretty closely until Oskar got sick. Fascinating vistas and intriguing geology; the samples and data will take years to analyze. You’re doing some great

research, Charlie, and you're lucky to be part of such a powerful team. I'm proud of you. Just keep it up. Say hello to Sirikit for me. Bye."

Charlie had to smile at the close. His father had never been one to talk a lot about his emotions; he was like grandpa, that way. He hadn't realized the depth of his father's anguish. He hit reply.

"It's good to hear from you, dad. I'm glad to hear the chemo is working, and I hope it wipes the stuff out completely. That'll make life so much easier for everyone. Remind mom again that there's no evidence the radiation has hurt me any, and my DNA has been pretty thoroughly checked! But I wouldn't worry too much if you have to go to Mars. Ceres isn't the only thing needing a voice; the entire solar system does. Mars doesn't have residents who were prominent members of the other outposts. Tang Enlai ran Jupiter, but has retired to Beijing. So maybe you can advocate for all mariners and the development of the entire solar system. If I know you, you'll find plenty of things to do, and you'll enjoy them. So I wouldn't worry much.

"Yes, we're on our way to Themisto. Himalia was great; I've got plenty of information for a Master's thesis, and possibly a doctoral dissertation as well. Our equipment is working really well. We were concerned about the reactor, but it produced full power for the entire month at Himalia without any anomalies, so we were able to produce plenty of hydrogen propellant. We won't be at Themisto very long; a week or two will be enough to 'do' the entire little world. Then we head to Callisto, perform two gravity assists to change our plane—Themisto's orbit is tilted 47 degrees compared to the Galileans—and we're home. I can't wait! It looks like I won't be on the Ananke mission, so I'll be at Callisto for the rest of our stay here. Plenty of time to work on graduate courses.

“Sirikit is doing well. The Confucianism conference didn’t go as well as they hoped, but it also wasn’t the disaster some think. The criticisms of Dr. Hong’s reinterpretation, while historically accurate, didn’t seem very important to the Callistan audience; they don’t want to follow a 2500 year old philosophy anyway! She and Dr. Elliott have completed another op-ed about unity that will go up in a few sols. Now she’s busy with a new research paper about the Grand Union; the Grand Union summit has breathed life back into the organization. As you can imagine, Hunjai Park and his graduate students are absolutely thrilled at the prospect of international economic coordination and the strengthening of the geo as a potential world currency. The world economy is actually looking up for once! Good news for Ceres, with the price of PGMs moving up again, though gold has dipped quite a lot.

“Say hello to Oskar and of course to mom. I’m sure this will work out well for everyone. Heck, even I’ll pray! It’s worth a try, I guess. It’s good to talk, dad. Bye.”

16.

Fire

March? 2076

The 10 by 8 by 5 meter metal Quonset was dark and crowded. All forty-eight residents of Elliott Borough packed into it to see their new collective space, their voices echoing off the bare metal walls. Sunlight streamed in through two large skylights cut in the nickel-steel ceiling; LED panels supplemented the feeble rays that entered. Electrical cables snaked along the bases of the walls to two environmental control units. They were whirring, adding oxygen and removing carbon dioxide from the air and trying to deal with the accumulating odors of bodies and a big collective dinner.

As the meal wound down, Will Elliott rose and stood on a box near the airlock. “When the Homestead Company was set up, we pledged to sell the assets to a borough government, once one was established here,” he began. “Of course, that assumed the borough would have the money! But I’m glad to say that the Homestead Company has now sold all of the primary plots of land it purchased, so that part of its investment has been paid off. The profits generated from those sales have covered the mining equipment we purchased, repaired, and resold; the automation software we paid Martech to develop; and the solar arrays we set up. So the Homestead Company has sold off its assets and has practically nothing to sell to the borough; and the borough, of course, has practically no money to buy anything, anyway. We do have the solar arrays here at Erstad, which we are hereby giving to the borough.” Will reached down to a satchel by his feet and pulled out an ownership certificate. He beckoned to Giovanni DiPonte and Celeste Petersen, the chair and secretary of the borough council respectively, forward. Everyone began to applaud as Will handed the certificate to them.

“I have one other gift for the borough. There was one bit of land twenty-five kilometers from here that did not fit into any plot we prepared; it was in between several of them. It was reported to have a tiny bit of gold, according to the survey our company commissioned, but it was too small to support a homesteader by itself. We hereby give that piece of land to the borough as well. Its small gold supply can be harvested collectively for the benefit of the borough.” He reached into his satchel and pulled out the certificate of title for the land, which he handed to Giovanni and Celeste as well, to a second round of applause.

“I’d like to add a few personal comments. I was very, very flattered when I heard you had decided to name this borough after me. I am personally averse to naming places after people. At first I felt relief that there would never be a capital city named Elliott, rather like the American capital, named for George Washington! That didn’t feel right. But when I thought of a borough of homesteaders, that felt right. Better, a place where Marsian values are being defined and put into practice; where people are the center, rather than corporations; where people help people and work together, rather than in large offices and factories. I am proud of all of you and of this place and feel a deep honor to have my name forever associated with this borough.

“As homesteaders, you have an important contribution to make to Marsian society. Never forget that. Ninety percent of the citizens of this world work for large organizations. Few are owners or workers in small businesses; even fewer work for themselves. Hence, this borough is unique. Mars strives to achieve a balance between the collective and the individual; in that struggle, you are the important reminder at one end. It is the smaller end of the lever arm, but as a result it can bring about considerable movement if it makes a great effort. You have the unique opportunity to demonstrate through example what it means to take care of neighbors, work together in voluntary endeavors, and sacrifice for others; to be individuals yet work

cooperatively. Even better, you are remarkably diverse; remarkable cross section of Marsian society. So this borough can serve as a powerful example to this world and to all of humanity. I am proud to be associated with you and will lend you whatever advice and encouragement I can. May this borough grow and its population spread out across its ruddy range.”

Everyone applauded again. Will nodded in thanks. “One further closing thought. Once we have finished our food and drink, I plan to drive over to the piece of land that the borough now owns, with a shovel, to dig for gold that can be donated to the borough government. If all of us went over, in a few hours we might very well be able to donate a substantial sum to the borough. I invite you to join me.”

Will stepped down from the box and turned to Giovanni. “I assume you can drive me over?”

“Of course! I suspect we’ll have almost everyone. We have three hours before sunset, which is just about the perfect amount of time for this project. This is a great idea, Dr. Elliott.”

“Thank you. It’s a demonstration of the service ethic I spoke about. I hope this borough will exemplify service and voluntarism. Mars is now getting so large, urban, affluent, and individualistic; it worries me, frankly. We’re losing some of the cohesion we used to have, because we’ve grown so large.”

“I’ve been surprised by the coverage of the arrivals,” said Giovanni. “We’re half way through the 6,000 immigrants. Complaints that the choices of sofas is limited! That they can’t furnish their apartments the way they want to!”

Will rolled his eyes. “I know. I had the first sofa made on Mars, you know. Ethel made it out of metal rods covered by pillows made of parachute material!” He laughed.

“It’s especially ironic when you consider our struggles here,” said Muhammad Rahman, the Treasurer of the borough council. “We’re earning every redback with our own labor. And as soon as we become a borough, the price of gold starts to drop!”

“It may be a while before it drops significantly, though,” said Will. “We can all be thankful that Earth is making another effort to pull itself together.”

“It’ll be a while before the economy really recovers,” agreed Muhammad. “But half the price of gold is based on fear and the resulting hoarding, so even a little bit of good news can depress the price.”

“That’s true,” agreed Will. “But the price is still pretty good.”

“We’ll manage,” agreed Giovanni. “And now that the borough owns the solar array, free and clear, we can sell the power very, very cheaply. That should help.”

“The roads and wells that the Commonwealth has built are very helpful also,” noted Muhammad. “We should be able to manage with a lower price.”

“Any idea when we might get a metal highway?” asked Giovanni, smiling.

Will chuckled. “Uzboi is expanding its production of panels, and it puts out close to a million tonnes of nickel-steel per year; that’d make something like 3,000 kilometers of roadway if all of it could be used and deployed. The Commonwealth is building more automated panel-laying machines and is even paying crews to lay them. Everyone loves the idea. But it’ll be two or three years before the highway connects Kalgoorie and Meridiani to Aurorae and Dawes, and that gets the priority, of course.”

“That’ll get a metal highway within 200 kilometers of us, at least,” said Giovanni.

Will nodded. He turned to Muhammad. “Where are you from? Kalgoorlie?”

Muhammad nodded. “I lived there four years; I arrived in 2072, eighteenth columbiad. I met Julia there and we got married three years ago. Before that, I grew up in Indonesia.”

“Oh, really? I visited Jakarta once, 2030 or so. A long time ago!”

“I went to university there, where I majored in geology.”

“Geology? My field. So, what have you heard about Mount Merapi?”

“I’m surprised you’ve heard about the eruption there, though I guess it has begun to become international news. I’m from Yogyakarta, the big city that spreads out just south of Merapi. I’m very worried; it’s beginning to look like a very big eruption. They may have to evacuate the entire city and its suburbs, which have more than a million people.”

“Oh, that is serious,” said Will. “It’s a stratovolcano?”

“Yes; huge and almost constantly erupting. Java is the world’s most densely populated island because the erupting volcanoes spread fertile volcanic ash all over the land. But sometimes the volcanoes are dangerous.”

“Let us hope nothing happens, then,” said Will. He looked at Giovanni. “It’ll take a while for everyone to suit up and get out of this module, so let’s get started.”

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“So, what happened?” Bill tried to sound calm, matter of fact, not angry or suspicious. He had plenty of reasons to be suspicious.

“I’m pretty sure I’ve figured it out,” replied Tomás Domingo, the assistant director of dome fabrication. He picked up a small object about the size of a fuse. “This power module was put in backwards. It’s pretty hard to do; you have to force it. When the fabricator was turned back on, the fans cooled by the power flowing through this module got no electricity, so they didn’t provide cooling. The temperature in that sector spiked really fast, and for some reason the

temperature sensor didn't warn us. In spite of the nonflammable nitrogen coolant, the dome material literally caught on fire; at the right temperature, it starts an exothermic decomposition. When the cover buckled and smoke began to jet out of the fabricator, we shut it down."

"What was the problem with the temperature sensor?"

"It got pretty badly cooked, so it's hard to say. But it was working fine this morning."

"How bad's the damage?"

Tomás shook his head. "It'll take us at least a month to repair the unit. We may have to cannibalize part of the unit to repair the rest of it; that's how bad the damage is. Rather than extruding a 30-meter wide strip of dome, we may have to extrude 27 or 24 meters."

"That's how bad the damage was?"

Tomás nodded. "The interior of the extruder got up to 350 Celsius in places."

Bill thought a moment. "So; since the damage is near the middle, could you swap in undamaged sections from the ends? I'm thinking we could get back to work in a few days, extruding 24 or 27 meters, and rebuild the damaged sections carefully and slowly, so we can do them right. If it took two months, we'd lose only 10 or 20 percent of production during that period; the equivalent of a week or two, rather than a month."

"Yes, we could do that. One section is toast; we may not be able to repair it at all. The other section was only lightly damaged and can probably be fixed in a week."

"Then let's do that. We're closing in on the dome already completed by the South Pole; the weaving of dome sections near the poles is already complex, so it may not be much of a problem. Who changed the module?"

"Cynthia. This morning."

"I see. Uncharacteristically negligent."

“Impossibly negligent,” corrected Tomás.

“Alright. Looks like she and I have to have a conversation.” Bill pulled out his communicator. “Where’s Cynthia Clarke right now?”

“Captain Shepherd’s office.”

“Thank you.” Bill turned and walked out of the repair area, headed to the ship’s hub, floated down to the tunnel connecting the *Materra* to the *Illumination*, and walked to Shepherd’s office, where he knocked on the door.

“Come,” said Tom. Bill opened the door and stepped in. Cynthia was sitting opposite the captain, across the desk from him. She looked at him and a light of defiance shone in her eyes.

“So, what’s your side of the story?”

She looked at him, tempted to say, “About what?” But she knew what he was referring to. “The section burned up. It can happen. We’ve had accidents before.”

“What happened to the temperature sensor?”

“I guess it failed.”

“And the module?”

“I don’t know why it failed.”

“You put it in backwards.”

Shepherd looked up, startled by that. She shook her head. “No.”

“Yes. It was rammed in backwards. It’s almost impossible to make the part fit, that way. That’s why the fans had no power.”

Cynthia stared at him. “Like I said, accidents happen. You should be able to fix it in a few weeks, maybe a month.”

Bill waited, seeing whether she would say “I’m sorry,” but nothing of the sort was suggested by her look. She stared at him. Finally, he pointed his finger at her. “You are relieved of all duties and confined to the *Illumination*.”

“You can’t do that!”

“Yes I can. We’ll program the airlocks. Tell you what, we’ll program them so you have access to one lifeboat; that way you will have an emergency escape. Except for this ship, you are no longer welcome on Themis.”

“We’re leaving in seven days anyway,” Shepherd said to her.

“According to astrolabe, the launch window to Venus is already open, and you have enough fuel for the delta-v,” said Bill. “I would encourage you to consider an earlier departure date.” He turned and headed out of the ship.

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The memorial service in Callisto Square was packed; Sirikit was amazed so many people turned out for it. Callisto’s three Muslims were pressed into service to read from the Qur’an and recite prayers in Arabic, because most of the victims were Muslim. Sirikit managed to work several Bahá’í prayers and readings into the program as well, and Hong Cixi added some beautiful passages in Chinese.

There were no Indonesians in jovian space, but Phan Quang Ty was from Vietnam and his wife, Amanda Arroyo Phan, was from Philippines. They both went forward to offer the eulogy. “We still know very little about the explosion of Mount Merapi,” he began. “Much of Yogyakarta was successfully evacuated during the preceding week, though we know that tens of thousands of people refused to leave their houses and possessions. There is still nothing visible from space. I have heard that even the Mekong Delta in southern Vietnam, some 2,000

kilometers from the mountain, is receiving many centimeters of volcanic ash. We know that the major cities on Java are so dark during the day that the lights have to remain on, and that the air is so thick with ash, automobiles cannot be driven and people cannot venture outside their homes.”

“The latest reports suggest that hundreds of thousands may have died,” added Amanda. “And I have heard from relatives in Mindanao in southern Philippines that they can’t go outside, either. Imagine the difficulties of the 150 million people on Java! The farmers, watching their crops get buried and their animals suffering from the ash! The mothers and fathers, worrying about what the food markets will have! The workers, wondering when they will work! The children, wondering whether the world is ending! Today we remember and pray for all of them.”

Ty resumed. “As a scientist, there is a lesson in this disaster for all of us: that the world we live in has laws, and these laws have both good and bad consequences. Each law has a yin and a yang to it, you might say. The very laws that allow life to exist also cause chaotic change. If there were no plate tectonics, there would be no volcanoes; but there would also be no land, because the rain and wind would erode it into the sea. If magma could not be saturated with water and carbon dioxide, it could not explode; but it also could not form the minerals we need, and that change in nature’s laws would also mean our blood would be unable to carry dissolved nutrients to our cells. The lesson to me, thus, is this: be grateful for what nature’s laws have brought us, and be wise to protect it against the negative consequences of the very same laws. This is a lesson we can apply to our life on Callisto as well.”

Ty and Amanda stepped down from the podium to nods by others. Everyone bowed their heads as a particularly poignant piece of Chinese music was played. It gave Sirikit a chance to reflect on the yin and yang in a whole new way.

When the music ended, Executive Cai Xiaopeng rose and walked to the front. “Thank you, everyone, for coming. This is a small gesture to our fellow people in Java. Please remember that we have a relief fund and it already has 102,000 redbacks in it; we want to make the donation in a few days, so you still have some time to contribute. Thank you, Sirikit, for organizing this beautiful program, and thank you Ty and Amanda for your commentary. You have given us much to think about, and many reasons for gratitude. Go, my friends, in peace.”

Everyone stood to leave the square, where they also ate their meals, socialized, shopped, held concerts and plays, and met as a community to discuss business. Callisto Square now had acquired a new memory. Xiaopeng walked over to Sirikit. “Thank you again, it was perfect.”

“It’s the least we could do. The relief fund is a more concrete gesture. I hope more people will contribute.”

“I think so; this is a community of good people. A few hundred thousand redbacks won’t do much, considering the massive scale of this tragedy, but it is an important effort.”

“I’m surprised we haven’t heard more about government efforts. Even the United States hasn’t made a commitment, yet.”

“It’s been only three days. This explosion was quite unexpected, in spite of all the seismometers and monitoring; Merapi was one of the most studied volcanoes on Earth! We still aren’t sure what is needed.”

“That’s true. It’s a mind numbing tragedy, the sort that happens only once or twice a century.”

“It’s the yin of nature’s laws, as Ty aptly noted.” Cai waved and headed to his office. Sirikit turned to the store, which was crowded. People rarely needed help to buy things, now; the store’s computer could answer most questions and calculate expenses fine. But Chen Baozhi was

looking for her. “Ty’s words were very well chosen,” began the *Tienan’s* chief geologist. “But they didn’t touch on the global dimensions of the tragedy enough, I think.”

“I agree. I was just talking to Cai Xiaopeng about the slow response of world governments to the explosion.”

Baozhi shook his head. “No, that’s not what I meant. There’s a good reason for their delay, actually: they don’t know what they’re going to have to give. Satellite imagery still can’t penetrate the ash cloud, but satellite radar can, and this has produced a preliminary estimate of the magnitude of the explosion. It was VEI 7; that’s the ‘volcanic explosivity index’ and it only goes to 8. A VEI of 7 blows between 100 and 999 cubic kilometers of ash and dust into the atmosphere. Merapi appears to have blown about 250 cubic kilometers of stuff into the air. The last time this happened was Mount Tambora in 1815; it blew 160 cubic kilometers of ash into the air. So this is almost twice as bad. In 1816, northern North America, western Europe, and northern China had essentially no growing season. India had a weak, late monsoon. Other areas had droughts or floods. There was widespread famine.”

Sirikit stared at Baozhi, digesting the implications. “And the Earth has about 10 times more people on it, now.”

“Exactly. And a much better transportation system; food can be moved around. But does it have the political will to do so?”

“Probably not.”

“The rich will manage, as always. It sounds like the Bahá’í principle of a world coordinating authority is needed rather badly.” Baozhi raised his eyebrows.

Sirikit didn't reply; she was still in shock, thinking about the economic impact on billions of people. "Thanks for letting me know," she finally said. Baozhi nodded and walked away. Sirikit headed into her office to look up the latest news, then email Dr. Park.

17.

## Responses

March 2076

“We hold this Future of Saturn forum under uncertain conditions,” began Yuri, as the assembled community turned to him to hear his introduction. “All our expectations about the future have been called into question by the eruption of Mount Merapi. We have no idea whether the demand for Helium-3 will drop to zero, by the time our Helium-3 reached Earth in 2082 or 2083, or whether demand will be several times higher than projected. Our subsidies from Earth for the next few years are uncertain; we can count on Mars to help us in emergencies, but we don’t know how much beyond that; our investment in Cererean PGM production is of uncertain value. Our terrestrial research colleagues may or may not have budgets, next year. Have I forgotten anything?” He paused; everyone chuckled nervously. “So, in a way it is not clear what we will talk about in this forum. But an election is coming on Sunday and the bylaws require a forum first. I am chairing the gathering because I’m leaving in a few weeks. I will miss all of you and wonder whether I should go back to Mars at this point, but I am sure whoever is elected Executive will do a fine job. To start us out, I recognize Father Okonkwo.”

“Thank you,” said Father Okonkwo. The Nigerian Catholic priest rose from his seat and pushed an app on his communicator, which converted it into a microphone. “I want to thank everyone for the welcome you have given me, over the last month. It has been quite a warm reception and I am already incredibly busy with your spiritual needs. You have forced me to discover a new definition of catholic! But the word does mean ‘universal’ after all. The interfaith programs were always strong, and now they have become even stronger. To them we have added

a monthly Catholic Mass on Sunday mornings and we will be starting a Christian education program for children and adults next month.

“One thing I hope we can focus on more is developing our spiritual lives, with a focus on virtues. Virtues have already been a strong focus here, thanks to the Bahá’ís, and we hope to complement their efforts. With this dark time we are entering—with all humanity—material goals, as important as they are, need not be our central concern. They are transitory and do not lend to our salvation, however you define that term. We shouldn’t obsess about declining GDPs, shrinking subsidies, and postponed development milestones. I am very impressed by the emphasis on quality of life, here; we have incredible interior spaces, diverse ecologies, and lots of family time. Let us enjoy our spaces, focus on the quality of our families, and strengthen the solidarity and unity of our Titanian community. I hope the Future of Saturn Forum can focus on those subjects, and our new Council can devote much its time to quality of life and quality of community priorities. Thank you.”

Father Okonkwo sat to light applause and hands shot up, Anne Hollingworth’s most urgently. Yuri saw her insistence and decided to choose someone else. “Tomas Racan.”

Tomas rose and activated his communicator’s microphone. “I want to thank Father Okonkwo. Titan had 60 Catholics—the largest single religious community—and it needed leadership. I’m grateful the Vatican has sent us a priest, and chosen one who understands mariners. I hope the Vatican will continue to send priests to Mars, where they get acclimatized, and then send them out across the solar system. We are members of the Diocese of Mars. It’s another example of why we need a Mariner League. I understand the Spiritual Assembly of the Bahá’ís of Acheron, when it is elected next month, will be under the jurisdiction of the National Spiritual Assembly of Mars. Our children are now moving into second and even third grade, in a

few cases; we have a lot of kindergarteners and even more preschoolers. The best way for us to handle an elementary school, once it gets larger, is to join the Aurorae Online District, because they have lesson plans that fit our situation and diversity. But to do that, we'll have to reset our calendars to sols and our clocks to Aurorae time. And if we do that, we might as well consider either borough status or some other affiliation with Mars; probably the Mariner League proposal. I think it wouldn't make sense for Saturn to be a borough of Mars; we are an emerging nation in our own right. So the League proposal seems best to me."

Tomas sat to murmurs of discussion. Yuri had not expected the Mariner League to come up at all, let alone so quickly. He pointed to the next speaker. "Anne Hollingworth."

Anne rose eagerly. "Regardless of whether we join a Mariner League, Titan has opportunities to streamline its organization. The organizational chart reflects a smaller community than where we are now, and certainly where we want to be in the future. When I left Aurorae, it was a city of over ten thousand people. We had a very efficient organization that supported steady twenty to thirty percent growth per columbiad. We had a GDP of three billion per annum. Proper structuring can move Titan a long way toward a similar level of growth; it can enable more efficient solicitation of collaboration grants from terrestrial universities, for example. We have enormous opportunities here, with Helium-3, with infinite underground space and near infinite wind and geothermal energy, with a hundred moons and a huge set of rings to explore, and with access to the best technology the twenty-first century can offer. I hope we can access more of that technology, obtain more support from Mars and Earth, and continue to grow our community."

Anne sat to excited applause by some, though Marshall found her speech to be devoid of significant new ideas and too much like a politician begging for votes. He raised his hand to be added to the list. Yuri nodded in his direction and glanced at his list. “Ryoko Furukawa.”

