THE MARS FRONTIER

Vol. 10

Challenges of Diversity

Contents

1.

Arrivals

February-April 2055

The shuttle *Simud* fell rapidly towards the surface of Mars, its large, rounded bottom still glowing ruddy from the heat of atmospheric entry. Among the passengers packed like sardines in the cabin was Dr. Forest Rivers, age 40. He was dressed in a pressure suit without a helmet; his slightly balding head had a short blond ponytail. He watched the screen closely as it showed the easternmost canyon of the Valles Marineris system rolling by them, the northern escarpment sharp and clear just fifteen kilometers below.

"Parachute deployment in three seconds," announced the pilot. "Here we go."

They could hear the mortar go off, blowing the drogue chute upward into the shuttle's supersonic slipstream, then the cord tightened and the shuttle jerked as the chute inflated. Gravity increased noticeably. Some passengers were startled, but Rivers remained unperturbed. Then a few seconds later there was a series of three pops as mortars fired out the main chutes, followed by a wrenching jolt as they inflated against the thin Martian air screaming past the shuttle at nearly two thousand kilometers per hour.

That startled, if not frightened, some of the passengers; simulations never fully captured the reality of landing on Mars. Rivers looked at the screen, which showed their flight profile relative to the Martian surface; it was proceeding nominally. Deceleration felt oppressive because they were not used to two terrestrial gees, after nearly five months of cruising between the planets at one artificial Martian gravity.

They passed several craters on the floor of Aurorae Chaos, or ‘Aurorae Valley’ as the area had once been rechristened by NASA because it sounded better. Second by second the ground grew noticeably closer, especially as the drag of the parachutes eliminated almost all of the shuttle’s forward motion and its trajectory tipped from nearly horizontal to vertical. Fifty seconds later—though it seems like an eternity—they could hear motors opening five engine ports in the shuttle’s rounded bottom.

“Parachute separation in three,” announced the pilot.

“He doesn’t give us much warning,” said Yoshiyaki Suzuki, a Zen monk strapped into the landing couch next to Rivers.

“No,” replied Rivers, and suddenly they felt the parachute cord separate, causing the shuttle to enter free fall. But just as everyone began to think something was wrong, the shuttle’s five main engines roared alive, blasting out hundred-meter flames of combusted methane and oxygen, and they were pressed back into their couches at nearly two gees once again.

Velocity, 500 meters per second, altitude 10,250 meters. . . Rivers made the grim calculation that if something went wrong, they’d crash in less than twenty seconds. But every second the shuttle was moving slower by twenty meters per second and the time of impact was delayed. The ground seemed to race upward at them, but the shuttle stayed on the landing profile projected on the screen, so Forest was unperturbed. Aurorae Outpost, the collection of verdant bubbles and buildings that was their destination, moved into view in the upper right corner of the screen.

The deceleration began to cut back, the roar of the rockets gradually weakening. They were only hundreds of meters above the surface now and dropping toward it at tens

of meters per second. The engines continued to throttle back, then shut off entirely. The vehicle bounced a bit as its five landing legs touched down.

"Welcome to Mars," announced the pilot. The passengers all began to applaud spontaneously.

"We made it," said Yoshiyaki.

"Indeed; hundreds of millions of kilometers." Forest extended his hand to Yoshi and they shook. Then they began to unstrap themselves, fold back their horizontal deceleration couches into seats, and stand in the aisle where their legs once lay. Passengers who had been wearing helmets took them off. Forest's chief assistant, Victor MacLeod, stepped down the spiral staircase nearby from a deceleration couch located above him and stood in the narrow, low space.

"Quite a ride," he said.

"Really. I hadn't realized it'd be so bumpy."

"The simulation doesn't give you a feel for that, and the Swift shuttle's ride from Earth orbit is much smoother," observed MacLeod.

There was a clank and they all looked toward the airlock. A mobilhab was already docking to the shuttle. Passengers began to pull luggage out of compartments under the deceleration couches and hand it to their owners. Forest reached down under his and pulled out the suitcases for himself and Victor.

They had to be patient; egress was not a routine and quick matter, like on a jet plane. The docking tube had to be latched into place very carefully and it always leaked a little. But in about five minutes the tube was in place and inflated, it was tested, and the

airlock door suddenly opened inward. A figure in a pressure suit entered and waved; the passengers