Their resident artist and store keeper rose. “I want to echo Father Okonkwa’s emphasis on quality of life. Our son arrived on the *Ptolemy* with his wife and we now plan to stay into our retirement years here. We’re still working fifty-five hours a week here, even though the official number is down to fifty. A lot more people would come to our cultural events if they worked fewer hours. So I’d favor shorter work weeks. Also, this cafeteria was great when it opened, but when I see the design of Callisto Square, with its soaring ceiling and multistory buildings around it, I weep. We designed this cafeteria at a time when we thought we’d be small. Now we’re very large. We need a new central space that is more spacious and airy.”

“Good idea,” said Yuri, nodding. “Seiji Takada.”

Their manager of telerobotic vehicles or TROVs rose. “I suspect our plunge into Helium-3 extraction will be delayed somewhat, and if that is the case, we need to invest a lot more into the technology to produce our own androids, robots, and TROVs. We’ve imported over 100 robots and androids on the *Ptolemy* for use here at the outpost, assembling items, running machines that humans can run, etc. This has greatly expanded our industrial base, since each one works 24 hours a day and doesn’t take vacation; they’re the equivalent of about 500 workers. We actually can’t use them all, right now; we don’t have the space. Hence the need to increase our industrial space. We can use them to make the machines they need to make more machines. I doubt we have to worry about being cut off from Earth, but the danger of such a development is far less than it would have been when we arrived here six years ago. We are literally in the position, now, to use our automated industrial base to grow itself. I hope we put a

lot more priority in doing exactly that, because it will enable us to build Helium-3 aerostats, exploration systems to set up on every moon, melt ever larger underground caverns, etc. That's where our future lies." He sat to applause.

Yuri nodded and said, "Marshall Elliott." Marshall rose and activated his communicator.

"Thanks, Yuri. I think we're getting some very good ideas for consideration; a new square and a focus on growing our automated industrial base are excellent ideas to pursue. I agree with Anne, also; we can always use restructuring to become more efficient, and there are always ways to pursue more collaborative research grants. But I want to return to the idea of the Mariner League. I agree, there's no reason to become a Borough of Mars, but we do need closer ties with our mother world. The fact is that Mars is now three times larger than it was when we left eight years ago, and with roboticization its economic output is five times what it was. It has a stable political system and rational allocation of resources. It also has complementary income sources from gold and PGMs; when one goes up in value, the other tends to decline. It produces several galleons and corvets per year, and if there's no terrestrial demand for them, they'll still want to employ those workers, so the ships will come to the outer solar system. They're bringing 6,000 immigrants this year and will bring 9,000 in 2078. My point is that we can expect continued support from Mars. It's nothing for them to send us a galleon and another 150 people every four years. They'll do the same for Jupiter, Ceres, and Uranus.

"If their continued support is virtually assured—and it comes with the fewest strings—then we should acknowledge that relationship. I agree with Tomas, pretty soon we'll have to shift to sols and align our clocks with Aurorae's. But we also need to pursue the Mariner League. The obvious first step is a virtual meeting of Councils with the Marsian Commonwealth's cabinet. That could lead to ideas for ways we could collaborate. I'd love to see

a conference of our geologists with the geologists on Callisto, for example; we could enrich each other's work immensely. The same is true of ecology specialists and perhaps of fabrication specialists. These are simple, concrete steps we can take to work our way toward a league without jeopardizing existing relationships with terrestrial governments.”

Marshall sat amid some applause as well; people liked his ideas. Marshall turned to Amy and smiled; he was not above showing off a bit, and he regretted a bit that he had done so. But he glanced at Anne and saw her staring at the floor moodily.

“Gwanya Kwok,” said Yuri. Marshall's friend, who was a horticulturalist, rose. “There's been a lot of talk in the last six months of a ‘supercavern’ much longer, wider, and higher than anything we've excavated before. With this robotic army we just imported, it's easier to create a supercavern than ever before. There's been a lot of talk about where to put it—especially how deep to place it—and how big to make it. I think Ryoko's comment about a new public space is the key to planning it. Rather than isolating it, we need to make the large space central to everything, put the cafeteria and stores there, and put housing and offices there. It should be our recreational, social, and living space; these other enclosures can become horticultural, industrial, and storage areas. That's the redesign I'd propose.”

That generated applause as well. “Surender Subrahmanian,” said Yuri.

The Malaysian geologist rose. “I would like to discuss the terrestrial situation a bit more. It has now been two weeks since the eruption. My relatives in Kuala Lumpur and Singapore are just now reporting that things are returning to normal, and they're a thousand kilometers from the mountain. Jakarta is still digging out from a meter of volcanic ash. More ominously, the cost of animal feed has doubled; everyone anticipates a shortage of it next year. So farmers are selling off their herds and the price of meat has plunged. The world prices for wheat, corn, rice, and

other foodstuffs have shot up. Governments with surpluses have ordered that exports be suspended. Food riots have already occurred in a few cities. Several governments already look wobbly. The price of gold has hit 5,000 redbacks per ounce, an all-time high; people are hoarding anything of worth. Meanwhile, PGM prices have dropped by more than half. My friends, this could be Armageddon! We're safe, out here, but who knows what will be left of Earth?"

"Surender, we all share your worry," replied Yuri. "But none of us here have crystal balls. The nearest equivalent is the daily column in *Mars This Sol*, where you may have gotten your statistics anyway. I see no advantage of us sharing our ignorance here. We can commiserate and support each other, of course, but there are other forums for that. Kurt Hollingworth."

The geologist rose from his seat. "This expansion of our industrial capacity is very exciting and opens up whole new opportunities for the study of the Saturn system. Not long ago, Martech contacted our exploration department about the design of a basic exploration system for a moon or asteroid. We have the ability to manufacture that basic system ourselves, except for a few items like fuel cells and electronics that we have to import. I would like us to set a goal of placing a basic exploration system on all 100 of Saturn's moons over the next decade. Once we have live exploration capacity on all of them, we'll have immense opportunity for scientific research. We'll have the ability to obtain all sorts of research collaboration grants from universities as well, leveraging our investment significantly. With very large, lightweight, steerable mirrors, we can power the science stations with solar power adequately, though 100 RTGs are not impossibly expensive either. This is the future of exploration; in a decade the moons of Jupiter and many asteroids in the belt will have exploration systems as well."

“Thanks,” said Yuri, nodding. He called on Rosa Chen, who elaborated on the need to at least double the floor space devoted to manufacturing and fabrication. Toru Takahashi spoke about the need to upgrade their computer power for various applications, and Sydney Kilgore emphasized the need to study Saturn’s weather and interior more thoroughly.

The attention of the audience was waning noticeably when Dr. Iris Geyer, the newly arrived Director of Helium-3 extraction, spoke about the need to stay the course and not turn away from or delay the project. Two others spoke up to agree. At that point, Yuri said, “We’ve now been speaking about the future of Saturn over 90 minutes, and I think we have heard enough for today. We have another dozen speakers, but I hope they can place their comments on the web forum for all of us to read. We’ve heard some significant suggestions and ideas today; I think this has proved very valuable. Thank you, everyone, for your contributions.”

He stepped down from the podium; everyone rose and headed out of the cafeteria. Marshall turned to Amy. “Well, shall we head home, or go for a walk in the bioarchives?”

“Home; we have to pick up the kids, and I really can’t relax much in the bioarchives because I see things that need fixing. Some good comments. What was that between you and Anne?”

“I don’t know. She irritated me. Her comment sound like campaigning to me; ‘elect me and I’ll streamline administration and get more university contracts.’ I don’t believe either claim. We don’t have that much administration, and we’re already getting all the university collaboration we can handle.”

“I think you’re projecting, Marshall. It was a suggestion for the community. She didn’t say she had to be elected to make these improvements. She could serve as a consultant to whoever is elected, after all.”

“I suppose.” Marshall shrugged and dropped the subject.

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“Will, everyone says our effort will be more effective if we stress relief of suffering worldwide, rather than strengthening international institutions and integration,” exclaimed Tang Enlai. “I have gotten rather strongly negative reactions to the feelers I have put out to Chinese government officials and even to some other Nobel prize winners. I’m inclined to suggest that any statement we sign and publish should not emphasize that this is the time for internationalism. What is our goal? Relieving the suffering of hundreds of millions in Southeast Asia, or converting the tragedy into a vehicle for international integration? What do you think?”

Will did not like that message, he shook his head throughout it. He immediately hit reply, careful to make sure it was going to the other Mars-related Nobel Prize winners: José Suzuki, their chief astronomer; Vanessa Smith Hunter, head of Martech and lead eobiologist; Ruhullah Islami and Pete Theodoulos, their former chief diplomats on Earth; Molly Armstrong, an eobiologist back on Earth after a career on Mars and Callisto; and Jiang Liu, an eobiologist back in China, also after time on Mars and Callisto. It was an impressive list, considering the small size of the Marsian population.

“Enlai, I know this is difficult. But that’s also why it is important. This is about more than the suffering of several hundred million people now in Southeast Asia; it’s about the suffering of millions, billions in the future if humanity doesn’t pull itself together. This crisis really *is* about world integration. We need to make that clear. People don’t like to hear that, but we need to speak the truth and not vacillate. I think we’ll make more progress than we expect.” He hit send and hoped he was right.

Within a minute his videophone icon flashed and beeped. Vanessa Smith was responding. “I’ll talk to Enlai,” she said. “Your language tends to be too Bahá’í specific, Will, and he hears that. But we’re old friends. Marsians understand the need of the mother world being united. Enlai helped a lot to reconcile the Chinese government with the establishment of Uyghurstan and Tibet. Both of those independent states will need a lot of help during this crisis; their climates will be severely impacted, and their climates are bad to begin with. If China is generous with them, China will win them back as friends. Enlai needs to concentrate on that.”

“That’s a good point. How have your calls gone?”

“Better than his, I’d say. I’ve videomailed almost two dozen Nobel laureates so far. Most are liberal, cosmopolitan types. They’ll sign a letter to the governments of the world.”

“Good. I hope they’re willing to call Presidents and Prime Ministers as well.”

“Perhaps some of them. A lot of that will fall on you, Ruhullah, and Pete.”

“I was afraid of that. By the way, Pete and Ruhullah are meeting together in Tehran starting morrowsol to polish a framework for action. They favor a ‘concentric circles’ approach. We’ll get as many people as possible to sign onto specific guidelines for response to the crisis, but those unwilling to do that can sign onto a less specific statement. We’ll probably keep it simple and have two tracks of response only. We should have that worked out by Saturdaysol. Then we’ll see who will commit to what. In addition to videomails and emails to world leaders, I’ll be on the media as well.”

“Good; you’re very persuasive in that medium. Let me know what else I can do. I’ve cleared most of my schedule this week.”

“Thanks, Vanessa. I think we can have an impact.”

“I hope so; the Earth is pretty screwed up, and Merapi has started to bring out the worst! Bye, Will.”

“Bye.” Will closed the line. Hearing he was finished, Ethel came in.

“I thought Enlai understood the situation better.”

“So did I, but Vanessa knows how to talk to him. I’ve got to get to my appointment with Jacquie. What’s the latest with Uzboi?”

“They plan to cut PGM production thirty percent if the price stays down. With gold going through the roof, Mars doesn’t need the money. Jacquie’s putting together a plan to use the spare personnel to produce and install more metal highway.”

“Even more highway? Wow. But I guess that makes sense.” Will grabbed his communicator. “I’ll be back in an hour or so.”

It was a short walk to the Commonwealth Building and Chief Minister Jacquie Collins’s office on the third floor. He always felt funny, walking into his old office. Jacquie rose when he entered. “It’s good to see you again, Will. How are you doing?”

“Pretty well! I had a good visit to the homesteaders in Elliott a few weeks back and helped them recover a kilo of gold for their borough’s new government.”

“I saw that on *Mars This Sol*. And now, with the price of gold rising to a record high, they’re doing well.”

“And receiving another gold rush.” The two of them sat at a table in Jacquie’s office. “I hear Uzboi’s cutting back on PGM production and focusing on extending the highway system.”

“That’s part of it. I don’t want to shrink Uzboi; it wrecks the housing market and causes all sorts of problems. But it was supposed to grow by 150. Those immigrants will now do highway work instead of mining for the first year and will earn bonus pay. We’re also putting out

three new crews to set up wind turbines and Uzboi will make a lot more of them. The highway passes a lot of prime wind sites and its built-in pipelines allow it to transport methane and oxygen, so we might as well expand and diversify our wind energy sector. Uzboi's also getting a big new agricultural dome, since we can now move the dome supplies up the road very easily, and they're producing standardized tunnel sections for Dawes and Cassini's gold mines."

"Oh? They're not being made at Cassini and Dawes?"

"No; the personnel there need to recover gold. We'll extent a metal highway to them as fast as we can and concentrate metal production in Uzboi, where it's cheaper."

"Good plan. You have a lot of options I didn't! What's happening on the moon?"

"We're still in negotiation, but it appears some of our 2077-78 immigrants will run Peary and Paranago. That saves money for the lunar stations and for us. Paranago plans to cut back on PGM production, but they're planning a metal highway like ours to the north and south poles, allowing them to move volatiles and other resources. Peary has huge surpluses of carbon, oxygen, and hydrogen as a result of Helium-3 production and it will benefit from a good metal highway to Paranago."

"They're in a very different situation than six years ago as well."

"Indeed. So, what can I do for you?"

"I'm planning responses to the Merapi explosion. Mars is dedicating some of its gold export to relief; I'm really glad to see that. But I've heard the criticism that it will just contribute to raising the price of food; more money chasing the same amount of food will push up the price of food. I'm wondering if we could actually send food to earth; wheat, corn, and rice in particular. We raise about 2,000 tonnes of each every year and could probably raise quite a bit

more. It won't feed a lot of people, but if we say we're exporting ten percent of our food production, people will understand the seriousness of the commitment."

"Ten percent of our total annual food production would be something like 1,500 tonnes of foodstuffs." Jacquie considered. "We're sending a lot of nickel-cobalt capsules right now, since opposition occurs next week. We're sending them on a fast orbit, too, because gold is worth so much. We probably could send one or two hundred tonnes of grains in the next month; not very much. We'd have to raise the surplus to send, which will take 3 months."

"By then, we could send it via Mercury in about 9 months."

Jacquie nodded. "The trajectories that loop close to the sun, also, have access to a lot of power, since we're using solar powered hydrogen plasma engines now for most cargo flights." Jacquie raised a finger. "But I see one problem with your idea, Will. All our crops up here are genetically modified; extensively modified for low light levels and high carbon dioxide. Many countries ban the import of genetically modified crops."

"They may drop their objection because of the shortages."

"Maybe." Jacquie thought a moment, then smiled. "Ah, I have the solution. Aram doesn't use genetically modified crops; it was against Tree Rivers' philosophy. They have huge areas of polder and they're financially strapped right now. We could pay them to raise non-genetically modified grains for export to Earth. You've solved a problem for me, Will!"

"Good! I think it's important to send food to Earth, even if it is a drop in the bucket. It's a symbolic statement. We need to sacrifice somehow, and the more significant our sacrifice is, the stronger our example. That gets to my other issue: a diplomatic offensive. The Marsian Nobel laureates are working on a statement of principles for responding to the Merapi crisis. We plan to take it to other laureates, and we hope they will take it to statesmen and the media. I'll have the

statement finalized in a few sols. I'll be contacting statesmen myself. Ruhullah, Pete, and I are also planning a diplomatic offensive aimed at the United Nations and Grand Union. We'd really like to work with the Commonwealth's diplomatic team."

Jacquie sat up in her seat. "I'd want to see us work together, too. Whatever diplomatic offensive you plan will be stronger if it's Mars's as well, and it will be weakened if it contradicts our efforts. I'm willing to be reasonably aggressive, too. I'll call heads of state and call in the ambassadors here in Aurorae. I'm not too worried about any damage we'll do to collaboration because frankly, it's all under threat anyway. There are riots, banks are closed, and stock markets are plunging. Everyone is turning to us and saying 'we still want to collaborate with you; we'll do it if you can pay.' If we're paying, we're calling the shots."

"I can imagine that funding for Callisto, Titan, and Uranus is in serious jeopardy."

"Exactly; and Ceres. But with gold through the roof, we've activated Project Crimson. The Crimson website has a 20 billion redback wish list. Two sols ago we agreed to purchase all the equipment in a bankrupt LED factory in Korea; 100 million redbacks, a bargain, and once we get the thousand tonnes of equipment here, we'll have the ability to produce about twenty times more LED panels and lights than we can use! There's space program equipment becoming surplus, orbital factories unable to cover costs or get loans to continue their development. So our capacities are going to double again."

"So, we're in a strong diplomatic position."

"I wouldn't put it that way. I'd say, we're in a strong position to be listened to, and if people don't like our message, they really can't afford to retaliate against us. So let's get your team and my team together in the next few sols and make a single plan. At opposition, round trip communication's not bad; 5 minutes each way."

“Great. I was hoping we could work closely. I agree, it’s essential. My third item is minor: Johnny Lind approached me this morning about a petition everyone could sign, not just up here, but on Earth as well. I think it’s a great idea.”

Jacque nodded. “Yes, definitely. Johnny, huh? He never struck me as someone wanting to advocate Earth unity.”

“His son has gone back to Earth to get a PhD at Caltech and he’s thinking of going back for a few years as well.”

“Well, he’s Distinguished Professor of Planetary Science at Martech, so he has access to their computers. He should put the petition there; it’s prestigious and neutral. Does he have a text?”

“Almost. He has a task force working on it now and they’re running it past Vanessa and me as well.”

“Good. There’s not much I can do; that needs to be a non-governmental effort. But I suppose it will reinforce the other efforts.”

“Definitely, that’s the idea.”

“Good.” Jacque sighed. “I don’t see us being able to have much of an impact, Will. We’re small and the parochial attitudes on Earth are immensely powerful. But we should try.”

“I agree, the odds aren’t good. But we need to think long term. Sentiments on Earth need to change. They will be forced to change because of adversity. This won’t be the last global crisis humanity faces. The sooner people realize they’re on one world together and they’re really neighbors, the sooner they’ll be able cope with future crises. Maybe we’ll see some progress compared to the war we just experienced.”

“I hope so, and I agree that we have to do everything we can. Including send grain; that’s a great idea. Let’s get together in two sols to talk strategies.”

Will nodded. “Great. My schedule is clear.”

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“Your burn looks perfect, *Illumination*,” said Bill, checking the Doppler radar readout from the bridge of the *Materra*. “The delta-v is . . . 1.8 centimeters per second low.”

“We copy, *Materra*,” replied Captain Shepherd. “Our inertial guidance confirms the number, and based on the signals on Themis’s sky towers, we appear to be pitched 0.02 degrees positive. Nothing we can’t fix. Of course, now that we’re under way, we finally got the call from Venus that we can buy propellant!”

“Maybe they didn’t think you really were coming. Congratulations, *Illumination*. Have a safe journey.”

“Thanks, Themis.”

“Godspeed and good bye.” Bill closed the line. “And good riddance.”

“It is good to have the dissenters gone,” agreed Irene. “We’re pretty crowded, but at least we can focus on Themis.”

“And we don’t have to worry about any more sabotage,” said Bill. “Just paying the bills.”

“Has the Green World ‘Headquarters’ asked for a contribution again?”

Bill laughed. “They won’t give us any money and they keep asking for contributions for the relief fund! And I find it unlikely they’ll actually donate any of it to the victims. It’s not clear they have anything, either.”

“And Victor—?”

Bill shook his head. “We won’t get anything from Aram.”

“What will we do?”

“Wait and see what the court says.”

He turned to his computer screen. The *Illumination* had taken 41 people with it; the *Materra* now housed 89, along with two life boats and two inflatable 35 by 75 meter bubbles, which they were converting into greenhouses. If everything functioned normally, they’d be fine; their living space was tight, but not impossible. Caravels without lifeboats had transported 150 to Mars before.

His email icon flashed; a message had arrived from Mars. He opened it and was surprised to see that it was the decision of the Commonwealth Court. “Oh, the news is not good,” he said to the others in the bridge. “The court has ruled that all property on Mars in the name of Tree Rivers now belongs to the Green World Community as organized through its elected leader, currently Victor MacLeod.”

“We don’t get anything?”

Bill kept reading. “Oh, it says that since Rivers sent us, all bills accumulated before his death must be paid from the estate. Any bills since that date ‘are subject to the relationship that existed between Themis and the Green World Community, Aram.’ In other words, if they tell us to abandon Themis and we do, they have to pay the bills to get us home, but if we refuse to leave, we have to pay the bills ourselves.”

“But . . . that’s impossible!” said Irene.

“I know,” replied Bill. He scowled. “We’ll have to think about that problem. We’re not abandoning Themis.”

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“You look nervous,” Amy said to Marshall.

He glanced at a chronometer on the wall of their living room. It read 18:58. “I am. Shouldn’t I be?”

“Hell, yes. You’re dressed for the position.”

“I’m dressed formally because I think Council members should be, especially for the gathering after the polls close.”

“I wonder what your chances of being elected Executive are?”

“I don’t know. But Yuri, Sridhar, and Andries all had more votes than I in previous elections, and they’re all leaving. Shiyoko and I are the only two members of the Council left. Of course, there’s Anne and Kurt Hollingworth; he was commander of the *Ptolemy* and she was mayor of Aurorae.”

“Yes, they’ll probably be elected to the Council, too.” Amy glanced at the chronometer; it read 18:59. “We should have gone to the cafeteria. I bet half the outpost is there.”

“We’ll go down in a minute. I don’t want people watching my face when I’m elected or not elected.”

“Yes, I don’t blame you there.” Amy reached over and turned on the wall screen, then pulled up the election website on her communicator and pointed it at the wall screen, so it would appear there. They waited. Willie, who had been sitting on the couch watching a cartoon on his tablet, looked up at the wall screen in anticipation.

Then the screen updated with the final results. “Whoa!” said Marshall. His name was on top: “Executive: Marshall Elliott, 205/455.”

“Congratulations, dear!” said Amy, kissing him.

“I need more than congratulations!”

“Daddy’s executive! Daddy’s executive!” chanted Willie, once he understood the wording and their excitement.

“Hey calm down!” said Marshall. “And don’t chant like that when we go to the cafeteria!”

“Okay, daddy,” said Willie, a little hurt. “Why does it say 205/455?”

“That means 205 people voted for me to be Executive. But other people voted for me to be on the Council. The Executive automatically is on the Council. Altogether, 455 people out of the 505 voters voted for me to be either Executive or on the Council.”

“I see.”

“And you can see that Anna Hollingworth came in second, with 170/450,” said Amy. “If something happens to daddy, she automatically becomes Executive. Shiyoko Takashima got 30/480, which means almost everyone wanted her on the Council, but only 30 people wanted her to be Executive.”

“I see.”

“And Kurt Hollingworth got 72/273,” said Marshall. “It looks like he’d be Executive if both Anna and I died in some sort of accident. Tomas Racan, Sydney Kilgore, and Ryoko Furukawa are the other three members of the Council, but you can see the names of the next three vote getters; if any of the Council members have to resign or die, the person who is number eight on the list automatically is added to the Council, then number nine, then number ten.”

“Let’s go to the cafeteria,” said Amy.

“We were just there for supper!” said Willie.

“Yes, but now people are gathering to celebrate the election,” explained Marshall. He reached down and picked up Millie while Amy grabbed the diaper bag. Willie grabbed his tablet

and the family headed out of their cottage and back to the cafeteria, which was in the next enclosure. As they walked over, Marshall's communicator began to vibrate incessantly. "I can't answer the phone now," he explained. "I have to think what to say!"

"Do you want me to answer it?"

"No, the talking will distract me. Oh, Lord, now I'm getting nervous and tongue tied!"

"You'll do fine."

"I hope so."

Marshall's mind went blank. They were now just thirty meters from the entrance to the cafeteria, so he switched to saying a Bahá'í prayer under his breath. He wasn't sure what else to do.

Amy opened the door and they entered the rear of the cafeteria. Yuri Severin was on the platform up front with the other six new members of the Council. "Here he is!" said Yuri, lowering his communicator. Everyone turned and began to applaud. Marshall, surprised, walked to the front and stepped onto the platform. He bowed slightly to the crowd in thanks.

"Don't bow; wave!" said Anne quietly. Like a politician, she was waving. Marshall, used to photographs of Bahá'í elections where all the newly elected members were looking at the floor, shook his head.

"No, that doesn't look humble."

"You're now a politician; you can't look humble!"

"No, as a leader you have to look humble," he replied quietly.

Yuri, seeing the exchange, stepped forward. "Ladies and gentlemen, you have elected your council for 2076-78, and here they are. They are all excellent choices; I congratulate you. I

can now leave the Saturn system, confident that it will be led well. Perhaps our new Executive can offer a few words.” He pointed to Marshall.

Marshall gulped; he was afraid of exactly that. But he stepped forward and looked at the crowd in front of him, trying to sound confident and decisive.

“On behalf of the seven of us, I thank you for your vote of confidence. We have three weeks before we are inaugurated, and I am sure we will spend many hours meeting with the outgoing Executive and Council to get up to speed on all the details of administering this system. We are at a historic turning point; or perhaps I should say we may be at a historic turning point, from a dependent community to a financially independent community, assuming Helium-3 production begins and Earth still needs it in four or five years! I think we can be confident that the Merapi eruption won’t send terrestrial society back into a dark age and that Helium-3 demand will grow, even if that growth is delayed somewhat.

“I can’t set out a plan for the next two or three years right now because none of us were running on a platform or set of goals. But I will dedicate the next few weeks to listening. We will all want to know what you think we should do. Then we will roll up our sleeves and get started.”

He stepped back into the line of the other Council members as the audience applauded. “Not much of a start,” mumbled Anne nearby. Marshall turned away from her and decided to ignore the comment.

People rose from their seats and moved toward the platform up front to congratulate those elected. Others began to trickle out of the cafeteria or stood and watched. Marshall was soon surrounded by people who wanted to shake his hand. It became a blur of faces, congratulations, and thank yous. Anne also had many people surrounding her, and she glanced at Marshall periodically to see how he was doing.

After five minutes, the crowds began to shrink. Finally, it was just the council members. Anne walked over. "Congratulations, Marshall. Clearly, you've proved yourself to the residents here."

"Thank you, Anne. Congratulations to you, too. I look forward to working with you."

"Thanks. I look forward to working with you, too. I have a lot of ideas."

"I hope the new Council members can be available Wednesday evening," said Yuri. "The outgoing Council is meeting at 7:30 and we hope all of you can join us."

"Yes, I'm sure," said Anne, and the others nodded as well.

"Good." Yuri turned to Marshall. "Shall we talk, quickly?"

"I'd appreciate that very much." Marshall followed Yuri Severin over to a corner of the room, where they had some privacy.

"Congratulations," Yuri began. "I'm very pleased; I was hoping you'd be elected. As you know, this is a big job. Your father became Commander of Aurorae Outpost, population 9, when he was 38. You're Executive of the Saturn system, population almost 700, at age 36. I'm sure you don't want to be compared to your father, but it is inevitable."

"I suppose it is. It's frightening, Yuri!"

"Of course; you understand what a huge responsibility it is. You feel the responsibility. You should be frightened, but you also should be confident. You looked quite confident, just now."

"Thank you, but Anne said my speech wasn't all that good."

"Forget about her words. She's jealous and disappointed. You'll do fine. You'll need to make a plan in the next few weeks, make sure you have support from the majority of the Board—your father was very clever to invite people to his house and feed them—then announce

it in your inaugural address or in a speech shortly thereafter. Humility, listening to people, patience, and decisiveness once you know your support; you know how to do those things. Anne's approach is based on what works in a town of 10,000. You know this place and its culture and what works."

"Thanks. I'm sure she has good ideas."

"I'm sure, too. But don't feel you have to defer to her because she's older and more experienced, either."

Marshall nodded. "Thanks."

"One more thing; get the transition underway right away for the Titan campus of Martech. You can't be Chancellor and Executive at once. It's too demanding."

"I've been think about that. Surender Subrahmanian is the logical choice."

"I agree. I'd get that going."

"Tomorrow. Right now, I have to go home and collapse!"

18.

## Visions

Bill almost leaped for joy when he saw the videmail from Cecie and George Tobin. Since they had contacted him 24 hours earlier, he had been desperately awaiting their second communication. He made sure his office door was closed and hit play.

“Good sol, Bill,” began Cecie. “I’m so glad we contacted you, and I’m glad you responded so fast. I talked to Ambassador Danforth yesterday afternoon between his meetings—he’s pretty busy, but as his chief assistant, I’m with him all the time—and he said there might be ways he could assist Themis. He’ll give me some questions later this sol to forward to you via email. There’s no guarantee he can do anything, though. George is much more likely to be helpful.”

Cecie, a former member of Aram’s Green World Community, shifted over so her husband would be in the front of the camera. “Good sol,” he began. “I went down to the court this morning and spoke to Judge Damrosch off the record about your situation. He’s a friend; you know how it is up here, everyone knows everyone or knows someone who knows the person, and in our case the Mars Bar Association only had 14 members anyway. He agreed that a case could and should be made that Themis’s bills up to the time of the decision about the disposition of Tree Rivers’ estate be paid by the estate. The lawyer they hired to represent Themis made a half hearted attempt, and I don’t think he conveyed the seriousness of the situation to you, either. The Green Earth Community—as one half of the terrestrial community now calls itself—has appealed the court’s decision, which could slow things down but could also stretch out the period of time when your bills are potentially coverable by the estate. So give me the word and I’ll draw

up a letter of intent for you to sign, indicating I represent Themis, and I'll draw up a petition to the court.

“More than that, I like the idea you mentioned of a video about Themis to put up on a crowd funding website. Yes, you should do that. There are a lot of people even here who may be inclined to make a donation to the continued development of Themis. I'm glad you have friend at Martech who can make the video; that's the best demographic to reach. But there's another piece you need: legal incorporation. Themis needs to elect a Council, draw up a Charter, and declare itself something; a government, a corporation, a religion, something. Then we can get you legally incorporated and you can open a bank account. So work on that. Oh, I'll need a name of the entity I'll be representing. I should add that I'll do all of this gratis, for now. If we get to the point where Themis actually has money, we can discuss when compensation can begin.

“Cecie and I are really happy to do this. We very much respected Rivers and what he was trying to do to 'green' Mars. When he sent out your expedition, we were fascinated and followed it regularly. You need to get on television and webcasts, Bill, and make the case for Themis. I think Themis can cover its expenses through crowd sourcing, for now, and perhaps tourism in the future. It's not a completely hopeless situation. Keep in mind that if it is of any use, I can contact my cousin Mike Tobin, who is Will Elliott's son in law, and arrange a time to see Elliott himself. He's still very active in all sorts of causes—he's trying to arrange world peace on Earth at the moment!—and Cecie and I get invited to his house every few months, since we are part of the extended family, as it were. There may be situations where Elliott might be able to help as well.

“That's all we have to report. Get us a green light and a name for your entity and we'll see what we can do. Bye.”

The screen went blank. Bill stared, still unable to believe his luck. George Tobin was a well-respected attorney; one of Mars's best. He served as a part time judge as well. His assistance was just what Themis needed to survive. Bill hit reply.

“Thanks, Cicie and George! You cannot believe what a relief I feel at your response. Yes, I am delighted to appoint you as Themis's attorney. Please do draw up a letter of appointment and I will sign it. I'll get started on the organizational side right away as well. We will be 'the Green World Community of Themis'; that's our name. As for the nature of our entity, we will be the government of a sovereign state. That's what we have been for 9 months already. I'll get the wheels turning this morning to schedule the election of a Themis Council. We were waiting for the *Illumination* to leave, and that happened three weeks ago. We are now ready to hold an election. Bye.”

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For an hour before the first Council meeting, Marshall walked around Acheron Outpost. He started in the *von Braun*, where they had a condo and spent four nights a week, then walked to the *Korolev* and around that galleon. From there he visited the *Ptolemy*, which had just arrived months earlier. With the three galleons, they actually had ample rotating, gravitied space for 750 residents, but with increased use of the underground enclosures in Titanian gravity they could accommodate a thousand or more if they had to.

Then Marshall descended one of three tunnels leading to their underground facilities, buried under the ice crust and heavily insulated against Titan's cryogenic cold. He started at N-7, one of their newest 75 by 35 meter enclosures, its lower half filled with floors and the upper half an open “park.” He worked his way down to N-1, which was their oldest industrial enclosure, then crossed to S-1, which was a garage, vehicle storage, and repair facility. It had several very

large airlocks giving access to the moon's surface via a deep canyon. From there he worked his way back up to S-6, mostly walking through the enclosures' lower levels, which were agricultural.

At S-6 he turned and entered their twelve bioarchives, each 100 meters by 50—twice as large as the 75 by 35 meter enclosures—and each featuring a different climate and ecology. The bioarchives hosted several thousand species and were not immediately necessary for their survival on Titan; rather, they provided large open areas with 50-meter arched ceilings and diverse species from which they could quickly obtain a range of drugs and specialized chemicals. Marshall found the bioarchive tunnels—all tilted downward with a trickling brook meandering across their floors—to be meditative and relaxing, but not grand. They did need a huge, high space.

With that thought in mind, he headed for the first meeting of the new Titan Council. “Technically, we're not the Titan Council, because we won't be sworn in until next week,” exclaimed Marshall, as he welcomed everyone around the table. “But we need to start to get to know each other. That's why I ordered the dinner for all of us.”

“Paid for by the community?” asked Kurt.

Marshall shook his head. “I didn't want to bother Yuri to authorize it; he's busy packing. I put it on my own credit card. Assuming the next galleon arrives in June 2079, we have 2 ¼ years before the next election. What do you think we should accomplish?”

There was silence for a moment while everyone looked at each other. Then Marshall looked to Ryoko Furukawa, seated to his right. “I think I was elected because I'm the artist,” she replied. “So my job is to remind all of you that science and technology isn't everything. Not only

the arts; we also need to live better. We have a lot more consumer goods than ever before, but I'm not referring to that, either. Quality of life: we need to look at ways to improve it."

Marshall nodded vigorously, then looked at Shiyoko. She had arrived at the beginning and had been commander of one of the caravels. "It's complicated, isn't it. We need to prepare for Helium-3 mining and aim for expansion to some new number; I'd say 1,000. That means developing our ecology, our manufacturing, and our science capacities."

Sydney was next; she was in charge of Saturn atmospheric research. "Saturn itself; it prepares for Helium-3 mining, too. Of all the objects in this system, it's the least studied, considering its size and complexity. Even geophysics of the interior appears to be possible." She said that with a smile as she turned to Kurt.

"I'd love to see us do geophysics of Saturn itself," he agreed. "It appears we can indeed develop some very strong, tough, atomic powered sensors and drop them down deep into the planet; maybe far enough down to pick up seismic waves, for example. But you know what focus I'd advocate: building automated exploration systems and dropping them on every moon in the system in the next five to ten years. In addition to that, we need to send crews to Enceladus for several months at a time every year or two, so we need a semipermanent base there. All the major moons will need to be revisited by human crews in a matter of five years; the ground breaking work Johnny Lind and his expeditions did already requires some supplementation." He looked at Anne, who was next around the table.

She stared at Marshall briefly, wondering what he was up to. "I've already said what my priority is: administrative reorganization."

"And I've pledged to get together with you to hear more," agreed Marshall, supportively. "Tomas?"

The head of environmental management nodded. “I’m in favor of all these ideas, but I’d certainly like to see the giant enclosure. Environmental control drools at the thought of setting it up.”

Marshall nodded. “That needs to be a priority, too; everyone wants a big enclosure. We’ve been debating how long and wide to make it, and I think I have a solution for that. I’d aim for the maximum width that the engineers have proposed: 200 meters, and 100 to 150 meters high. That means going deeper into Titan, but that’s not difficult; the lowest bioarchive enclosure is 75 meters down. I suggest we aim for a length of only 100 meters for now, so it is much wider than long, but behind the far wall we’ll extend the enclosure and we’ll remove the far wall when the enclosure is 200 meters long. With a system like that, we could make the enclosure infinitely long if we wished. I’d call the enclosure ‘cathedral’ because that’s what it will be; our magnificent expanse of Earth, under the surface of Titan. So think about that; I want to propose that in my inaugural speech next week.

“I also have some ideas about nomenclature. When we were still on Mars, trying to choose the place to build this outpost, we reviewed several dozen candidate sites and chose ‘Acheron’ because it had the best cryovolcanism, and therefore the potential for geothermal energy, and because the volcanic ridges and peaks had wind energy potential. We knew the area had lag deposits of meteorites and plenty of tholin, which were the other necessary resources. Six years of Titanian geology has confirmed the wisdom of our choice. But even if it had revealed a better location, Acheron was plenty good enough, and Titan doesn’t need two outposts; the entire surface is a 90 minute flight from here.

“So there really is no reason to continue the official name of ‘Acheron’ any more. Colloquial speech has usually shifted to ‘Titan Outpost’ anyway. I don’t think, 100 years from

now, we will see dozens of cities spread across the moon's surface because there are no resources anywhere else that we don't already have here. So I propose we rename the outpost 'Titan.' It is more fitting.

“Similarly, this council is sometimes the 'Titan Council' and sometimes the 'Saturn Council.' I think we should fix the name as 'Saturn Council.' It will clear up its jurisdiction over settlements on other moons. If any of them ever become permanent—possible, certainly—we will need separate Saturn and Titan Councils. But I think it is unlikely any other outpost will grow as large as this one. We can control Helium-3 production from here as easily as from any moon closer to the planet.

“As for our other priorities, I think they have been stated well. Most of them are inevitable and are set not by our policies, but by the personnel we already have or will receive in two years. We must expand Saturn research and prepare for Helium-3 production. We must expand study of the moons. The possibility of building automated exploration systems is new and I would like to pursue it as well if we have the human resources. The priorities for 2079-82 largely have been set already as well, because we know what mix of personnel will come here on the *Cassini* in 2078.

“There is one other priority I think we do need to add, however: strengthening our relationship with Mars. That relationship can do more for this place's future growth than administrative streamlining, expanded scientific research, or any other focus. With the new turmoil on Earth, any support we can get from there may not prove reliable, even with Helium-3 production. I think the main mechanism for strengthening our relationship with Mars is the idea of a Mariner League. It will define the relationship between the various 'outer settlements' and Mars, which is rapidly emerging as a sending center for everyone. At its current rate of growth,

the Marsian population will top 50,000 early in the next decade. There is no reason why all the other ‘outer settlements’ can’t exceed a thousand.”

He paused while everyone digested his comments. “The Mariner League idea is one your father has been pushing,” noted Anne.

“Indeed,” agreed Marshall. “But it’s a good idea, wouldn’t you say?” He smiled and looked at Anne, who reluctantly nodded.

“Do you think, Marshall, that we’ll ever be recognized as an independent country, the way Mars has been?” asked Ryoko.

“I think that has a lot to do with whether Helium-3 is successful and makes money. If the settlement in the Saturn system is financially self-sufficient and its population grows even more—to several thousand—then it’s inevitable. But independence as an official thing, including foreign policy and such, really requires more population than a few hundred or a thousand. Mars is barely viable, in that sense. We are *de facto* independent now; we elect our government and determine our own laws. What we need is a kind of trusteeship status where someone—Mars—takes care of foreign policy, provides legal appeals, and covers our deficits. That’s what I think the League should become; a half-way house to independence.”

“That makes sense,” agreed Tomas. “And that is indeed what we need.”

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“Mommy, can you *please* make it to the 1<sup>st</sup> grade concert tonight?”

Jacquie Collins put down her breakfast toast. “I’m sorry, Mary dear, but Wednesol nights I have my public meeting, and tonight I’m supposed to be at the Caspian Elementary School from 6 to 8 to answer questions.”

“But we’re singing ‘Red Mars Our Home’ and ‘This is Your Land’ and I want you to hear my class!” Mary almost cried when she said it.

“You could explain to people when you arrive at 6 that you have to leave early at 6:45,” suggested Mario. “That’s be enough time to get to Cathay Elementary by 7. And you could promise to come back.”

“I suppose that would work.” Jacquie looked up. “Miki, please send an email to the principal at Caspian Elementary School that I can stay for the public meeting only from 6 to 6:45 this evening.”

“Done,” replied the voice of her automated assistant.

“So, no supper together tonight?” asked Mario.

“Why don’t the two of you come to my office at 5 or 5:15 with something?” suggested Jacquie. “My schedule’s clear then; right, Miki?”

“Correct.”

“Okay, I’ll pick up Mary and we’ll bring you something from Deseret. Now, tomorrow night, remember, I’ll be at work late; we’re three-d printing a new version of the LH-150 and it’ll go until midnight.” He was referring to a new rocket engine that Martech was developing.

“I remember. I’ll pick up Mary, help her with her homework, we’ll hang out at home, and I’ll get her to bed,” said Jacquie. “Right dear?”

“I wish you both would be home more often!”

“I know, but this is a busy time.” Jacquie gulped down the last of her coffee. “Ready to go to school?”

“Yup.” Mary had finished her oatmeal a minute earlier. She stood up and grabbed her tablet. They waited and Mario stood as well. Then the three of them walked out of their house, a

comfortable second story, 150 square meter flat in a tunnel between Liberty and Zanzibar enclosures. They crossed Zanzibar, with its architecture reminiscent of the wooden structures on Madagascar, and Punjab, with its Indian design, and entered Cathay, which was Chinese in appearance. The elementary school, one of four in Aurorae, was at the northern end. They walked Mary to the door, kissed her, and then Mario and Jacquie headed to Andalus.

“Busy day?”

“Fairly busy; the usual. I’ll be meeting with the latest two flights of immigrants at 9. That should be interesting.”

“That’s one of the highlights of your job.”

“It is. Sounds like the LH-150 is coming along.”

“We’re on schedule. It’ll make the Mars variant of the Prometheus a bit more efficient, and we can always export engines to Earth if the ability to manufacture them there lapses.”

“I can’t see that happening. So far, this crisis doesn’t look as serious as the American-Chinese war.”

“The economy has stabilized a bit, after the initial panic.”

“Agriculture won’t be hit for several months, except in Southeast Asia, of course. The trickle of aid Indonesia’s getting is absolutely appalling. I hope to meet with the entire diplomatic corps up here next week to urge them to do more.”

“Will that do any good?”

“Who knows? It’ll match the plan Elliott is putting together and coordinating.”

“Some pretty big names on Earth have made some pretty sharp comments about the refusal to coordinate assistance adequately.”

“And it still hasn’t done much good. I’m meeting with Will this afternoon, too.”

They exited from the tunnel between enclosures and into the bright sunlight of Andalus. When they reached the steps of the Commonwealth Building, they stopped and Mario gave Jacquie a kiss. “Good luck, my dear!”

“Thanks, have a good sol, honey.” She kissed him back. Then Mario headed across the square to Martech’s Department of Propulsion and Jacquie headed for her third floor office. When she reached the top of the stairs, she saw George Tobin sitting in a small waiting area. He rose. “Huma said I might be able to bend your ear for one minute.”

Jacquie hesitated. “Sure, George, come in. I’ll treat you like an arriving email.”

“But more face to face, at least!”

“Yes, definitely. What can I do for you?” Jacquie opened the door of her office and stepped in, with George right behind.

“I’m now the official Mars agent for the Green World Community of Themis. As you probably heard, they elected a Council two weeks ago and are drafting a Constitution and Bylaws, based on Ceres’s.”

“Everyone uses Ceres’s; they did a good job. How are they doing?”

“I talk to Bill Hollingworth daily. He seems to be doing a good job. The dissenters have left. They’re getting back on schedule to complete the first dome in early July. The *Patares* arrives from Phobos in June with two other domes, so at that point they can start to give Themis an atmosphere. I’ve petitioned the court to require Aram to pay all the outstanding bills for Themis through March 31 on the theory that the people are there because of Rivers’s orders and until the court ruled about the disposal of the estate, they were still functioning according to those orders.”

“So, who’s paying the bills now?”

“We’re working on that. We have another petition into the court asking that a portion of the Mars assets be given to Themis on the grounds that they are part of the Aram community. Alternately, Aram needs to pay their bills. We’re also crowd sourcing their expenses and people have already donated 150,000 redbacks.”

“A small start?”

“Something like that. Would it be possible for the Commonwealth to continue extending health coverage to Themis residents for the rest of the year? That’s the big worry; an accident there suddenly requires emergency medical advice.”

“Mariner Hospital is the best place to offer that.” Jacquie considered. “Send me an email. I’ll copy it to Health Services and various others for comment. But I can’t imagine we’d cut them off in an emergency.”

“What about routine matters; consultation about a sprain or a severe headache?”

“Put it in the email so we can discuss it. But I can’t imagine we’d turn such a request down. They have a physician, right?”

“Yes, and one certified to practice at Mariner.” George rose. “One other question, Jacquie: borough status for Themis.”

She looked at him, surprised, then laughed a small laugh. “Why should we subsidize the terraforming of a little 300-meter asteroid with no resources? The Council would never approve it.”

“But what are they going to do if they have no money?”

“Get in their ships and head to Earth or Mars, and abandon Themis. George, Themis is a sort of religious or ecological thing. It is neither practical nor useful.”

“I concede that, Jacquie, but it is inspirational for a lot of people, so there is a connection with Mars.”

“Even if it is inspirational, we could be laughed at for supporting it. We’d need more of a reason than that.”

“I’ll keep thinking about the problem, then. They didn’t ask me to ask about borough status; that was my idea. They are more interested in independence, frankly.”

Jacquie smiled at that. “I wish them luck. I’m not always sure Mars is independent. We’re being buffeted by some pretty powerful forces.”

“I’m sure. Have a good sol, Jacquie.”

“You too, George. Good luck with your efforts. Wish Bill my best.”

“I will.” George Tobin stepped out of Jacquie’s office and closed the door behind him. She went to her desk and pulled up the morning’s emails. Miki had put the new email from Helmut Langlais right on top.

“Morning, Jacquie. We’re reexamining our priorities up here, in the light of the slight recovery in PGM prices, and were wondering what long term plan Uzboi is developing, if any. Does your advice that we make up our own plan based on maximal use of human resources still pertain? We’ve heard some pretty amazing proposals for the use of Uzboi nickel-steel. Please advise. Bye.”

Jacquie hit reply. “Morning, Helmut. According to our economic team, the recovery in PGM prices is probably temporary. The initial panic over the Merapi eruption is over and the ash cloud’s damage to the climate and agriculture is still some months into the future. We’re glad people are looking into Platinum as a safe investment; that should help hold up the price of that element, at least. Our advice to Uzboi and Ceres remains the same: base your PGM production

on demand for the byproducts and transfer people from meteorite processing to byproduct utilization. There's no reason to deplete our meteorite sources as fast as possible, build up huge stockpiles of 'waste' iron and nickel that will have to be reprocessed later, and earn only a marginally better income. We're better off lowering production to the point where we are using the nickel-iron byproduct. As long as the resulting income still covers your expenses, that's best. It won't help Jupiter and the other outposts who have invested in PGM profits to help cover their expenses, but it'll be better for them in the long run.

“As for ways to use the iron and nickel byproduct, Uzboi is indeed considering 'wild' ideas. The latest is to build a metal highway northward, possibly all the way to the pole, 2,000 kilometers distant. The mountains of the Argyre Basin provide some of the best wind energy on Mars, especially the far rim closest to the seasonal cap where CO<sub>2</sub> is alternately freezing out of the atmosphere or sublimating back into it. Water is also abundant up there. The idea is to use wind power and water to make methane and oxygen, thereby shipping both water and energy southward to Uzboi and Aurorae. They're also speculating about a direct Uzboi-Dawes Highway. Of course, there's plenty of unused wind energy and water on the existing highway to utilize first. The Uzboi Highway has plenty of capacity to ship metal products and carbonyl to Aurorae, where we're already building highways in two directions. We'll be lining the edge of the escarpment with wind turbines and making new, larger metal tunnels for underground construction between enclosures. Ceres already has a metal highway program, so you can expand it. You also have started making large rockets for moving water to low Earth orbit and now there's a proposal for a habitat in Venus orbit. So you have plenty of possibilities for using waste iron. I'd focus on them. I know Martech is providing you technical support, too; we can ramp that up. I hope that helps. Bye.” She sent the message and reminded herself that another

brainstorming session about the expansion of Ceres had to be held. In spite of the economic problems on Earth, Ceres was being viewed as a safe investment.

She turned back to the correspondence. The overnight media report contained a digest of articles about Mars—they were still getting excellent coverage—and a separate digest of economic and political news, which she read carefully. There was also a third digest with space news: Mercury was expanding the gold output of Caloris Outpost and shrinking the PGM production from Concord; Parenago was downsizing and cutting PGM production on the lunar far side; Peary was cutting back Helium-3 production because demand had dropped; plans to place three 2000-megawatt solar power systems in geosynchronous orbit were postponed because of funding issues. The last item was good news for the outer solar system because solar power sats were the big competition to Helium-3 fusion, but the drop in demand for Peary's tiny Helium-3 production was very worrisome.

Hun-jai Park had sent the latest weekly update of terrestrial economic trends. The Chief Executive of Phobos emailed her about an extra flight for bringing migrants to Dawes. The ministry of revenue reported that tax collections were running ten percent higher than projected because of the increase in gold prices. That meant the cabinet would need to meet soon and debate which supplemental expenditures to approve.

Then a new videomail dropped into her inbox: a message from Marshall Elliott. She opened it and was immediately struck by how familiar his face was. He looked more and more like his father all the time.

“Good morning, Chief Minister Jacquie. I'm finalizing my inaugural address—I'm sworn in tomorrow—and a major aspect of the speech involves our relationship to Mars. In brief, everyone up here is in favor of a closer relationship. But it is not clear to anyone that borough

status is ideal; we are not a part of Mars, after all, and are never less than 1.5 billion kilometers from Dusty Red. The Mariner League seems like an ideal solution, and by ‘Mariner League’ I refer to a relationship with Mars that is rather like the old trusteeship relationship, or the ‘commonwealth’ relationship that a few island territories retain to the United States. In other words, the mother country provides foreign relations, judicial and legal oversight, and economic protection; the trusteeship territory runs its own domestic affairs with minimal oversight. I want to propose the establishment of Mariner League in my inaugural and indicate a few steps in its eventual evolution, with a trusteeship relationship the final stage. I’d appreciate any comments and suggestions you have, where this idea is concerned.

“There’s not much news up here. With the arrival of the *Ptolemy*, we have received 150 new residents, so we’re all excited by that. The *Ptolemy* also brought several thousand species for our bioarchive enclosures, which will be gradually diversified over the next two years, and we’re looking forward to that. We are pressing forward with preparations for Helium-3 mining in 3 or 4 years and are very excited about the possibilities it creates. I hope all is well with you and your family. Bye.”

Marshall’s face faded from the screen and Jacquie leaned back to think. He had not asked permission, just for advice. Of course, if she needed to press him, she had a mechanism to do so: she could talk to Will. But she also suspected Marshall had already had conversations with his father about the matter. She and the cabinet had discussed the Mariner League idea before and had decided they would leave it to others to initiate the effort. No one had articulated the idea in as much detail as Marshall had, however.

Jacquie hit reply. “Good sol, Marshall. It’s good to hear from you. I suppose you’re tired of hearing this, but I’m proud of the first child born off Earth, the first born of Mars, who is now

the chief executive of the second largest planetary community beyond the moon. It sounds like you'll start your service to Titan with vision and energy. I congratulate you and look forward to hearing your address.

“Regarding the Mariner League, the Commonwealth government does not seek to impose it on the other planetary communities and has avoided initiating the effort, because we have felt the other planetary communities need to do that. But we will participate in a League and certainly will want to help shape its role in the exploration and settlement of the solar system. We do not have bottomless pockets, but we do want to play a central role in such a League, and that means we will have to shoulder responsibilities. That is already our policy, as you know.

“So make a specific proposal; get the ball rolling. We'll be glad to collaborate.

“I'm glad to hear everything is going so well on Titan. It's a remarkable community, located in a truly remarkable place in the solar system; possibly the most interesting world system of all. Best wishes with your upcoming term. Bye.”

She sent the videomail and turned back to her inbox. Yuki Tajima, the Minister of the Treasury, had just sent an email. *Here are the latest supplemental expenditures. The equipment is available at a bit more than half the usual price because of a business bankruptcy and will making it possible for us to produce solid fuel nuclear engines more cheaply. Alexandra (see her comments below) says we should be able to increase our production rate to six per year and reduce the price to 10 million each. Some of the equipment will be useful for our gaseous core nukes as well. The vanadium, hafnium, and zirconium would go to our strategic reserve. The price is 70% the usual price on Earth; the supplier needs to liquidate inventory to cover debts. It's cheaper than the production at Cassini and Thaumasia. I've approved both.*

Jacquie skimmed the approval emails from all the required people and glanced at the actual purchase information, then replied to Yuki, *I approve, too. But I'm concerned that we're undercutting Thaumasia. We need to push down their production prices, which are still higher than import prices. Check their development wish list for items we can import to make their operation more efficient. The Commonwealth can afford to spend 10 or 15 million and provide them machinery as a long term loan.*

She sent the reply and spotted an email from Alexandra Lescov. *Jacquie, three Martech engineering profs are planning a joint summer course to design a deep space habitat based on the specifications we have from Venus. We'll include their engineering team. I want to spend about 1.2 million redbacks on this to hire terrestrial experts. I think we can get parallel courses going at Caltech and at Moscow Institute for Technology. Some of the graduate students at both places have applied to immigrate; it appears that four or five of them are candidates for our 'top hundred' program. The courses will allow us to evaluate them better. We need this course, also, because we have to keep innovating; otherwise, we won't be able to retain top engineers. The deep space habitat we're looking at is in the several tens of thousands of tonnes range, but will allow fully normal family life in low radiation conditions and ten to fifteen year missions to objects beyond Jupiter, as far out as the Kuiper belt. They'd basically be like the Uranus settlement, but mobile, and they'd be a way to test missions with interstellar potential if we can develop much faster propulsion systems. That's why the courses are so expensive.*

Jacquie immediately hit reply. *Wow. Great. But I need a budget to approve the expenditure, Jacquie. We can afford it, but we need to jump through the hoops.* She sent the message.

It was already time to go downstairs to the meeting with arrivals; in fact, she was slightly late. She rose from her desk and headed down to the chamber of the Mars Council, where the reception for arrivals was being held. Last week, Lufthansa's thousand migrants had arrived; United Spaceways was bringing another thousand next week. Every day, 125 descended to Mars from Phobos, and every other day Jacquie met with two flights of arrivals in the council chamber. She reviewed her boilerplate speech quickly in her mind as she hurried down the stairs.

The chamber was packed; the tables with food and drink were particularly crowded. As soon as Jacquie entered, a throng circled around her, so she shook hands, introduced herself, and asked people their names and where they were from. It had been a four-month flight; not rated for children, so the bulk of the people in the chamber were unmarried and in their twenties.

After fifteen minutes of talking informally, Jacquie walked up front. "We should get started," she said. "Please take a seat." She waited as people headed to seats and sat. "The chamber is designed to accommodate 250 people, so we can barely squeeze in. I think this is the perfect place to welcome all of you to Mars because when you vote in elections—the next one will be in July of next year—your representatives will meet here to approve our laws, pass resolutions representing our aspirations, and create the conventions and values that provide us with common ethics and culture. This building is the heart of the Marsian Commonwealth. My office is up on the third floor; the Supreme Court meets in the South Wing. There are no restrictions on walking around the building, so feel free to wander and take a look. It is the seat of your government.

"I'm sure you've already heard this several times, but welcome to Mars. You are a remarkable group, intelligent, very talented, and anxious to get started on the dream of exploring new worlds. You were selected from a pool that was twenty times bigger than the number who

could come this columbiad. Some of them will arrive in the twenty-first columbiad; some never will be able to achieve their dream. You are blessed and fortunate to be here.

“At least I hope you feel that way. You have already noticed that your apartment is smaller than anything you’d rent in New York, Paris, or Tokyo, that prices are ten times higher than on Earth, and your salary is only five times higher than what you might earn on Earth. It is shocking. But none of us are here to make a fortune. The salary scale here is fairly flat; I earn six times more than the base salary of a new arrival. If you want to earn more money, real estate and stock in PGM and gold mining companies have proved fairly lucrative, if you manage them right. In four years, when you are married and starting families, you will find that your earning power is sufficient. At least you won’t have to save for college or retirement or catastrophic illnesses; the system takes care of them. Our high level of immigration allows us to be generous where all of them are concerned.

“All of you have aspirations. Mars is a good place for them, but it is not a utopia. It does have a little bit of crime, but not much, because there are cameras in all public places. Many of you are very disillusioned about Earth, and I don’t blame you; it is a basket case of nationalist chauvinism, racism, egotism, selfishness, and corruption. It doesn’t have to be; we are a professional society and thus have much less of those characteristics. But they are not absent here.

“All of you want to advance in your careers, and again, the high immigration rate means there are constantly new opportunities. Mars had 16,000 people just two years ago; it’ll have 24,000 by the end of this summer; it may have 36,000 by the fall of 2078, almost two and a half years from now. Growth like that does mean there are new positions and promotions. But that does not mean you will get the promotions you want or feel you deserve. People do get

disillusioned here. If you have high expectations, you are likely to get disillusioned as well. Always remember that you are here to contribute to the greatest adventure in human history: the expansion of human consciousness into space. We serve that aspiration; our goal is to help it progress. If you look at it that way, you will not be disappointed.

“As for myself, I was born into a middle class family in Kingston, Jamaica, 44 years ago. My father was Scottish, my mother a Jamaican of African ancestry. I ended up a civil engineer interested in building roads on the island and protecting its harbors from rising sea level, but I applied to come here and ended up in construction engineering, then Chief Executive of Tithonium Outpost, then Minister of Space Exploration, and finally—much to my total shock—Chief Minister, two and a half years ago. Who knows what some of you will be doing, ten or twenty years ago. Who knows what world you will be living on; Mercury to Neptune may not exhaust the possibilities. If you dedicate your talents to our quest, we will all be amazed by what results.”

She paused; everyone applauded. “Questions? Here’s your chance to ask the Chief Minister a difficult one!”

The audience chuckled. No one spoke at first, but then hands shot up. Jacquie pointed to a young man and asked him to give his name and country of origin.

“I’m Jess Chen, from Australia, though my father was Singaporean originally. You mentioned immigration several times. Can we really keep up such a rapid expansion of population? The logistics must be getting impossibly complicated.”

“Good question, Jess. The end of rapid immigration has been projected several times, and it hasn’t happened yet. We brought 4,000 here in the 19<sup>th</sup> columbiad, 6,000 in the 20<sup>th</sup>, will bring 9,000 in the 21<sup>st</sup> and probably 12,000 in the 22<sup>d</sup>. That does represent a slight slowdown;

traditionally, each immigration has been sixty percent larger than the previous one. We can go from 6,000 to 9,000 by moving to two round trips per columbiad, which will also spread out the arrival times. We can do that because the Prometheus rocket allows us to obtain hydrogen cheaply enough to switch to solar thermal or solid core nuclear propulsion, both of which allow the higher delta-vs necessary to make two round trips in a 26 month period. Increased thermal protection also makes it possible, because one of the two round trips involves passing relatively close to the sun; either a Venus flyby or a Mercury flyby. Next columbiad, we'll be using corvettes as well; their interior volume is 2.2 times as much as a galleon's, so they can carry about 2.5 times as many people. New Prometheus passenger cabins will transport 200 to and from orbit. All those changes can push immigration up to 20 or 30 thousand per columbiad. Beyond that, new innovations will be needed." Jacque pointed to a young woman.

She rose. "Tina Jain, from India. I'm in horticulture; my expertise is tropical agriculture, particularly rice-vegetables-fish combinations. But I'm also interested in opening an artistic business. I make pottery, clay sculptures, and I paint portraits and landscapes. I'm concerned that the horticultural work will be so demanding that the art will be impossible, and the business climate will make the arts business impossible anyway. I've heard a lot of horror stories, too; of very long work hours and a very difficult environment for starting businesses."

"Thank you, Tina. Excellent question, also. Work hours are long for the first two years in particular, so you may find it difficult to do much art during your first columbiad here. But things get easier after that, salaries go up, and there are promotions. Our society is very much oriented around seniority. As for the business climate, I am proud to say that my administration has made a lot of progress over the last two years. We are providing twice as much money for small business loans, the Chamber of Commerce is providing better support services, and Marbuild has

started providing small business spaces, which are available for very cheap rent. In a few months, an arts coop opens with several dozen studios for rent at a very reasonable rate. As a result, the number of small businesses has increased dramatically. We hope to quadruple the size of that sector of our economy in the next few years.” She pointed to a young red-headed man.

He rose. “Jeremy Donaldson, USA. I have an MBA and have been hired by Marfab, but I want to open a business of my own some day; or maybe I should say some sol. My concern is that this place is too socialistic for businesses to thrive. It seems to me that has been the problem heretofore. The flat salary scale, in particular, is pretty discouraging.”

“Welcome to Mars, Jeremy, and good luck with your plans. You should speak to Henry Smith of the Chamber of Commerce. He doesn’t feel the flat salary scale is that much of a problem. It isn’t that flat; there are business presidents earning ten times as much as the living wage at the bottom of the scale. That’s nothing, compared to the thousands of times as much that corporate CEOs earn on Earth. But our markets are much smaller, and that’s the biggest problem for businesses. Aurorae provides a much better environment for businesses than any other borough because it’s larger; it’s growing to 14,500, whereas our second largest borough, Dawes, will have 2,500 or so. The next five years will see several revolutions you need to be aware of. First, population growth: in five years Mars will have more than twice its current population, and the population growth should continue at 25 to 30 percent per columbiad. That’s a huge business opportunity. Second, transportation. The metal highway connecting Aurorae and Uzboi has cut transportation time for passengers to 8 hours and for cargo to 24 and has cut the cost of transportation to a quarter of what it was. Our goal is to connect Tithonium to the west and all the eastern boroughs—all the way to Cassini—to Aurorae in five years. Automated cargo trains will be able to take 1000 tonnes of cargo from here to Cassini, 8,000 kilometers away—the

distance of Alaska to Florida or India to Europe—in five sols. The interborough passenger vans will take just two sols. At that point, we will have an integrated economy, with all sorts of business implications.” She pointed to a young man in the back row, who rose.

“Jerry Sasson, France. I saw in *Mars This Sol* last week that the Commonwealth was considering allowing immigrants to pay their own tickets to Mars. My parents would like to immigrate but can’t qualify. Can you tell us anything more about the new policy?”

“Thanks, Jerry. The policy is a proposal and is not finalized, but probably will be in the next six months. Of course, now that you are here, your parents can apply and they’ll receive consideration based on different criteria. But if you weren’t here and they wanted to pay their way, they’d have to pay about half a million redbacks each for the ticket, and they’d have to have skills that would allow them to earn a living after they got here. If they wanted to open a business, they’d have to have 1.5 million redbacks they could invest, and then they’d get the ticket for free. Of course, they’d have to pass the same medical and psychological screenings as everyone else. The plan will be more complicated than that, but those are its basic features.” She pointed to a young woman in the front row.

“Tahirih Morales, and I’m from lots of places; my mother’s English, my father’s Mexican, I’m a citizen of both those places and of the European Union, and I grew up in Haifa, Israel. I’m a cryogeologist, and my question is simple: when will we send a settlement to Neptune?”

There was a scattering of laughter from the audience and Jacquie smiled herself, but it was also obvious to her that the people who laughed knew Tahirih. “Why, do you want to go?”

“I do! I applied for Uranus, but didn’t make the cut.”

“You still might, you know; there are always vacancies, especially in a large expedition. We don’t have plans to send a settlement to Neptune, but probably in 2078, once the Uranus mission is underway, we will set a date for the first Neptune flight, probably five years later or about 2083. The economy will be an important factor. The Neptune expedition will certainly involve at least one corvet, maybe as many as three, in which case it could have a crew of 1,000. The Neptune system is a fascinating one, with Triton as a fascinating world all by itself.”

“Then what?” asked Tahirih.

Jacque smiled. “There’s speculation about a mobile settlement—a sort of enclosed cylindrical habitat with advanced gaseous core engines—cruising the outer solar system indefinitely, receiving passenger and supply flights periodically. It’d be heavily shielded so that families could be raised there safely. It’d visit the Kuiper Belt, visit Pluto, and possibly cruise through objects at the various Lagrange Points of the outer planets. There are far more worldlets beyond Jupiter than in the entire asteroid belt. It’d be a precursor to a multigenerational interstellar vehicle, if humanity ever chose to send one out.”

Other hands shot up, but Jacque shook her head. “I think I’ll take other questions informally. Let me wrap this up. You have come to an incredibly exciting place. Aurorae alone has 37 distinct climates, each with their own species; our kids don’t just feel ‘native’ around a single ecology, but around the full range that Earth possesses. Walk around and familiarize yourself with them. We now have over 2 square kilometers of polder and in the next four years we will enclose 5 square kilometers more, believe it or not, then the equipment will move down our metal highways to the central highlands to make mega-enclosures there. Get certified to wear a pressure suit and drive a vehicle and go outside; this world has 144 million square kilometers of range. After almost three centuries of studying the Earth, research there is not exhausted and

there are tens of thousands of geologists, geophysicists, geochemists, and others in the Earth sciences. Martian geology is not close to being exhausted, either. Volunteer to serve at the North or South Polar Stations; Tahirih, you might enjoy that. Get training in other areas than your Masters degree; learn horticulture, serve on a highway team, work at a mining outpost. We need our people to have multiple skills, and all of those skills will count if you apply for an expedition to an asteroid or another world. Marsians constantly go out to Mercury, Venus, and the other destinations in the solar system. Your children may be setting out for the stars. This is what we do, and you are now a part of the effort. We welcome you, your hard work, your bright new ideas, and your contributions. Thanks for coming.”

19.

## The First Meeting

Mid April, 2076

“Fabrication and construction has the people,” explained Rahula Peres, head of that department. “The Cathedral Enclosure will take a fairly small crew; six. Explorations Systems Fabrication is the biggest new draw on our resources that has been proposed; it’ll require a team of 35. The Helium-3 aerostat team will be reduced from 50 to 25 as a result. But Iris Geyer says the reduction won’t affect her work much because the aerostat design still isn’t ready, so her team doesn’t have anything to start building anyway. The entire aerostat team will be available to help with exploration systems fabrication for 12 to 18 months, then they’ll have to turn to the aerostat, at which point Exploration Systems Fabrication will shrink. Some of the others will come from the spaceport; space vehicle maintenance has a lot of spare human resources, unless something breaks, of course.”

“How can you excavate and enclose a 200 by 100 meter tunnel with just six people?” asked Anne Hollingworth, skeptically.

“The system is highly automated,” replied Rahula. “We excavate a series of narrow tunnels along the perimeter of the enclosure and install the wall casing section by section. We have an automated melter roughly 3 meters wide and high and wide; it’s bullet shaped, except it has a flat bottom with steel tracks to move forward. The tracks can be heated; once the melter is in place, the heat is turned off and the melter freezes into position. It is attached to a power umbilical, a steam umbilical that feeds 200 degree centigrade pressurized steam to it, and a waste water hose. It melts a tunnel in front of it 5 meters wide and high. The waste water flows off, is

filtered to extract tholin and meteorite, and is expelled onto the surface of Titan to freeze a solid, concrete hard layer above the enclosure.

“The melter is followed by a unit that emplaces pre-shaped nickel-steel wall sections five meters square; it places a section and ‘nails’ it to the ice wall with five-meter long hollow spikes through which it injects steam to melt the route for the spikes. Finally, it welds the wall section to the previous wall section. When the full hundred meter length of tunnel is completed, another tunnel is started above it but a bit closer to the center of the enclosure, and another course of wall section is spiked in place and welded to the lower course. Meanwhile, a robotic wall unit welds a second nickel-steel wall to the first, but separated from it by 2 meters; insulation will be blown into the void between them later. Braces are added between the wall and the still intact ice filling the center of the enclosure to ensure the stability of the walls. Once the tunnel being excavated along the right side of the enclosure meets the tunnel being excavated along the left side—they meet at the peak of the enclosure—the metal casing is then complete and forms an arch, so the braces can be removed and the ice filling the enclosure can be melted and removed. A semicylinder 200 meters wide, 100 meters high, and 100 meters long contains 3 million tonnes of ice, a staggering amount, but with either reactor putting out 100 megawatts of heat, we can melt 500 tonnes of ice an hour, 12,000 tonnes a day, 360,000 tonnes a month, so the whole volume can be emptied in less than a year. The easiest way to do it is to separate the nickel-iron meteorite magnetically and let the rest, and the tholin, accumulate on the floor; it’ll form about 2 or 3 meters of ‘protosoil.’ All that work requires only six full time workers. Adding wiring, lights, pipes, and buildings is much more labor intensive.”

“But we’ll have to do a lot of that work to prepare for the 2079 arrivals anyway,” noted Marshall.

“Yes,” agreed Rahula. “The first hundred meter section of Cathedral will be illuminated in 2 years; meanwhile, the second hundred meter section will be encased and most of the interior emptied of ice. Theoretically, we could add 100 meters of length to Cathedral every 12 months, and do so indefinitely. Each 100 meter section will require about 20 megawatts of illumination, and we can add that much wind and geothermal energy every year with our current construction capacities. If we could get the people here, we could add 100 people per year. We have that capacity right now.”

“Is it wise for us to put our entire expansion into a single ever-lengthening enclosure, though?” asked Kurt Hollingworth.

Rahula shook his head. “We could do it if we left emergency doors that could close off the enclosure every 200 meters or so. That way, if there was a collapse, it could be isolated. It would be better, eventually, to create a parallel enclosure a few hundred meters away with interconnections between them.”

“This is quite impressive,” said Tomas Racan. “Horticulture already has twelve bioarchive enclosures and the twelve B-75 bubbles, so we have plenty of ecological diversity and crop space. We would not have a problem with a single large enclosure that presumably would have a single environment, probably the ideal one for humans. It’d be the easiest one for us to maintain, so it would require the least expansion of our resources. It also could manage with Martian light levels, that is, 10 megawatts total rather than 20. So it would not strain our power as much as suggested.”

“What are the plans for landscaping, water, housing . . .?” asked Shiyoko.

“We haven’t made them yet, but there will be a waterfall, a brook, a pond, park areas, perhaps some agriculture, and buildings that are against the sides and don’t interrupt the sight lines.”

“Ask the Martech Department of Architecture for advice,” said Ryoko. “They’re quite good.”

“Are we ready to approve this item?” asked Marshall, trying not to sound too anxious or excited. It was the first meeting of the new Council and his first major initiative.

Sydney Kilgore nodded. But Anne cautioned, “We should have a formal vote.”

“Well, do we have a consensus that Cathedral Enclosure is approved?” asked Marshall.

“We need a budget,” added Anne.

“We have a budget, Anne,” replied Shiyoko. “Because we have a personnel allotment. Everything here is made here, so knowing how many people are assigned to a project is a budget, basically. That’s how the previous Council worked.”

“Well, shouldn’t we formalize things now? Titan is growing. And shouldn’t Rahula not be present for a Council vote?”

“We don’t have a rule about that,” replied Marshall. “Some Council meetings are open to the public. Let me repeat, and a nod is sufficient; do we have a formal consensus to move forward with this project?” He looked around the table and everyone nodded except Anne, whose body language betrayed frustration rather than opposition. “Then let it be recorded that the Council unanimously approves the Cathedral Enclosure, subject to a more detailed financial analysis in the form of a written report to the Council. You can do that, Rahula?”

“Sure. The personnel allocation needs to include such things as two or three geology expeditions to Acheron Delta to dig nickel-iron meteorites, for example, and time from construction to lay electrical lines and pipes. There are important details to formalize.”

“As always,” agreed Shiyoko.

“So, are we ready to move on to the next item?” asked Marshall. People nodded, so he added, “Thanks, Rahula, for your very thorough presentation.” He turned back to the Council. “This is the proposal for establishing a Mariner League.”

“Premature,” said Anne, quickly. “And Mars should be pushing this, not us.”

“But I exchanged videomails with Jacquie Collins and she said it wasn’t Mars’s place to start such a league,” replied Marshall. “Rather, they wanted the initiative to come from the other planetary settlements.”

“But why us?” asked Kurt. “Sirikit Thanarat has been writing a lot about it, and she’s on the Jupiter Council. Why not them?”

“They can’t afford to anger China right now,” replied Shiyoko. “We’re the largest off-Mars settlement, so we’re the logical leaders.”

“If Mars doesn’t want to take the lead, how do we know they want to participate?” asked Tomas. “Without Mars, the league wouldn’t mean much. The main purpose of the league is to regularize finances of the outposts, right?”

“That’s one purpose,” agreed Marshall. “Mars is willing to participate; Jacquie said that to me. They don’t seem to want all of us to request borough status, though, because that would represent a level of commitment that they may not be ready for. On the other hand, some kind of regularized commitment to the settlements would make it easier for us. The other purpose of the

league, simply, is consultation and coordination. It'd be useful to everyone to have a joint meeting of councils periodically.”

“What would we gain, meeting with the Callisto or Ceres Council, though?” asked Kurt. “It'd be quite a complicated meeting, if you ask me, with the huge time delays! And if we become financially independent from Helium-3, would League membership compel us to subsidize other settlements?”

“I think there's a lot we could gain from a series of exchanges with the Ceres Council,” replied Marshall. “They're the oldest off-Mars council, they have the most experience, and they're dealing with rapid expansion and a transition to financial independence. The Callisto Council could benefit from exchanging with us, so we would be assisting them. That's one of the main ways we help each other. As for subsidizing other settlements, it's premature to worry about that; we're still not earning anything at all. But if nations invest in our Helium-3 mining on behalf of Callisto, then we would be sending profit to them; or to Earth, if the shares so specified. It's part of the reciprocity of any League that the members help each other out. It's like insurance, that way.”

“Would the Uranus mission be included?” asked Ryoko.

“I don't think so because they have no Council,” said Marshall. “But once they have one, we could consider including them. Or we could decide they can't be included until they launch, or until they arrive. The group would have to decide who to invite.”

“Who are you thinking about?” asked Shiyoko.

“Mercury, Venus, the Mars cabinet, Ceres, Callisto, and us. Not Peary or Paranago; neither of them have permanent inhabitants. They're transitory lunar facilities, even if they're large.”

“Of course, Ceres is a borough; the others aren’t,” noted Anne.

“But it’s a ‘planetary settlement,’” replied Marshall. “Phobos is a borough, too, with a permanent population, but it’s a four-hour flight from Aurorae. You can get there faster than you can drive to Uzboi.”

Shiyoko nodded at that, as did Ryoko. “I am very concerned that this is premature,” repeated Anne. “We’re a new council and we need to be focusing on reorganization. This is an ‘external affairs’ matter and settlements don’t do external affairs.”

“Maybe they should start,” replied Marshall. “And this has nothing to do with reorganization. We’ll get to that on the agenda next.”

“As I understand it, Marshall, right now you’re just talking about a rolling day-long series of video exchanges,” said Shiyoko. “The speed of light won’t allow anything synchronous. I think we should dedicate a day to such a meeting and see what results. No one will be forcing us to do anything.”

“Yes, we’d send a video stating Titan’s aspirations to everyone, then we’d watch the other Councils state their aspirations. We’d ask questions and make comments about each one. Each Council would listen to the questions and comments it received and would provide a response to them; that’d be round two, several hours later. Then people would listen to and respond to the responses and offer their wrap-up; round three, in the evening. Something like that. It works pretty well with interplanetary science conferences.”

“That’d work, and it would be very interesting to hear the aspirations of the other places,” said Ryoko.

“What would we hope it would produce, though?” asked Anne. “There’s a big gap between a bunch of aspirational presentations and a focused organization.”

“Perhaps a small committee to draft a next step would result,” said Tomas.

“I could see some real advantage to exchanging aspirations,” said Sydney. “I have only the vaguest idea what they’re doing on Mercury and Venus, even though Magellan Station does some important research on Venus’s atmosphere. I know the names of a few atmospheric scientists at Magellan, but otherwise I don’t even know the names of the Council members or what they do.”

“It’s all on the web,” said Anne.

“True, but seeing their faces, hearing their voices, getting even a small sense of personalities, brings the relationship alive,” replied Marshall. “We really have no relationship at all with any of the other settlements, right now! I think the place to start is getting to know them a little bit and getting a sense of our shared aspirations. I don’t know where we go from there, but we can trust the process at that point.”

“I agree,” said Shiyoko.

Ryoko and Tomas nodded, then Sydney. Marshall looked at Anne and Kurt, who were not nodding. “So, do we have a majority of 5 in favor?” Marshall repeated, and the other four nodded.

“Can we now turn to the matter of reorganization?” asked Anne. “We have an entire plan for simplifying and streamlining the organization that I sent to everyone. There’s also the proposal to establish a Borough Manager to free the Chief Executive of most day to day decisions.”

Marshall scowled at that. Shiyoko saw his body language. “I think that’s premature, Anne,” she said. “We need to give Marshall a chance.”

“I was sworn in just two days ago.”

“Have the two of you met and discussed the reorganization plan?” asked Tomas, looking at Marshall. “I’m sure there are ways we can streamline our overall operation. That’s always the case. Furthermore, it’s a good idea to shake things up every few years anyway, to keep everything fresh.”

“That’s true,” said Marshall.

“Have the two of you discussed reorganization?”

“Not yet,” said Anne, looking at Marshall disapprovingly, like he had been avoiding her.

“We can meet tomorrow,” Marshall offered.

“We could at least review the plan,” encouraged Kurt, looking at Anne.

“Do you want to reduce the number of people reporting to you to three, one of whom, as manager, would run 2/3 of the operation?” Tomas asked Marshall.

“That’s a feature of the plan that I would need to be convinced to try,” replied Marshall, trying not to sound too negative.

“Me too!” exclaimed Tomas.

Shiyoko nodded as well. “I’ve commanded quite a few expeditions. You need to be available to everyone. We don’t need a series of layers between the Chief Executive and the residents.”

“This is an outpost, not a ship,” replied Anne. “It’s heading toward 1,000 residents in a few years. It needs to plan for the future.”

“It does; I agree with Anne,” said Marshall. “So I want to study the reorganization proposal. Can we meet tomorrow morning?”

“Any time convenient for you,” she replied.

“How about 9, then,” he said, sensing that the sooner he met with her, the happier she’d be.”

“And we’ll take it up at the next Council meeting, then?” asked Tomas.

“Yes,” said Marshall. “The other items are all on the consent agenda and I hope you read them. Questions?”

Everyone turned to the screens with them to flip through reports about various matters that Yuri has usually taken to the Council and Marshall had decided to continue. They skimmed the items they had already read through and nodded as Marshall ran through the item numbers.

“Alright, shall we adjourn?”

“So moved.”

“Seconded.”

“Then we are adjourned. Thanks, everyone,” said Marshall. He grabbed his tablet and rose. Shiyoko came over to update him about the launch schedule and Marshall nodded in thanks for the information, then headed to his office.

It was strange to have Yuri’s old office. Marshall had barely moved into it the day before and it still didn’t feel comfortable. The lights automatically came on as he entered. He sat at his desk, looking around. Titan Outpost needed a new government center. It had no fancy entrance, no majesty; it was plainer than anything else in the outpost. Even the Titan Campus of Mariner Institute of Technology was grander. It was another item to bring to the Council.

“So, are you going to agree to any reorganization at all?”

Marshall looked up; Anne was in his doorway. “I’m sure I will, but not tonight, I’m tired.”

“Fair enough; 9 a.m., then. What about the manager position?”

Marshall scowled at her. “Anne, at least give me a chance to fail before declaring me incompetent and replacing me with someone else; perhaps someone with decades of experience on Mars, capped by a stint as mayor of Aurorae.”

“I’m not volunteering for the position.”

“Glad to know it. See you tomorrow, Anne.” He watched her leave his doorway and heard her walk down the hall, then out of the executive’s suite. Titan’s thick air carried even faint sounds well. “Ivy, close my door,” he said to his personal assistant. The door slid shut and he sat in the silence for a few minutes. He was tempted to videomail his dad, but he wanted to deal with the personnel friction himself, and he wouldn’t get an answer for at least 3 hours anyway. He closed his eyes a few minutes and said some Bahá’í prayers, then headed home to be with his family.

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“Welcome back to Callisto!” exclaimed Sirikit.

“I’m home!” replied Charlie, giving her a tight hug and a passionate kiss. “I missed you so much!”

“I miss you so much!” she replied, staring into his eyes. Then they kissed again.

“Don’t block the exit,” admonished Jean Paul Poirier, pushing past them.

“Oh, sorry!” Charlie grabbed his flight bag with one hand and took Sirikit’s hand with the other, and they started out of the arrival area.

“So, you had a good flight.” She and Charlie exchanged videomails at least once a day, so it wasn’t a question.

“It was incredible. Himalia was quite interesting; I can easily write a doctoral dissertation about it. Easily. We think we can reconstruct the fragmentation history and provide evidence for

its capture early in the solar system's history, when Jupiter was still surrounded by a gas nebula. Themisto was quite interesting as well; definitely a captured asteroid all by itself, probably captured during the late terminal bombardment era."

"So, how many worlds have you visited now?"

Charlie frowned. "Mars, Ceres, Lutetia, Phobos, Deimos, Callisto, Himalia, Themisto; eight! And I haven't even visited Earth!"

Sirikit chuckled. "And I'm at three, which is two more than most people, and I haven't visited Earth, either. I suppose we'll go there someday, though."

"Who knows."

They passed through a series of pressure doors and entered the C-100. They walked through the edge of the store and into Callisto Square. Sirikit stopped and pointed. "Look how much progress has been made since you left! They've installed metal flooring all the way to the end of the enclosure!" Charlie looked eastward down the 100 meter expanse at metal surfaces all the way to the end, with beams rising on the north and south sides to support tiered buildings that climbed the curved edges half way to the zenith. "Wow! They have the square itself finished and they're working down to the end. How soon before they install trees and such?"

"That's the last step, and the metal surfaces you see are not the top level of the enclosure. In most cases we're looking at the first or second stories. It'll be another year and a half before construction's finished. They've completed filling the water envelopes of both enclosures as well, several months ahead of schedule, so you can walk freely around them both and not worry about cosmic radiation."

"Great. I've gotten my share and don't want any more for a while. And I do want to walk around. Any green areas?"

“Yes, three stories under the square there’s a circular pathway through the hydroponics and especially through all the baby trees they’ve started growing.”

“That’ll be really nice to see. And can we see Jupiter in here?”

“We can, and it’s beautiful! But you have to go down the enclosure quite a ways. I’ll show you later.”

“You said we’ve moved into a new apartment here, in the south side, right?”

“Yes; this way to the ramp well.” She pointed and they walked across the square to the building on its south side. They moved vigorously up the steep ramp—Charlie often found he liked ramps because moving up them fast simulated Martian gravity, which he missed—to the third floor. “So, do you still have a Council meeting tonight?”

“No, we held it last night instead because we didn’t want to spoil the return; I’ve missed you so much, Charlie!”

“Good; I’d rather have you at home with me. Did the Council discuss the plan for a league summit?”

“Yes; it was a pretty quick discussion, too, because we were all in favor. Two days ago, Mercury agreed to participate, and Ceres just agreed a few hours ago.”

“I heard about Mercury, but not Ceres. That’s good news.”

“Yes. Mars hasn’t committed, but it will, so we’re just waiting for Venus.”

“Why did they choose May 15? That’s 4 weeks away!”

“It’s the next time that Universal time lines up with Aurorae time.”

“Oh, of course.” Once every month or so, the clocks in Aurorae were in synch with Universal time on Earth, which is what all the stations kept, except Ceres, which kept Aurorae time.

They exited the ramp well and entered a long, open balcony open to Callisto square. Each unit had its own section of the balcony, sometimes with two chairs and a small table; walking by neighbors, one could stop and chat with them. Sirikit stopped in front of 3F and pointed. The door unlocked for them as they approached it.

They entered a living room 5 meters square with a kitchenette against the back wall. There was a rug, wall screens, and a chair; the kitchenette had a hole where the refrigerator was supposed to be. "Pretty bare, I've ordered another chair and a sofa, but they won't be ready for a few months," said Sirikit.

"It's nice," said Charlie, looking around.

They walked back, through a narrow hallway separating a bathroom, on the right, from a large closet on the left. "The walk in closet is huge!" he observed.

"It's designed so that it can also serve as a nursery."

"Oh." He wasn't sure what he thought of that and wondered whether she had requested it, or whether it was standard issue. They walked into the bedroom itself, which also was fairly bare, but had a queen sized bed and a chest of drawers. The rear wall immediately drew Charlie's attention, however, and he headed straight toward it. "Wow, this is a window, and not a three-d screen, right?"

"Right! Look at Callisto!"

"And Jupiter! We can actually see Jupiter!" He walked to the left side of the window and strained to look to the right, where Jupiter perpetually balanced on Callisto's eastern horizon. At the time the sun was in the western side of the sky, small but intense, shedding its light across Callisto's icy craters and snowy hills, and bathing a nearly full, pastel Jupiter in powerful

illumination. He sucked in his breath in surprise. “I can’t believe it’s so clear! We’re looking through a layer of plexiglass, three layers of Kevlar plastic, and three meters of ice!”

“If you move your head from side to side, you can see some distortion, but not much,” said Sirikit. “The ice crystals grew slowly in pure water with no air in it, so no bubbles formed and the crystals are transparent. When the sun sets and when the lights are turned off in Callisto Square, you can actually look up and see the stars!”

“Really? Who would have ever thought that would be possible!”

“I know. This entire B-100 is a transparent cylinder of Earth; it’s almost like being outside. And it’s so large, it’s really quite roomy, plus there’s a second one that by the end of next year soon have a metal floor with a layer or two of horticulture underneath. This place . . . I don’t know what to say, Charlie, we’re *building* something here, something remarkable and special, something worth making a long-term commitment to. It’s a place to raise kids and build a world; a world that, I think we can be confident, will have a few thousand people in fifteen or twenty years, as the cost of transport continues to decline.”

“That’s pretty optimistic, wouldn’t you say? There’s no economic basis for so many people.”

Sirikit smiled. “The Mars economic team just completed a new analysis of ‘planetary settlements.’ With all the advances in robotic manufacturing and three-d printing, they concluded that a settlement of 500 or more needs relatively little external support; they need medical services, some periodic advice about repairing items, and the import of electronics. Their main export—scientific knowledge—can provide about half the finances to cover those expenses. The other big expense is passenger transportation back and forth, but that’s coming down. A

settlement of 500 has the manufacturing and construction capacities to build the infrastructure to accommodate immigrants.”

“Mars has proved that. So this place can grow?”

“Absolutely, even without export of Helium-3, assuming Mars or some combination of nations are willing to provide a subsidy about a third as much as the old estimate.”

“That’s a significant improvement.” He looked at the walk-in closet. “Is this a standard feature of these apartments?”

“No, I just wanted to see what a potential nursery looked like.”

“Oh? Why?”

“Well . . . I could see us staying here on Callisto for a while. It’s an exciting place, it’s building this magnificent outpost, it has overcome major problems of leadership, it has a very strong Council, it’s doing great research . . .”

“It is, but I thought you wanted to go back to Mars?”

“Well, I do, but if we decided to stay another 2 years, I wouldn’t complain.”

“I see.” Charlie nodded and hesitated a moment. “Because over supper last night, the crew on the *Barnard* was discussing our future plans. Some of us—including me—are rotating back to Callisto and sitting out the expedition to Ananke, so that the rest of the crew can go, as well as some of the Chinese researchers. We’re moving up the departure to June because Callisto has made plenty of hydrogen and oxygen propellant for our use. We discussed a trip to Pasiphae and we may add it, with a launch in November. It turns out, it’s possible to go from Pasiphae to a main belt asteroid in about six months, from there to Ceres in another 4 months, and from there to Mars in 6 more months. If we decide on that expedition, the entire *Barnard* crew will be departing from Callisto in November, maybe December at the latest.”

Sirikit's eyes opened wide in surprise. "What? You mean we'd leave early?"

"Yes, but we'd get to Mars in March of 2078, about the same time we had planned to get there originally. We'd leave here with a particularly heavy load of propellant; about 500 tonnes, enough for a fast trip with three stops. We'd pick up 500 more tonnes at Ceres for a fast trip to Mars, which would also be enough to put us into orbit around Mars with minimal aerobraking, so we'd have substantial cosmic ray shielding on the entire trip. And you'd be free to concentrate on your doctorate because you wouldn't have any Council or store duties on the trip."

"But I've been elected to the Council for 2 years."

"I know. I'm sorry about that."

"I don't like the plan, Charlie."

"I know; I'm not thrilled by it, either. But it would mean visiting three more worlds, and you'd see Ceres. It's not final, either, because only a bit more than half the crew was on the *Barnard* at the time. We need to hold a meeting next week and talk about it."

"Yes, I'd favor that!"

"It's a good plan for the majority of the crew, though. We're an asteroid and iceteroid team, after all. Once we're back at Mars, the *Barnard* will go out on another expedition, probably a three or four year trip in the asteroid belt. It's on permanent rotation among different crews to explore asteroids."

"But are you planning to go out more?"

He looked at her. "We'll need to make that decision together. If we're going to start a family, I'll need to stay close to home."

"Definitely. And after the kids are grown up and out of the house, you'll be maybe 50 and can do a lot of exploring then. You might even be commander of several expeditions."

“That’s true. We’ll figure it out.”

“We will.”

20.

Summit

May 2076

“So, these are the famous two doors?” said Jacquie Collins, as she strode into the entrance area of the Institute of Space Vehicle Design.

Alexandra Lescov, the Director, laughed. “It sure is, Chief Minister Jacquie. The left hand door leads to Martech, whence come out engineering graduate students, and the right hand door leads to Marcraft, where spacecraft parts are tested and fabricated.” She extended her hand.

“Welcome.”

“Thank you.” Jacquie shook Alexandra’s hand, then turned to shake hands with Jamsheed Khan. “Good to see you again, Jimmy.”

“Thanks, Chief Minister Jacquie. Glad to welcome you to the Institute.”

“And June, I haven’t seen you in an age.”

“Thank you, Chief Minister Jacquie,” replied Dr. June Addison. “Perhaps we can have lunch some time and catch up.”

“I’d love that.” Jacquie waved at the central doorway. “Let’s see the Institute. I’m so proud that Mars has developed this university/corporate partnership.”

“It’s unique in the world,” said Alexandra, leading the way. “The chief engineers at Marcraft and the space vehicle engineering faculty of Martech are equal partners here, and most of them have joint appointments and do both jobs part time. It means our classrooms are infused with practical, current problems, and our research and development is grounded both in theory and in lots of engineering students.”

“They’re young and full of fresh ideas,” confirmed Jimmy. “There are thousands of students on Earth aspiring to come to Mars and join our facility.”

“Which trains its own hires,” said Jacquie. “What percent of the new staff get their terminal degrees here?”

“Relatively few,” replied Alexandra. “We get better cross fertilization by hiring newly graduated engineering students from the top schools on Earth. Bu we do have a dozen local undergraduates—Mars born or they arrived as kids with their parents—and two dozen Masters students. The local kids get a really top notch education.”

“I can imagine.”

They walked past a dozen classrooms able to accommodate as few as 15 or as many as 300 students. “Most of our Seminars are for our staff,” said Alexandra. “All of them participate in a weekly seminar of some sort and we give incentives to them to present at least once per annum.”

“How many staff?” asked Jacquie.

“We’ll have almost 300, once the last ships arrive from Earth in two months,” Alexandra replied. “We’ve built it up very fast; it opened in January with 50.”

“But that was before the nuclear propulsion department and space structures department were integrated,” noted June. “We moved into new, expanded facilities her in the last two weeks.”

“So I heard; and they’re much better, I understand.”

June and Jimmy both nodded. “Night and day,” he replied.

They passed the classrooms and several hallways branching off to the right and left. There were large rooms filled with generous cubicles, illuminated by skylights, where dozens

were at work. They passed the entrance to a large metal cylinder 30 meters in diameter that provided space to assemble and test large structures. They passed through a long, “park” cylinder with skylights and artificial illumination stimulated lush greenery. Picnic tables and small work nooks surrounded by vines provided attractive spots to socialize, consult, or brainstorm, and as they passed through they saw all three going on. Then they reached the administrative center and entered a meeting room.

“Very attractive facility,” said Jacquie, sitting. The others sat around the table as well. “So, what do you have for me? Because I want to make an announcement about future plans before the summit of planetary settlements next week.”

“Lots of updates and proposals,” replied Alexandra. “My updates are fairly routine and quick: We now have the ability to manufacture Prometheus rockets and engines here. Currently, we are not planning to do so because we own 51% of the terrestrial manufacturer, so we get a portion of the profits, and the factory there will be more efficient if it’s making more vehicles. We’ll manufacture the Prometheus only if the factory on Earth is impaired by conditions there. The equipment we imported will be used to make other spacecraft unless there’s an emergency on Earth. Three more first stages and three more second stages are on their way here right now and two of them are bringing hydrogen transport tanks. All of them can operate as single stage vehicles to Mars orbit or two stage vehicles to Phobos.

“Helium-3 extraction: We’re running the aerostat design through a second independent engineering audit to make sure we didn’t miss anything. Once the Uranus 1 and Saturn 4 crews are assembled on Phobos, they’ll start with the fabrication of the parts, a task that will continue throughout the voyages to Uranus and to Saturn. The nuclear aerospaceplane’s design won’t be ready for another year, but fabrication work will begin before the Uranus and Saturn launches,

and the first vehicles should be in an advanced stage when the expeditions reach their destinations. They will come in under budget. June, do you want to update the Chief Minister about nuclear engines?"

"Sure." June Addison leaned forward. "The plan to manufacture 50-tonne bimodal nuclear engines with LOX augmentation is proceeding well and the first ones should be ready in 18 months, in time for the next columbiad. The Mercury and Venus Commissions have added contracts to ours, pushing up the number of engines manufactured to 18.

"So we're concentrating on gaseous core engines. We've raised our output to 2 engines a year and cut the cost per engine fifty percent as a result. We think if we raised output to four per year, we could cut the price by another fifty percent, and at that level they may be competitive for Martian immigration, especially if we can extend their life and reuse rate, which we think we can do. They're model 3s with the higher specific impulse of 3,500, so the amount of hydrogen needed for each immigration flight would be cut drastically."

"Oh?" said Jacquie. "Any possibility we could increase the number of flights for each vehicle to three per columbiad? That would make a huge difference."

June shook her head. "No; the speeds of the planets are quite high and we would be working against them, rather than working with them. But we can initiate very fast 5 week flights to Mars, which will work well for families and will allow thirty percent higher passenger densities. That'll cut passenger costs, even with the gas core engine. We may want to give it a try with one gaseous core engine and a galleon in 2078.

"Our big new project proposal is a huge five hundred-tonne thrust gaseous core engine. That's as large as any chemical engine ever flown and ten times larger than any gaseous core engine ever flown. Such huge engines are useful only for very, very large vehicles, since

accelerations more than 1 percent of gravity disrupt the vortices that confine the gaseous uranium hexafluoride reactor mass. Jimmy will say more about such vehicles.”

“I’m sure you’ve already been calculating in your head what we would do with 50,000 tonne vehicles,” began Jimmy. “Anything less would have an acceleration too high for the gaseous core engine. We’re looking at a whole new class of vehicles. We could build something three times the size of the corvet, or even ten times its size, and perhaps we’ll design such a vehicle as well, but right now we’re looking at cylinders the same length as their diameter; that’s the closest shape to a sphere and therefore has the smallest surface area. For example, a cylinder 100 meters long and 100 meters in diameter would have a surface area of a bit less than 50,000 square meters, and one tonne of water or hydrogen per square meter would give it a mass of 50,000 tonnes, which would provide robust radiation shielding. Spun at 2 revolutions per minute, the 33,000 square meters of ‘floor’ would have half a gee of gravity. If the vehicle had just three stories, it could accommodate 7,000 people at 15 square meters per person, and it would still have the entire hollow interior to serve as an open space and gym. It could easily have four or five or even six stories and that many more passengers. In exploration mode, with 100 square meters of floor and horticultural space per person, and three stories, the vehicle could house and feed 1,000 people. The metal and plastic structural mass would be in the vicinity of a thousand tonnes, plus about a tonne per person in exploration mode or 200 kilograms per person in passenger mode.”

“How much would this monstrosity cost to build?” asked Jacquie, startled.

“Five to ten billion,” replied Alexandra. “We’re still not sure. Ceres would be the place to get the materials from, unless we can lower launch costs from the Martian surface even more. It

might be possible to build it on Ceres, but the lower gravity of Phobos would make it much easier.”

“But even if it costs ten billion, consider that it would have a very long lifetime; perhaps a century,” said Jimmy. If it had six stories in the interior and transported 15,000 people each trip, over ten columbiads it’d transport 150,000 people and the cost would be under 70,000 redbacks per person, exclusive of consumables and hydrogen. As a mobile settlement for exploring the outer solar system, receiving caravels or galleons every year or two to rotate residents and supply items it couldn’t manufacture, it’d be able to explore almost forever.”

“How would we ever transport 15,000 people to such a vehicle, or off it?”

“It’d be large enough to be comfortable for a long period of time, so it could spend six months in Earth orbit receiving passengers, 4 months to reach Mars, and 6 months in orbit here to offload them,” replied Alexandra. “The people on board would be working the whole time.”

“The first example would be built for Magellan Station,” said Jimmy. “They’ve made an informal request, so we’re considering their needs. They want two or three tonnes of water shielding per square meter, so it’d be quite massive. But it’d start with only one story of housing, work, and horticultural space. As their population increases, they’d build more themselves.”

“And there’s no need to move the structure to Venus in a year or less,” added Alexandra. The construction crew and researchers could board here to build and set up the interior while the vehicle was in transit. It could do a gravity assist at Earth and pick up more people there, then do a few gravity assists at Venus to circularize its orbit so that the delta-v to get to Magellan would be fairly small. If it took three or four years, that’d be fine.”

“For that matter, the set-up of the first passenger vehicle could be completed during its first flight,” said Jacquie. “And every flight could improve and expand its facilities. That would reduce the construction costs as well. When will you have a design?”

“Six months for the preliminary,” said Alexandra. “I take it we have the green light?”

“Definitely! I want to be able to announce the plans informally at the Mariner League summit next week and provide detailed information in 6 to 12 months. And we need a name. We have the caravel class of vehicles, the galleon class, the corvet class . . . how about ‘carrier class’? Like an aircraft carrier.”

“Sure,” said Alexandra, nodding. “And it could easily be made bigger, if we wish. These ‘carriers’ won’t be able to aerobrake. They’ll be designed to carry the propellant for deceleration because the propellant will provide radiation shielding.”

“And for four-month trips between Earth and Mars, we could easily use hydrogen and oxygen propellants, which are cheaper. Excellent. Can you give me a 2-page memo summarizing the plan in the next few sols?”

“We’ll do that,” agreed Alexandra.

“What else?”

“That’s it.”

“Excellent.” Jacquie rose. “I’d like to see more of the facility and meet people.”

They all rose and walked to the space structures design area, where Jacquie asked questions, shook hands, and viewed screens covered with schematics and databases. They walked into the cafeteria and sat to have coffee with whoever was there. Then she shook hands again and headed out of the Institute, pleased with what she had seen and happy that she would have significant news for the League summit.

A vibration in her pocket reminded her that her communicator had been receiving messages. The latest videomail was from American Ambassador Danforth. She converted it into text so she could skim the message, then stopped in a quiet spot where she could dictate a response. “Ambassador Arthur, if you want to make a statement before the League summit, you need to ask Marshall Eliot, chief executive of Titan, not me,” she dictated a response. “Titan’s the host, so Titan makes the decisions. Obviously, the United States cannot join as a voting member, but perhaps a way can be found to accommodate your voice. I think that’s fair.” She hit send and saw the same basic request from George Tobin. “George, you need to ask Titan whether Themis can join the League summit, not me. Titan’s the host, so Marshall Eliot’s the decider. Bye.” She sent the message, irritated that everyone was assuming Mars was really the decision maker. This was a matter she was glad someone else was handling.

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*What to do with the ambassadors.* Marshall Eliot sat at his desk, weighing all the options and their implications—political and financial implications. They weren’t to be angered; financial support for more than Titan was involved, and their threats could pull Mercury, Venus, and Callisto out of the League before it even formed. There was the situation on Earth to consider, too: the climate was holding up to Merapi’s eruption so far, but very early frosts were forecast in the fall, followed by a severe winter, a very late spring, and cold summer in 2077; summits and conferences to deal with the crisis had been mostly ineffective and food futures prices were up to triple their level before the eruption; the economies were mostly recovering from the initial panic, but were still in recession, and unemployment was very high; 15 countries had raging civil wars and 90 had experienced terrorism in the last year; the United States presidential election was six months away and the campaigning was already hot, so Congress was completely

deadlocked on everything; China was putting new pressure on the Tibetans and Uyghurs to reunite; the European Union was struggling to manage its economic problems and future food shortages; the Latin American and African Unions were impotent and fractured; low earth orbit industrialization was stalled again, and low earth orbit tourism had declined, but lunar tourism was holding up because the rich still had plenty of money. Most nations had restructured their space agencies, which no longer sponsored expeditions or programs solely for their nationals, so they could cut back on cooperative efforts fairly easily. That was an unfortunate consequence of Mars's efforts to develop cooperation and collaboration.

He wasn't altogether sure what the implications of all the facts were, but it was clear that support for space exploration was more fragile than ever. It was important to be respectful and courteous, perhaps even deferential; but even then, support could diminish for reasons beyond his control. He wondered what his father would do in this situation. As he pondered the matter and considered videomailing him, there came a knock on his door.

"Can I come in?" asked Anne Hollingsworth.

"Sure, Anne; sit down." Marshall pointed to the table near the door to his office and rose to join her there. "How can I help you?"

"Bill emailed me a little while ago saying that George Tobin—their agent on Mars—asked Chief Minister Jacquie Collins whether Themis could be part of the League summit, and she said you were the host and in charge of details of that sort."

"I am. Phobos hasn't asked, but our definition of participation is a 'planetary settlement,' meaning a settlement on or around a planet, and Phobos is part of Mars. Ceres is part of Mars, but it's located on a dwarf planet."

“Themis certainly isn’t a dwarf planet, but the settlement there is independent. It really has its own sovereignty. Shouldn’t it be included, too?”

“Well, it’s not a settlement officially founded and sponsored by a nation, either.”

“But that’s not part of the definition.”

“No, it isn’t. But I think you’d agree that including Themis is complicated. Some would say it’d make a mockery of the effort. Others would question the grounds. They’d ask whether any space ship on a long-term voyage should have representation should have representation.”

“What about Uranus?”

“They don’t have a completed crew or a Council. They aren’t even assembled in one place; that’s scheduled for late July when the immigrants currently swarming Phobos have descended to Mars. So no, they aren’t included.”

“I see. Marshall, under what circumstances do you think we could include them?”

He looked at her. “Anne, if you were in my position and your son weren’t the Commander of Themis, what criteria would you use?”

She hesitated. “I . . . think any community should apply to participate.”

“Well, Themis has applied; then what?”

She hesitated again. “I think any community should be included that applies.”

“Peary? Paranago? Marius Hills? ISS3? L1 Gateway? Phobos?”

“Well, of them, only Phobos is permanently inhabited and has elected institutions, but maybe I’d include Phobos if they applied.”

“Alright. So, you’d make the inclusion as broad as possible.”

“Yes, I think so.”

“I see.” He paused to think. *Inclusion*. That was a legitimate principle. *Consultation*. That was legitimate as well; people needed a place at the table. “And if you had a broad principle of inclusion, how would you exclude representatives of the United States, China, European Union, and India?”

“They’re not space settlements, like Themis, Phobos, and the rest.”

“How about this,” suggested Marshall. “At this late date, with the summit three days away, I am not inclined to issue any additional invitations. But we plan to broadcast the summit live over the internet. What if Themis records an opening statement and puts it on their website, and we spontaneously add it to Titan’s own report? That’ll get them heard.”

“But we’re all supposed to be able to ask each other questions and make counter statements.”

“That’s fine. They can post their statements and questions to their website. Questions can come from any council member of any council, so you, me, or anyone else is free to repeat their questions if we wish.”

That startled her. “That’s . . . true.”

“You may have helped me solve my other problem, Anne: the ambassadors want to be able to make statements, too. Perhaps I should let them post their statements to the web and then we’ll replay them. For that matter, the official league summit website could take questions and comments from the public, and perhaps we could repeat a few of them in the official discussion, so as to invite the public into our deliberations. Only the invited bodies will have a vote, but I’m not sure we’ll actually vote on anything, anyway.”

“I . . . can live with that,” replied Anne. “I’ll be happy to repeat Themis’s questions. Including the public is a good public relations decision as well.”

“I think so. It will ease Themis into the discussion, allow the voting members to consider a formal request to add Themis, and it’ll allow Themis to make a formal, written request.”

“I sense that’s the best we’ll get. But perhaps that’s just as well. Otherwise, you’ll be under pressure to include all sorts of folks.”

“Exactly. It’s a slippery slope. Thanks for understanding.”

“Alright.” She rose. “Have a good day, Marshall.” She turned and walked out of his office.

He watched her go, then turned to his tablet. He had to send a few messages. Jacquie could add a representative of Uranus to her group, if she wanted; perhaps even someone from Phobos. And the Marsian media firm he had hired to run the web conference now needed to add a public channel and hire someone with good judgment to screen public comments, so a select few could be included in the discussion. He also had to write several ambassadors.

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“Have I missed anything?” said Sirikit breathlessly, as she dashed into the Council’s meeting space.

“No; we’ve waited for you,” replied Cai Xiaopeng. He pointed at the wall screen.

“You’re only a minute late, and the only thing that has come in are the introductory remarks. We’re pretty far out.”

“I hope the *Barnard* didn’t schedule this meeting to interfere with the summit,” said Phan Quang Ty, suspiciously.

“No; they weren’t paying attention, and some people wanted a breakfast meeting. Jean Paul will be here any second.”

“What did they decide?” asked Hong Cixi.

“A compromise: the *Barnard* will go to Pasiphae, then come back here and leave from here in January or February. That way, everyone doesn’t need to go to Pasiphae, the ship can be stripped down and light in weight, then it can take on a big load of hydrogen and oxygen and use a deeper gravity assist for its first flight to an asteroid in the outer belt.”

“So, you’ll be here a little longer; good,” said Xiaopeng.

Just then Jean Paul Poirier hurried in. “Sorry.”

“That’s okay; we just heard from Sirikit. Let’s get started.” Xiaopeng pushed a button to play the preliminary comments.

Marshall Elliott’s face appeared on the screen. “Welcome, everyone, to the first Mariner League summit. As Chief Executive of the Saturn system, it is my privilege to invite the Council members of Mercury, Venus, Ceres, and Jupiter and the cabinet members of the Mars Commonwealth to this rolling day-long gathering. In addition, we have invited a speaker to inaugurate our meeting and will have brief statements from several ambassadors to Mars. We may have a few additional comments as well.

“I am very excited that we’ve agreed to this gathering. We share many common problems; we all hope to grow and become financially self supporting; and we all aspire to become important contributors to the solar system wide human civilization that will emerge in the late twenty-first or early twenty-second century. We need to work together to bring about that development. We are the cutting edge of human expansion; we are already a major inspiration for cultural and technological innovation; we will take our species to the stars. We share a common culture that emerged on Mars over the last several decades, and together we will carry mariner culture forward into the future.

“Allow me to remind everyone of the structure of this summit. Channel one will carry official communications among us. Contributions can be made to that channel by any of the invited entities. We will all receive contributions on channel one at different times. I suggest we try to listen to comments from the settlements in order from the sun outward, so that we all have the same experience, but if you don’t receive the various contributions in time, feel free to do what you think best. The summit will be a rolling interaction. Titan is over 100 light minutes from Mars; Callisto, 55 minutes; Titan and Callisto are over a light hour from each other. The rest of you are much closer together and will hear each other much sooner.

“Channel two will continuously carry the spontaneous images of our council chambers to each other; the six screens will allow us to see each other in an informal and spontaneous setting, but completely out of any chronological order. Nevertheless, being able to drop in and eavesdrop on each other’s conversations will help give us an idea of who we are as people. To avoid cacophony and be able to hear the official channel one contributions, we will have to mute the audio on channel two most of the time.

“Channel three is a public channel. The ambassador’s statements will be there; Themis will be posting a contribution there; anyone will be able to pose questions there. We will no doubt find a few of the contributions there worthy of repeating on channel one. Thus even though this summit is restricted in terms of voting, it is open to the public, and we have hired a staff to review the comments and respond to them.

“I taped this comment last night, so that we would all be able to start with it in the morning. Most of us have taped our opening statements about the status and future aspirations of our communities, or we will be taping them this morning. The morning is devoted to hearing each other and planning our responses, which will be taped and listened to in the early afternoon,

starting at 12 noon universal time, corresponding to 12:18 p.m. Aurorae time. After we hear each other's responses to the morning session there will be one more round of responses, starting at 3 p.m. universal time. Possibly we will need to exchange emails a fourth time to confirm any decisions we choose to make.

“So that's the plan. Thank you for joining us. I would now like to introduce our principal introductory speaker, Ms. Sirikit Thanarat Langlais. We had invited Nobel Peace Prize winner, Dr. William Eliot, but he deferred to the coauthor of the series of articles that appeared in *Mars This Sol* over the last few months. Ms. Sirikit.”

There was a pause. “When did you tape this, Siri?” asked Cixi.

“Last night,” she replied.

A moment later the screen changed and Sirikit's face appeared. She was always surprised to see and hear herself. She and Will Eliot had worked a week to prepare the brief speech and she felt nervous watching herself. “Greetings, fellow participants. I feel honored to be asked to summarize some of the ideas that have been proposed for a Mariner League.

“Most proposals are graduated; start small and work toward the more complex and interactive. This summit is an example; there is no expectation, no requirements, no mutual responsibilities. We are talking together, sharing perspectives, searching for common priorities, and perhaps we will find ways to collaborate. But all collaboration is voluntary. We hope the result will be the creation of trust, so we can pursue more ambitious goals.

“An obvious step is to find common areas of need: propulsion, advanced environmental management systems, common needs for genetically modified organisms—especially low-insolation plants—and formulate common plans to solve those problems. Most of us are now members of the Martech system and thus share a far-flung research institution.

“A second step is to create a Mariner League secretariat, assuming we identify tasks that such a secretariat can pursue on behalf of all of us. We would also need to determine how such a secretariat would be paid for. A small secretariat that tracks areas of common interest and concern and consults with all parties to make them aware of ways they can collaborate could prove cost effective. It might even save more money than it costs. Any common organization must be viewed as a means, not an end.

“A third step would be to expand the areas of concern that a secretariat can handle on our behalf. It could oversee joint projects, for example, or propose common standards. Right now we all default to Chinese, American, European, or Marsian standards, so we do not have common technological standards, safety standards, legal standards, or environmental management standards. Common standards could save all of us money in the long run. Marsian standards may not always work for all of us, so there may be situations where Marsian standards will need modification to serve the rest of us.

“A fourth step would be to give a secretariat authority to enforce such standards. At that point, we would all be giving up a certain amount of governing authority to a common institution. That would require modification of charters and constitutions and would need much more elaborate systems for consultation, not only among the governing authorities, but among the residents they represent as well.

“It is difficult to say what steps follow after that. Some of us are sovereign entities; some are not. Some are boroughs of sovereign entities. A League with the authority of a European Union could knit together sovereignties. It might also provide trusteeship authority over entities that are not yet ready for sovereignty, if that could be arranged. Perhaps that’s a Mariner Union rather than a Mariner League. No one can predict where this summit might lead, but there are

many possibilities, and the sky, as they say, is the limit; although in this case the solar system might not be the limit. I look forward to seeing what we devise together.”

Her picture faded on the screen, the others turned to her and applauded. “Well done!” said Xiaopeng, though Sirikit thought she heard a touch of jealousy in his voice.

“Thank you,” she replied, shyly. “There really are many possibilities. I hope we can pursue them, and I hope we can bring China along in the process.”

“China is being battered by its own internal and external problems right now,” said Xiaopeng. “It’s hard to say whether we are better off slavishly following Beijing, or accepting the inevitability of loss of their support.”

“Because we could follow them slavishly and still lose their support,” agreed Cixi. “They’re cutting university budgets sharply right now.”

“Anyway, let’s tape our statement,” said Xiaopeng. He pushed a button on his screen and popped up the statement on a screen in front of them, then pushed a series of icons to record and transmit the statement on channel one.

“Greetings from Callisto,” he began. “I am Chief Executive Cai Xiaopeng, sitting here with our Council: Wang Chenguang, Jean Paul Poirier, Phan Quang Ty, Sirikit Thanarat Langlais, Pierre Archambault, and Hong Cixi. Callisto has a population of 232 adults plus 9 children and 20 on the way, for a total of 261 human beings. In the last year we have undergone a huge expansion and inaugurated our Council. The expansion has included a construction team that has inflated two 50 by 100 meter enclosures, filled their radiation shields with three meters of ice, and filled one of the enclosures with plants and buildings. We also have a larger geological team that is exploring the Galileans and outer satellites with greater sophistication

than before. Another galleon will arrive in two years, increasing our population by 150. Figuring in natural increase, we may hit 450 or 475.

“Our plans for the next four or five years are more or less set because the crew for the next galleon is being recruited. Everyone is interested in aerostats right now, so we’re getting a series of aerostats to float in the jovian atmosphere and drop probes periodically into the deeper layers. We are designing automated stations for deployment on Europa and Io and the Ganymede station will be expanded; it’s the only one that humans can visit safely, because of Jupiter’s Van Allen belts. We will also get rovers and satellites to deploy on or around the small inner satellites. Our geology, geophysics, and atmospheric physics teams will double again.

”Longer term, we would like to have a goal to expand Callisto Outpost to at least a thousand residents. At that size, we can produce most of the basic items we’ll need, and we’ll have science teams able to carry out robust and vigorous research. At the moment, the Jupiter system provides no economic basis of settlement, but we will continue to search for exports. The asteroid belt may provide us the best opportunities, so we will be interested in collaboration with Ceres and Mars. That’s our report.” Xiaopeng touched an icon to end the transmission.

“We’ve got some things to say,” exclaimed Jean Paul.

“Let’s see who has come in,” said Xiaopeng.”Mercury, and Venus. Let’s listen to the worlds in order.” He clicked on Mercury’s statement.

A conference room at Concord Station, Mercury, appeared, In addition to the five-person Council, several dozen others sat watching. “Greetings from Mercury,” exclaimed a tall, middle-aged man. “I am Gabor Horvath, the Chief Executive, and here are the other four members of the Council: Gerhard Frick, our mineralogist; Brenda Benet, robotics; Teresa Soares, Director of the Spaceport; and Krishna Meena, Director of Power Systems. Mercury currently

has a population of 239 adults and 66 children, for a total of 305. Unlike everyone else, we can build our own housing; we have plenty of gravity, so we don't need galleons. In the next three years we will expand to over 400. Thanks to regular passenger flights between Earth and Mars that pass Mercury, it is relatively inexpensive for us to fly in new residents. It also means we have considerable interchange of population with Mars, and about half our residents have lived there. The fraction of our population choosing to raise a family here is increasing and our school is now struggling to provide quality education. We may switch our clocks to Mars standard time so that our children can participate with those of Ceres, Phobos, and Aurorae in the largest educational system off Earth.

“This summit has prompted us to conduct a series of ‘Future of Mercury’ forums to review our priorities. We have three launch windows per year to Earth and a relatively short flight to get there, which gives us a strength. The Mercury Commission has contracted for three solid core bimodal LOX-augmented nuclear engines and since their purchase price has been covered, we do not need to include it in cargo transport fees, which will reduce our import and export costs. We have also purchased two Prometheus first stages and two Prometheus second stages, the former to transport cargo, especially liquid hydrogen, to our Portal Transit Station at the Mercury-Sun L2 point, the later to transport passengers. They also promise a major reduction in transport costs. As a result, our transport costs to Earth will be fairly reasonable.

“Mercury has the best solar power in the solar system, the highest surface temperatures that human beings have to deal with directly, and areas colder than the surface of Pluto. The Caloris mineralogical zone, where we have a gold mining station, holds considerable potential because of the very unusual minerals, often in very high concentrations; as you know, we have reopened our gold mining facility there, and we want to expand Caloris into a permanent facility

that will exploit minerals other than gold. Caloris may achieve borough status in a few years as a result. Conditions there are extreme; the entire facility has to be at least ten meters underground, no one can come to the surface during dayspan because of the extreme heat, all power has to be produced during the day, and all accumulated heat has to be stored for release during nightspan. Caloris is a very difficult place to live and work.

“Here at Concord, we now are mining PGMs, in spite of the drop in their price. It is still a small operation, but we hope to expand to 50 tonnes per year, which will require the processing of 100,000 tonnes of meteorite. We’d like to import the equipment to produce metal highway of the sort Mars is now making; we’d connect Concord to Caloris with a road and pipeline. The pipeline in particular would be useful because it’d allow methane and oxygen to be made at Concord and sent to Caloris, where it can provide energy, water, and carbon dioxide.

“That’s the biggest item on our wish list; worth about 750 million redbacks. If we can move people and cargo between Concord and Caloris quickly and cheaply—at night only, unfortunately—we’d be able to grow both boroughs more effectively and continue to expand our presence here. Our science team, of course, is constantly expanding and our Martech campus is quite vigorous.

“That’s our report. Back to all of you.”

“Maybe we should lobby for some nukes as well,” commented Cixi.

“I wonder whether they’d help?” replied Cai. “Perhaps. We can get to Earth extremely fast from here with chemical propulsion via a gravity assist from Jupiter. It’s a shame we are not aware of rare minerals that form as a result of interactions with an ice crust!”

“The comment about switching to Mars standard time so that the kids can work with the kids on Aurorae was interesting,” said Cixi. “We’ll have to consider that pretty soon, too. They really can’t work with Marsian kids without being on sols instead of days.”

“It’d be confusing for it to be Wednesday here and Saturdays there,” agreed Xiaopeng. “Let’s hear Venus next.” He pushed a button.

Irina Mukhamadova appeared at the center of a scene with four other people in a small conference room. “Greetings from Magellan Station, currently in orbit some twenty thousand kilometers from Venus. With me are Harold Laan, Pauline Augustine, George Domeyko, and Naoto Ozawa, the other members of the Venus Council. We have an unusual arrangement here: I am Commissioner of the Venus Commission and split my time between here and Earth. When here, I am eligible to be elected to the Council and in fact I am a Council member and Chief Executive. When I leave, I am just Commissioner.

“With the arrival of our first galleon in December, the population of Magellan Station exceeded 100. The station consists of a galleon, two caravels, and now a single asteroid a mere 20 meters across. We will be receiving three more asteroids, one per year, each slightly larger than the last, and together they will give us an anchor, as it were, a real ‘moon’ to live on or next to. We anticipate receiving another galleon in 3 years and growing our population to 200. With that much volume and with about 50,000 tonnes of moon next to us, we will feel sufficiently stable and permanent to consider ourselves a real settlement. We already have three children on board and that number will start upward in a matter of months.

“The biggest problem we have, of course, is that the world we are studying burns up everything we put on it. Rovers now last about 18 months at ambient conditions of 460 Celsius. But because of the heat and their compact nuclear power sources, they are extremely expensive.

Currently we are operating six on the surface, plus three solar powered aircraft that remain at an altitude of about 55 kilometers, where the sunlight is strong and the temperatures manageable. We also have an inoperable surface repair station that got burned up when its air conditioning system failed.

“Our short-term wish list includes a permanent robotic aerostat operating at 55 kilometers. Our technology made it possible to place aerostats into the atmospheres of Jupiter and Saturn; now we’d like your aerostat technology to update ours. A permanent solar and nuclear powered aerostat, with multiple hot air balloons to keep it afloat, could serve as a base for automated aircraft able to go to the surface to drop off a rover or pick one up and bring it back up for maintenance. We’re already bringing about 2 kilograms of samples from the surface to Magellan every year, and with an aerostat able to accommodate larger rockets, we could increase the quantity a hundred fold.

“Our long-term wish list involves a much larger station, one able to accommodate hundreds, perhaps 1,000, in comfort, with a large interior open space. The vehicle would probably be a rotating hollow cylinder. Ultimately, such vehicles could be built with dimensions measured in thousands of meters; they could be complete worlds. Venus needs such a vehicle if it is to acquire a permanent settlement and ultimately become a sovereignty of its own. We have followed the news from Mars about such a class of vehicles with great eagerness.

“Back to you.”

“The ‘carrier class’; intriguing,” said Sirikit.

“It is,” agreed Xiaopeng. “Mars is next, and I’m sure it’ll be part of their report.” He reached over and pushed an icon on his tablet.

“Good sol from Mars,” began Jacquie Collins. “With me are the Commonwealth cabinet, whom I won’t introduce, but I will point out, in addition, John Anand Tian, Director of the Uranus project, and Zhang Bao-zhi, Chief Executive of Phobos Borough, whom we have invited to join us this sol.

“We recently made an important decision about immigration that has enormous implications for everything else, so let me start there. Every immigration will be 33 percent larger than the previous one. Thus 2076’s involves 9,000 people; 2078 will be 12,000; then 16,000, 22,000, 29,000, 39,000, 52,000, 69,000, 92,000, 122,000, 162,000, 215,000 . . . that gets us to the year 2100, when, including natural increase, Mars should have about a million people. Right now, 4,000 people generate about a billion redbacks of GDP, exclusive of mineral production, so Mars should have a GDP of about 200 billion redbacks.

“Can Mars actually manage such a large immigration? A passenger vehicle able to transport 500 between the surface and orbit would need to fly 430 times in 2100; a dozen such vehicles using a dozen different spaceports could easily handle that part of the trip over six months. But we will need much larger vehicles for transport between the planets. A corvet can transport maybe 2,000 per columbiad, but we probably can’t be flying 100 of them over a nine-month period.

“Hence the need for the ‘carrier class’ vehicle, the smallest of which will be a cylinder 100 meters in diameter and 100 meters long. It would be designed for low accelerations and would not be able to aerobrake. Our plans for the ‘Carrier 1’ are extremely preliminary and are still changing in basic details, but I can give some examples. We can manufacture an inflatable of that dimension at Aurorae and can launch it to Phobos; it would have a mass of less than 100 tonnes. We’d inflate it, fill water bags built into its outer envelope for radiation shielding, and

build inside; no dry dock necessary. Rotated at two revolutions per minute, the inside of the cylindrical surface would have half a gee. The interior surface area is 31,400 square meters, so one story could accommodate 2,000 people, with the rest of the hollow volume being open for aerial games, jogging, and park areas. If the interior were filled with ten stories, the open space would be reduced to half the width and a quarter of the volume of the vehicle and the carrier could accommodate 10,000 or more for the year it takes to fill the vehicle, move it to Mars, and offload its passengers. We'd need 20 such vehicles in 2100, unless we built even larger models. Some of the passengers could be construction specialists who could build additional stories for the next flight while en route, so the carriers would be continually expanded in capacity while in use. Their mass would be about one tonne per passenger, including radiation shielding, consumables, life support equipment, and accommodations, and they'd need about 2.5 tonnes of chemical propellant per passenger for the interplanetary leg.

“I think all of you can imagine what we could do with vehicles of this size. One would allow Magellan to expand to 1,000 people, then add accommodation as it wished. They could not be landed on any object with significant gravity—Phobos, yes, but not Ceres, Callisto, or Titan—so on those worlds we will need to use corvets and caravels. We'll probably phase out construction of galleons at some point in favor of the other two. In exploration mode, 2 or 3 tonnes per passenger, a carrier could cruise the outer solar system indefinitely, receiving caravels to rotate passengers, visiting asteroids, iceteroids, Kuiper belt objects, even dwarf planets for as long as desired. My current guess is that we'll send three corvets and a thousand people to Neptune in 2084, then send out a carrier with a thousand people to the outer solar system in 2088 or 2090.

“What is Mars’s commitment to the Mariner League? Obviously, it will be much larger, 25 years from now, than currently. Our present GDP is about 20 billion redbacks—largely mineral exports—and our commitment is about ten percent. Much of that is in the form of spacecraft, twelve galleons between 2068 and 2076; three on Titan, one traveling to or from Titan, three heading to Uranus, one on Callisto, one on Ceres, one heading to Callisto, one heading to Ceres, and one orbiting Venus. As immigration is shifted to corvets, galleons currently traveling between Earth and Mars will be available for other places. By 2086—ten years from now—Venus, Callisto, Titan, and Uranus can probably expect to get an additional galleon, Ceres two, and several of those places will also get corvets. I think it is a reasonable goal for Venus, Ceres, Callisto, Titan, and Uranus to all have more than a thousand residents in the next 10 to 15 years. Beyond that time horizon, no one can predict.

“I should add that Phobos doesn’t get an individual report in this summit, but we anticipate that its population will remain about five percent of the Commonwealth’s total. It could have 50,000 people when Mars has a million. Ceres does get a separate report, but because they are a borough, we are attaching their report to ours. It follows.”

The screen froze and Jacquie’s image faded away. A moment later, Helmut Langlais appeared, surrounded by the Ceres Council members. “Greetings from Ceres. With me are Carter Levine, our Director PGM production; Juliette Delafontaine, our chief physician; Sophie Chen, director of environment; and Kenneth Leonard, Director of the Spaceport. We’ve been here on Ceres for ten years, following an earlier year-long visit 18 years ago. Ceres currently has 156 residents, including 29 children, and will receive a galleon with 155 more people in about a year.

“Currently, we are producing 150 tonnes of PGMs per year, plus 45,000 tonnes of nickel and 1,500 tonnes of cobalt. We’re casting the cobalt into spheres, placing the PGMs ingots

inside, and launching them into Ceres orbit. Whenever the launch windows allow, we're filling the cobalt spheres with water, adding solar panels and an electrolyzer, and launching the spheres straight to Earth using the hydrogen and oxygen the solar power produces. This allows Ceres to generate about 2 billion redbacks per year, half of which goes to Jupiter, Venus, and Saturn through investment arrangements. The remaining will expand Ceres, pay for its operations, and pay for a program of exploration of the asteroid belt that we anticipate starting in 2078.

“The doubling of our population will allow increase of PGM production to 250 tonnes and will allow us to extract rarer elements—like gold—more efficiently. We'll also be able to convert the nickel-iron we produce—several hundred thousand tonnes per year—into structures. We're already producing nickel-iron highway panels to build a 400 kilometer road to the Mahuika impactor, and it'll be complete in another year. Our goal is to circle Ceres with a road and build connectors to it from other geologically and mineralogically significant sites.

“But more important, Ceres will start to produce nickel and nickel-iron structures for space use. They're much heavier than aluminum or other metals, but we have plenty of water and plenty of solar power, so that doesn't matter too much. The cobalt spheres have given us experience building vehicles for interplanetary transport. Our next goal is producing a water transporter 30 meters in diameter and 100 meters long, able to hold 70,000 tonnes of water if it were full. Ceres has an underground ocean; the one closest to the inner solar system. We have a shaft all the way down to it. We also have access to several huge underground ice bodies that we can easily melt. Martian immigration will require immense quantities of hydrogen and oxygen fuel. A water carrier with very large solar arrays could transport almost half its water to Mars, or to Earth with a Martian gravity assist. If, every time there is a launch window, we send multiple

water carriers Mars-ward, Ceres can provide all the water needed for the immigration. The metal can be recycled or sold at its destination.

“Beyond that, we have two other projects to pursue. We can export metal carbonyls to Phobos, providing their dry docks and manufacturing facilities with potentially unlimited quantities of metals in liquid form. We hope to send the first shipment in two years. The second project is construction of large structures, either on the surface of Ceres or in orbit; it may be that we will be able to build carriers or prepare part of them for completion at Phobos. If Mars does indeed expand to a million people in the next quarter century, Ceres plans to be ready to match them. If Phobos can remain at about five percent of the population of Mars, perhaps Ceres can remain at one percent, which is what we will be next year? We have the water, PGMs, and metal carbonyls to export to low Earth orbit, Phobos, and perhaps other places in the solar system. Indeed, we may want to target the 2080 gravity assist opportunity when Jupiter can speed our cargo to Saturn and Uranus. Those are the possibilities on our long term wish list.”

Helmut’s face froze, then faded. “That’d be ten thousand people on Ceres in 2100!” said Jean Pierre. “What an incredible center for asteroid exploration it’d be!”

“I wonder whether they’d want to be an independent sovereignty at that point,” commented Xiaopeng.

“Maybe,” said Sirikit. “But they’ve tied their star to Mars, and who wouldn’t want that, with Mars potentially expanding to a million in a quarter century? And let’s say they only manage to expand to a quarter million; that’s still ten times as big as they are now.”

“Yes, I wonder whether they can import a quarter million people in a columbiad,” said Pierre. “By her calculation, it requires one or two hundred billion redbacks of vehicles and half a million tonnes of propellant.”

“But she also said Mars would have a GDP of a hundred billion redbacks,” replied Sirikit. “They’re now letting people emigrate and pay their own way, as long as they pass the psychological and medical tests. They’d load the passengers on over several months—first the construction people—fly them to Mars in six months, then unload them over several months in the same order as they loaded them on, so no one would be on board much over nine or ten months. There would still be time to fly the carrier back to Earth via Mercury.”

“That’d work,” agreed Pierre. “And if they built a carrier 2 with a 200 meter diameter and a 200 meter length, they’d be able to transport 80,000 or more in one ship.”

“Let’s hear Titan’s report,” said Xiaopeng, and he pushed on an icon to hear the last report.

“Greetings from Titan,” said Marshall Eliot. “With me are the other members of the Saturn Council: Anna Hollingworth, Shiyoko Takashima, Kurt Hollingworth, Tomas Racan, Sydney Kilgore, and Ryoko Furukawa. Titan currently has a population of 680; we’re the largest planetary settlement outside the Commonwealth. Currently, we are beginning construction on a large aerostat for deployment in the Saturn atmosphere for Helium-3 extraction, beginning construction on a nuclear powered aircraft for use in the atmospheres of Saturn and Titan, beginning design work on a manufacturing line to produce automated science systems for deployment on Saturn’s hundred moons, and beginning the excavation of the ‘Cathedral’ enclosure, which will provide us the largest underground open space yet. Titan Outpost has 12 bioarchive enclosures and 10 construction/park enclosures that already total 3.1 million cubic meters; we have a truly huge terraformed space, which is facilitated by Titan’s thick atmosphere and its cryogenic crust.

“We are the first settlement outside the Commonwealth that can anticipate a time when we can cover all our expenses. We will probably be able to start export of Helium-3 about 2080. What that means to our future is not yet certain, but we anticipate growing to a thousand by about that date, assuming that terrestrial civilization doesn’t collapse in the interim. We want to expand our scientific teams as much as possible, because the Saturn system has a lot to teach humanity. We also want to move toward a more genteel work week, with more time for family and more resources devoted to the arts and sports. Again, our size makes this development possible.

“That completes our report. But we would like to refer you to the report from Themis. They are not a planetary settlement, or they have not been so recognized. But allow me to play their brief statement, for our benefit.” Marshall pushed a button and his image was replaced by that of Bill Hollingworth.

“Thank you for allowing Themis time to make a statement,” he began. “We are 89 people in one caravel, landed near the north pole of an asteroid that is 300 meters in diameter. In about a month, 30 more people will join us; a few weeks after that, we will complete the first dome, which is 500 meters in diameter. The caravel that is coming has 2 more completed domes, which we should have wrapped around Themis and rendered air tight in another year. At that point we will start to pump water up into the gaps between the domes, and in above five years we will be living underneath two meters of transparent water on a world that will have an atmosphere close to terrestrial pressure. Plant life will spread over the surface and oxygenate the atmosphere, and at some point in about a decade we will have a livable world with a breathable atmosphere and 300,000 square meters of surface; enough to feed several hundred of us quite easily and comfortably.

“The problem we have is, how to get from where we are now to where we want to be in about a decade. Because of the passing of our late Prophet, Tree Rivers, we are now an independent community with no financial foundation. Our needs are not enormous, but they are steady: we need medical advice, environmental and engineering advice, and ten million redbacks of imports every year or two to maintain our equipment. With that, we will thrive and become an example of human perseverance and courage. Without that, we will struggle, we may succeed, we may fail, and we may die. We don’t know, but we are determined to bring mother Earth to this ball of chondrite and nickel iron. We seek collaboration with anyone and everyone.”

Bill’s image faded from the screen. “That’s quite a contrast!” said Xiaopeng, laughing.

“It is!” agreed Cixi, also laughing.

“I know Bill,” replied Sirikit. “I’m glad Titan included them; it was kind, and they are a ‘world settlement’ of sorts. Someone will have to help them, but obviously it won’t be Callisto. What amazes me about this series of reports is that even though most of the information isn’t new, putting it together gives a whole new perspective on our situation here.”

“I agree,” said Jean Pierre. “I wish we could set a growth goal.”

“I think we can,” replied Xiaopeng. “Mars has committed twelve galleons in 9 years, and that doesn’t even include the caravels. They have repeatedly said they’d commit a galleon a year to the mariners. If Venus gets a carrier, it won’t need a galleon; in fact, its two galleons might be freed up for other uses. Let’s assume we’ll get one every five years, and after ten years we’ll get a corvet every five years instead, because Collins said they were phasing out galleons. And let’s assume that a galleon can accommodate 500 and a corvet can accommodate 1,000, because our low-gravity surface facilities will supplement them. They can’t transport that many to Callisto because their deep space rating is a third as much, but there will be passenger flights every two

years anyway. We're getting another galleon in 2077, so let's assume a third will be added to the outpost in 2082 and a corvet in 2087. At that point we'd have accommodations for 2,500 people, and our accommodations will be growing by a thousand a decade."

"That's a reasonable guess," agreed Sirikit. "Titan has three galleons; they already can accommodate 1,500, though I think they consider their capacity to be 1,200. If they grow to 2,500 or 3,000 people and are covering their expenses with helium-3 production, they should declare independence."

Xiaopeng shook his head. "It'd be meaningless. They are independent now; they are masters of the entire Saturn system, just as we are masters of the jovian system. Until we have several tens of thousands of people, we'll still need medical support; even Mars needs that sometimes. None of us need representation at the United Nations. But what we do need is a Mariner League; I think this exchange makes that clear. We need Mars and its steady commitment."

"I agree," said Wang Chenguang, who had heretofore said nothing. Xiaopeng looked at her in surprise. "Well, we're all out here, off Earth, together," she elaborated. "China, the US, Europe, India, Russia: They have a bigger commitment to their economies than to us. Most of their 'space' money is spent on their own research institutions. Half the time the research isn't even relevant to us; it's a theoretical exploration that interests one of their scientists. We need to coordinate with each other and with Mars. The nations need to fit their priorities into our needs. That's what the Mariner League needs to do."

"Let's listen in on the conversations of the other Councils," suggested Sirikit. "We'll get to know them better that way."

“And prepare our responses to the reports,” said Xiaopeng. “We can also listen to the statements of the ambassadors; they’ll arrive in another 60 to 90 minutes.”

21.

## Implications

Mid May 2076

“The results were unexpected,” Sirikit said to Charlie that night. “It was interesting to listen to the informal discussions of the other Councils. They had the same reaction we did: we had a whole new vision of where the mariners are going, and new ideas where our respective worlds could and should go.”

“I listened to the various reports,” said Charlie. “Not many people got work done today; at least half of Callisto was following along. I was struck by the fact that there was relatively little new information. Jacquie Collins’s summary of immigration plans and her report about the carrier were both covered by Mars This Sol. The immigration plan even was accompanied by video reportage giving the reaction of various Marsians.”

“I know, and I agree. The immigration plans have to be publicized; Jacquie has to build public support for it and make the economic demands of immigration predictable, so supply and demand and employment can grow appropriately. The carrier idea is pretty extensively covered on various Martech web pages, too. But I hadn’t researched the plans of the other places, including Ceres, and knew little about them. And none of us had thought about our plans in the context of Mars’s plans. Then the ambassadors got their chance to speak, and they made it worse for themselves. A bunch of encouraging words about our ‘adventure on behalf of all humanity’ and platitudes about the human spirit did not give us any confidence that their governments could make any concrete and predictable pledges of support.

“I think most people gathered in Callisto Square watching the summit felt the same. The Chinese looked particularly disappointed about the fact their government offered no pledge for

Callisto at all. They mentioned their ongoing research on hydrogen plasma engines and gaseous core nukes; they are devoting a lot of money to those projects.”

“The so-called ‘Chinese’ galleon leaving earth for Jupiter later this year was paid for by Mars,” said Sirikit. “It’s a poorly hidden secret.”

“Everyone here knows that. So, we have a League?”

“I’ve got to go back to the Council chamber at 11 p.m. for a final round of emails, our fifth. But yes, everyone agreed that we needed ‘step 2’: a secretary-general and a secretariat to develop a common set of standards, priorities, and plans. We’re not going to decide what those standards, priorities, and plans will be: we’ll let the secretariat propose them to an oversight committee consisting of one representative from each world. At least that was the result of round 4. We hope round five will be a series of ‘we agree’ emails.”

“Good. And who will the Secretariat-General be?”

“We’ll see. We have proposed a name, but I can’t say anything more until that person is asked and responds.”

“Of course. It’s a big ‘vision’ job, and needs to be someone who is trusted.”

“Exactly.” Sirikit felt her communicator vibrate and pulled it out of her pocket. “It’s Esther!” She pointed the communicator at the big screen on the wall of their bedroom and pushed the play icon.

A moment later, Esther and Wicahpi-Luta appeared on the screen. “Siri, your keynote was incredible! So simple and direct, and it laid out a path! We were watching it in the Martech cafeteria and I think half the university was there, and we applauded after you finished. A lot of people stayed in the cafeteria all day watching the back and forth. We dropped in several times; it was a sort of rolling party. Good thing it was Saturdays here and no one was in class. Everyone at

Martech wants a Mariner League, that's clear, and a strong League, too. Maybe a Mariner Union based on Mars."

"I think more than half of us would add 'and good riddance to Earth,'" added Wicahpi-Luta. "We're watching this new league coalesce, and what happens on Earth? A suicide bomb in New Delhi, an assassination in Nigeria, a day-long national strike in Canada, two countries withdrawing their pledges for aid to Indonesia, stock markets going down . . . all the usual craziness. In space, we're pulling ourselves together, and it barely makes the BBC news." He looked at Esther. "Tell her the latest wedding plans."

"Oh, yeah. Dad is officiating, of course, but the Bishop has agreed not to object to a ceremony that includes Wicahpi-Luta's dad and mom using Lakota and Maori traditions. So those delicate negotiations are now complete."

"Thank God our dads are old friends from the flight out," added Wicahpi-Luta. "We're going to Tithonium for our honeymoon and we're on the July 1 flight to Phobos, which is the deadline for joining the Uranus project."

"Or supposed deadline. They may add fifty more people to the project, because the galleons will have more zero-gee accommodation. The Uranus community keeps getting bigger!"

"Anyway, we wanted to call and express our excitement about what you have done and are doing, Sirikit. Hi, Charlie! We're sure you'll see this, too. Hope to hear from you soon. Bye."

"Bye," added Esther. Then the screen went dark.

"We had better reply quick; I have to get back to the Council Chamber," said Sirikit. She hit reply. "Thanks! It was a really exciting and exhausting day up here, and I think we'll be thinking about the ideas exchanged for a long time. But it does look like we'll get a League, and

that's the important development. It was good to see Dr. Tian involved, even if Uranus is still just a project."

"We were glued to the screen in the cafeteria here as well," added Charlie. "We're looking forward to watching the wedding and wish we could be there. But we'll stay as close as we can this way. We're doing well up here. Looks like the *Barnard* leaves Callisto for Ceres in January, makes a few stops, and gets back to Mars in mid 2078. Sorry we'll miss you. Bye."

She hit send and rose to head for the Council chamber. The message flew to Jovian laser satellite 2 and was beamed straight to Mars. It arrived about the same time the Mars Cabinet and its guests finished up their deliberations for the day.

"Can I talk to both of you for a few minutes?" John Anand Tian asked Jacquie Collins and Zhang Bao-zhi, Chief Executive of Phobos Borough, as everyone began to leave the conference room in the Commonwealth Building.

"Now? Can't it wait?" asked Jacquie. "I need to get home, and I'm pretty tired."

"I'm sorry, but I think it's pretty quick. And we have a flight back to Phobos tomorrow morning."

"Alright; let's go to my office." Jacquie pointed across the hall, so the three of them walked over.

"It's actually a pretty simple request, though perhaps it isn't quick," said John, as they entered her office. They sat. "I videoed Gandimohan Ramanujan and Adla Ndung'u during supper so we could review the implications of the summit for the Uranus Project. We already have 300 of our people on Phobos, and we'll have everyone in less than two months. Our complement is now 500; we'll be larger than every 'planetary settlement' except Mars and Titan. We'll be moving around, too; six months on Phobos, six months on Deimos, several months in

orbit around Mars off both moons. Our plan was to elect our Council after trans-Uranus injection, but now we're thinking about holding the election in January, after six months, and a year before departure. The three of us also think that the three galleons need appointed, unelected commanders, and that I shouldn't be a galleon commander; I have too much to do overall for the project, as Uranus Commissioner. We don't want to apply for membership in the League; not till after we're on the way. But we do think that the Uranus project should be, essentially, an 'honorary borough' with an elected Chief Executive, its own regulations and its own disciplinary process."

"Honorary borough." Jacquie repeated the term neutrally.

"Which means you wouldn't be part of Phobos borough," added Zhang. "But you are a few kilometers away from the outpost, and you will be going to Deimos borough and floating in orbit."

"Exactly. We won't be attached to any of the existing outposts. We'll be semi-independent, producing most of our food and getting our vehicles set up and ready for the flight. Normally, we would handle disciplinary matters anyway. If we were an honorary borough, we would have to adopt all of the borough laws and regulations, and then when we depart, we'd retain them, which would give us the legal foundation for the Uranus settlement."

"That makes sense," agreed Jacquie. "Would you elect a representative to the Commonwealth Council?"

"I don't know; that's why I said 'honorary.' Five hundred Marsian citizens moving around in orbit; it wouldn't make sense for us to vote as members of Deimos Borough because we'd be two thirds of the population. We'd be there next summer when there's an election. Some

of us could vote at our former addresses on Mars, but that wouldn't be true of the 150 people who have just arrived from Earth."

"We'll have to do something," said Jacquie. "This will require legislation, though; the Chief Executive can't create a borough. I think it's a good idea. I'll support it."

"And I suppose I will, too," said Zhang. "It's a bit strange to have 500 people in a borough but not at its outpost, but visiting the outpost often anyway. I suppose it's a bit like New Tokyo, up on the escarpment; part of Aurorae Borough, but a separate village."

"With its own representative in the Commonwealth Council, though technically it's a representative of an Aurorae district, which largely coincides with New Tokyo," pointed out Jacquie. "That's a good precedent to mention. More importantly, we'll be giving the Uranus settlement a more solid foundation. That's the key point."

"I agree," said John. "This is about how we create and send out settlements; how we propagate the mariner way of life. If we're going to be sending out carriers with a thousand people to explore the Kuiper Belt, they need to be 'world settlements' of their own."

"You're right," said Jacquie. "Let's draw up the legislation."

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"So, we didn't get anything," said Irene to Bill, the next morning in the cafeteria of the *Materra*.

"No, but I made our case. I was emailing with my mom last night; she asked all three of the questions we posed during the second round of discussions. She said that we need to apply for membership, formally. She also thinks that George Tobin should meet with Jacquie Collins again."

"What are we going to do?"

Bill shrugged. “Muddle through. Mars will provide emergency medical consultation; they’ve already pledged that. As long as environmental management is working, we’ll have food and water and air. Right now, we can repair our equipment and we have enough spare electronics. We’re fine for a year or so, except for some sort of huge emergency. If that happens, no one can get here anyway, and everyone will help via the internet.”

“The Republic of Themis.”

Bill chuckled. “The Republic of Themis. We are an independent country on a rock, for what good it’ll do us. Until they send us a bill, we can’t pay, and a judge rules we lose jurisdiction over the rock. But would anyone pay to enforce the decision?”

“I wonder. We do have nickel-iron, and we’re already processing it for our construction, so we will have some PGMs to export.”

“I doubt more than a tonne or two. PGMs are worth about 1.5 million redbacks per tonne, and we need several million redbacks per year of income to cover necessary imports. If we want to import Barbie dolls and Coca Cola, that’s more.”

“We can manage with essentials.”

“But for how long? Once we have the domes up and the atmosphere in place, we’ll move into a steady state maintenance situation. We no longer have a prophet. We’re now an elected republic like everyone else. And they have malls; we don’t.”

“I wouldn’t worry about that too much; not now, anyway.”

“We may have to worry about it when we have lots of kids and the caravel’s frictionless bearings wear out. We can’t be floating in zero gee.”

“No, we can’t. Don’t worry so much, Bill. We’ll take things as they come. Have you checked the crowd source funding lately?”

“No. I should do that, the publicity yesterday may have helped.” Bill pulled his tablet over and asked it to pull up the crowd source bank account. Since it knew his voice, he didn’t need to use a password. A moment later, the screen updated. “Wow! Ten donations and 2.4 million redbacks of new donations!”

“How’s that possible!”

“One donation was 2.34 million redbacks! That’s amazing! We’ve never gotten a donation over 5,000 before!” Bill clicked on the number for details and a message came up: *To the friends on Themis. I have been following your efforts with great interest and was very impressed by your statement yesterday. I have made a large donation; converted into redbacks, somewhat over 2 million. I would like to purchase 5 hectares overlooking your “south sea” for a house, and I’d like to be able to come to Themis every few years for six months or so in order to have peace and quiet in order to write. Please let me know whether that might be possible.*

*Thomas Quint.*

“Who’s Thomas Quint?” asked Irene, looking over his shoulder.

“An entrepreneur, I think. Five hectares; that’s a sixth of Themis. That’s too much.”

“On the other hand, if he’s almost never here, and he pays generously, it might be worth it.”

“Maybe. I’ll forward this to George. He can ask the initial questions. Meanwhile, the Council will need to consider this offer. It looks like our fortune has shifted.”

“At least a little bit.”

“Yes, at least a little bit.”

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“I was very impressed,” said Mike to Will, as he put his legs into his pressure suit. “When Venus asked whether quotas for the various settlements could be established based on Mars’s population, Jacquie didn’t smile politely and say ‘no.’ She indicated that something like that might be possible.”

“I was surprised by that,” agreed Will. He glanced at Mike briefly and wished he had a 35 year old body, like his son in law, rather than his 74 year old body. “But currently, the population of the world settlements adds up to 1,500; 7% of Mars’s. Mars is devoting 10% of its GDP to them. If it continues to devote 10%, it is likely that the settlements will have a population in the 7-10% range of Mars’s.”

“Hard to believe that they could have 70,000 people, by 2100.” Mike pulled the pressure suit up and pushed his arms into it, then zipped up the front. He had to suck in his gut. “This is tight; I’ve put on weight.”

“That’s always a problem, but now I’m losing weight a little bit. I have less appetite than I used to.”

“But you’re healthy?”

“Oh yes, I just had my semiannual battery of tests.” Will pulled his suit on as well. “And my memoirs are finished; through the end of my second term, anyway. So I can focus more on my terrestrial correspondence.”

“With whom?”

Will smiled and looked around the locker room. “I’ll tell you outside.” He zipped up his suit and sealed the seam. Then they both grabbed their life support backpacks and put them on, checking each other’s set-ups and running the diagnostics. Satisfied, they grabbed their helmets and headed for the airlock.

Mike opened a private communications channel to Will after they closed the airlock. “Liz and I were even joking about moving to Callisto for a few years, after the kids are in university,” he continued. “That’s at least twelve years, and by then Callisto would probably have 3,000 people.”

“Why Callisto? She couldn’t continue her dancing there.”

“She’d be in her mid 40s and would be teaching dance, more than dancing. Jupiter has the biggest planetary magnetic field in the solar system, and we still know very little about it. By then they might have a neutrino telescope in low jovian orbit. Jupiter’s mass will modulate the signal, allowing us to study the interior of Jupiter, and the modulation will also tell us the location and strength of the neutrino sources.”

“Yes, I saw the proposal, but I doubt anyone will spend the couple billion to build it, not any time soon, at least.”

“I know, but you can dream!”

Will chuckled. “If Earth ever pulls itself together and chooses to devote even a tenth of a percent of its GDP to space, all sorts of things will be possible.”

The light above the outer airlock door turned green; Will pushed a button and the door opened. They stepped out and headed toward Face Rock Park.

“Is that what your correspondence is about?”

“Yes, definitely, and it’s taking an hour or two a day, sometimes. Remember that email you got from your second cousin, asking to be put in touch with me?”

“Jane Farragut.”

“That’s right. Well, she’s on the campaign staff of Marc Lee.”

“Really? Is that why she wanted to be in touch with you?”

“Yes. She emails me questions every sol or two from Lee. Sometimes she replies with a new question within 5 minutes of receipt of my email. Furthermore, the style of her communications has changed, compared to the first email or two. So I am pretty sure I’m emailing Lee himself.”

“The conservative candidate for President!”

“That’s the one. ‘He’ asks a lot more questions than Mennea ever did, and he has repeatedly asked me about the sources of my ideas. Furthermore, I’ve done a little research. Marc Lee has a Bahá’í aunt. His mother’s sister.”

“Really?”

“Yes. So I’ve been quoting Bahá'u'lláh and `Abdu'l-Bahá to him, explaining the passages sometimes, setting them in context . . . I’ve even sent him some of Shoghi Effendi’s vision of the future of humanity.”

“And how has this arch nationalist reacted?”

“It’s hard to say; ‘he’ hasn’t shown his hand. But my impression is that he has had to look at the rest of the world a little differently. The conservative nationalist vision is running up against a lot of limitations; obvious limitations. The conservative media rants just as extremely as ever, but it’s getting old. The demographics are getting old, too; the young people are turning it off. They need a new argument, and nationalist arguments can be made in favor of international structures.”

“What arguments?”

“The same ones France used to build European unity; that integration can be a megaphone that amplifies your voice and influence. I was making that argument to Mennea for years, but he wouldn’t use it, except feebly. He was a liberal and disliked the argument that the

U.S. should build international mechanisms to continue its domination of the world. I don't like the argument, either, but if it brings the conservatives along, it's useful."

"But they'll use the international mechanisms to dominate!"

"They can't. Every year, the GDPs of other countries grow compared to the United States, so its influence has to shrink. Why? Because everyone else has adopted its model of democracy, rule of law, and capitalism. That model is itself collapsing, but it still works better than anything else. The population of the United States is pretty large, but the European Union's is larger, as is India's and China's. The Latin American Union will grow more unified—in fits and starts—because their unity makes them as large as the United States. The United States can't stand aloof anymore; people don't even want its dollars as much as they used to."

"That's why it's suffering as much as it is."

They followed a path across the labyrinth in front of Face Rock and past the monument to Mars's Fallen, which now had seven names inscribed on it. They entered the crack separating Face Rock from Boat Rock and began to ascent the latter up steps cut in the rock. That quickly brought them to the top, 40 meters above the Outpost. They walked to McGregor Overlook, named for Ethel's mother, who had passed away during their first year on Mars. The stone structure had been expanded and was now quite impressive. They stopped to look over Aurorae.

"And when you arrived, you were my age, and nothing was here at all," said Mike.

"That's right. I was actually 34, not 35, and it has now been forty years. Forty years." Will repeated the number, as if he couldn't believe it. "Now, almost 20,000 people live right here." He pointed to a big area of excavation to the east, across a busy metal roadway from the outpost. "And in the next few years we get 'Australia,' the biggest enclosure yet but the smallest

of the projected series of enclosures, which will allow Aurorae to grow to a quarter million or a half million.”

“And on both sides of Boat Rock. Will we ever cover the rock itself?”

Will nodded. “Probably, some of it. The roadway running along the southern base will have to be put in a tunnel. The eastside roadway will have housing tunnels put under it. The spaceport will be moved even farther north so any danger to the city is minimized. I wouldn’t be surprised if the original landing pads will be preserved as historic sites, with enclosure surrounding them!”

“I saw in *Mars This Sol* that they want to land the first caravel here to add it to the museum, but Phobos wants it for their museum instead.”

“They produced it, and caravels were never designed to land on a planet the size of Mars, so it’d be tricky to bring it here. We have so much surplus now, we can afford the arts and museums.”

“And any consumer goods we want; that’s a huge change, since I arrived here.”

“Let’s walk,” said Will, pointing.

They left the overlook and walked west along the crest of Boat Rock, past two spinning wind turbines—the wind was strong that sol—to the western end of the rock. They descended the trail and cross “the notch,” then climbed to the top of Layercake Mesa. When they reached the western end of Layercake, they again faced a large area of excavation. “Atlantic East and West, Pacific East and West; so many enclosures,” said Will. “This place keeps growing.”

Just then, Will’s communicator buzzed. He looked at the caller identification. “Jacquie Collins. I had better take this one,” he said to Mike. He pushed a button to connect with audio, but not video. “Good morning, Jacquie, how are you this sol?”

“Pretty good. Where are you? No video?”

“No, I’m outside; I have to keep up my certification, and Mike has the same issue, so we go out together every month.”

“I see. Can you stop by my office this morning? I want to bounce some things off you.”

“About the League?”

“Yes, we’re sorting out a lot of issues.”

“I’ll be glad to. We can go in at Baltic and take the metro.”

“If you could, that’d be great. Eleven?”

“Sure, I can be there by then.”

“Thanks. Bye.”

“Bye.” Will closed the line and reopened his private line to Mike. “She wants me to stop by; can we go in at Baltic?”

“Sure. It’s ten minutes’ walk from here.” He pointed and they headed back east along the crest of Layercake to the edge of Baltic enclosure, which covered a small part of the top of Layercake. They entered an airlock there, peeled off their suits, checked them in, hurried down the mountain, and entered the metro station at Baltic Square. A car whisked them back to Andalus in minutes. Will hurried home to change into decent clothes and headed right over to the Commonwealth Building with two minutes to spare.

Jacquie had a tall glass of Marjeeling tea ready for him when he arrived. She pointed to it and rose from her desk. “These new counter-pressure suits dry you out.”

“They do, but we were out only an hour. Thanks, I’d love to have a cup.” He shook hands with her and they both sat down.

“What did you think of the summit?”

“I think the time was right for it. I couldn’t have done it; all the settlements were too small, except maybe Titan, and Callisto was still under military-style administration. But now they’re all in a good position to plan. What was the reaction on Earth?”

“Mixed. I’ll know more in the next few days, when the ambassadors will all come meet with me. None of them offered anything concrete, and it showed.”

“It was quite disappointing.”

“It was, and that’s a big challenge to Mars, because we can’t do it all. The idea is to lead, not to do everything. Our final round of deliberations was by email and lasted into the evening, but the results were unanimous: everyone wants a Mariner League with a secretariat and a Secretary-General. The Secretary-General has to be someone who is trusted and who brings considerable prestige and experience to the job. We unanimously agreed that I should ask you to shoulder the responsibility.”

Will pondered. “I was wondering whether that was the purpose of this meeting. I have a lot of tasks on my plate right now. It isn’t very obvious, because they aren’t that public, and can’t be: a group of us are writing many of the world’s leaders and trying to persuade them to strengthen international cooperation. I think we’re making progress.”

“I know about that effort because you’ve mentioned it to me several times. I don’t think that effort and this office are incompatible. In some ways, they complement each other. The office may strengthen your voice.”

“Perhaps. I’ve finished my memoirs; they’ll be published in a few months. So that task is finished.”

“I don’t think the Mariner League will grow very quickly. A lot of your effort will be to define its tasks and shape it. I can’t think of anyone better qualified to do that than you.”

“Thank you. It is an attractive challenge. How long?”

“Four years, I suppose. We actually didn’t get that far. A charter is a first priority.”

“I need to check with Ethel. We discussed the possibility that this would happen last night, and she was not opposed, but I can’t say yes without consulting with her.”

“Of course. When can you do that?”

“I’ll go home and talk to her right now. I suspect we can make this official in an hour or two. We need to make the announcement quickly.”

“I agree, Mr. Secretary-General.”

Will smiled. “I guess I’m back out of retirement!”

## Plot Summary

Ch. 1: June 2075: *Barnard* reaches Callisto

Ch. 4: Aug. 2075: Callisto starts on its C-100 enclosures; Wicahpi-Luta and Esther are accepted to Uranus-1; Homestead Company begins operations; Bill realizes Rivers lied; poll about election begins on Callisto

Ch. 6: Sept. 2075: Drafting of Callisto Charter begins; Rivers admits sometimes he expresses his “genius”; Mennea assassinated

Ch. 7: Oct. 2075: Ganymede mission completed; 10 homesteaders near Erstad crater

Ch. 9: Nov. 2075: The first vote on Callisto; Council assumes authority Jan. 1, 2077

Ch. 10: Dec. 2075: *Barnard* leaves Callisto for Himalia; Sirikit talked to Will Elliott about a Mariner League; Caspian enclosure completed at Aurorae; homesteaders organize Elliott Borough

Dec. 26, 2075: *Gan De* leaves Callisto for Earth

Ch. 11: Jan. 10, 2076: *Patares* launched from Phobos; Rivers dies; *Barnard* visits Himalia

Jan. 2076: Metal road completed, Aurorae to Uzboi; metal road starts Aurorae toward Tithonium, Uzboi Highway toward Thaumasia

Ch. 12: Mid Jan. 2076: Venus gets its first asteroid; Council there considers the Mariner League

Ch. 13: Late Jan. 2076: Bill plays the recording of Rivers, destroying his reputation as prophet; Will Elliott goes to Aram to force them to form a government; plans for Ceres “mall” replaced by carrier plans; Oskar has leukemia; Flora Rivers claims prophecy; Bill hold pop election and is elected leader of Themis. Captain Shepherd and Cynthia decide to leave with the *Illumination* a month later

Ch. 15: Feb. 2076: *Ptolemy* arrives at Titan with Hollingworths; population rises to 693 (656 after departure); *Barnard* leaves Himalia for Themisto

Ch. 16: March 2076: Will Elliott visits Elliott Borough as it is formally inaugurated; arson damages a plastic extruder on Themis; Mount Merapi explodes on Java; *Illumination* leaves Themis (pop 89) with 41 people for Venus; Marshall elected Executive of Titan

Ch. 17: Apr. 2076: George Tobin becomes Themis’s attorney; Marshall proposes “Cathedral” enclosure; Themis starts on Constitution and Bylaws

Ch. 19: April 2076: First Saturn planning meeting; Cathedral can be melted in a year, illuminated in 2; Saturn proposes a Mariner League; Charlie returns to Callisto; the first C-100 is metaled and Callisto Square is taking shape

Ch. 20: May 2076; Carrier is proposed; Mariner League summit held

Feb.-June 2076: 6,000 transported Earth to Mars (pop. 22,000)

June 2076: Jumla-Elysium Highway completed; work on "Australia" enclosure begins east of Aurorae

Plot ideas and Chronology:

Autumnal Equinox: Oct. 24, 2074

Dust Storm Season begins: Dec. 15, 2074

Dust Storm Season ends: Apr. 10, 2075

July: Second Green World crew launched from Earth

Helmut and family must return to Mars; Oskar develops leukemia

Aug. 25, 2075: Vernal Equinox

October 2075: A virtual circumnavigation of Titan is complete

November 2075: Tad and Johnny Lind and Gandhimohan Prathan reach Mars from Saturn on the *Beagle*

Chinese opposition to election ends when Jacquie and Tao agree that China will pay for half a second galleon only and there will be Chinese sponsored expeditions on and from Callisto.

Venus gets a galleon, 2075

January 2076: *Ptolemy* (Saturn 3) arrives at Titan after 18 month flight; it turns around and flies back to Earth in three months

January: Third Green World launch to Themis with dome, including Suzanne and babies

Jan? 2076 Tree Rivers dies suddenly of a stroke. Green World Community fragments

Jan 2076: Galleon *Herschel* launched to Earth, then to Ceres in June; Galleon launched to Earth to fly to Jupiter later in the year.

Later 2076: Chinese/Marsian Galleon leaves Earth for Jupiter

2076: Venus gets first NEO

February: Saturn-3 galleon from Mars reaches Titan after 19 month voyage

March 2076: Marshall elected chief executive of Titan; Saturn 3 departs for Mars

Opposition 20: March 19, 2076

Jan.-July 2076: 6,000 transported Earth to Mars (pop. 24,000)

Summer 2076: first Corvet is launched to Earth to serve as hotel

Autumnal Equinox: Sept. 10, 2076

September 2076: Galleon leaves Titan for Mars

Dust Storm Season begins: Nov. 1, 2076

Dust Storm Season ends: Mar. 26, 2077

2077: Venus gets second NEO

June 2077: Caravel launch to Ceres from Mars (Mars-Ceres Opposition: Dec. 6, 2077, launch 172 days earlier)

Vernal Equinox: July 12, 2077

Dec. 2077: 1-year launch window Mars to Jupiter

Jan. 2078: launch of Jupiter 5 (and Saturn and Uranus-1)

Opposition 21: April 27, 2078

Autumnal Equinox: July 29, 2078

Dust Storm Season begins: Sept. 20, 2078

Dust Storm Season ends: Feb. 15, 2079

Vernal Equinox: May 30, 2079

Autumnal Equinox: June 15, 2080

Opposition 22: June 16, 2080

Dust Storm Season begins: Aug. 7, 2080

Dust Storm Season ends: Jan. 2, 2081

Mars-Ceres opposition: Feb. 12, 2081

Vernal Equinox: April 16, 2081

Autumnal Equinox: May 3, 2082

Dust Storm Season begins: June 24, 2082

Opposition 23: Sept. 1, 2082

Dust Storm Season ends: Nov. 19, 2082

Vernal Equinox: Mar. 4, 2083

Autumnal Equinox: Mar. 20, 2084

Mars-Ceres opposition: Apr. 18, 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

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

Mars-Ceres opposition: June 24, 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

Mars-Ceres opposition: Aug. 30, 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

Mars-Ceres opposition: Nov. 5, 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

Mars-Ceres opposition: Jan. 11, 2097

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

Mars-Ceres opposition: Jan. 17, 2100

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

Completed volume 2, June 30, 2014.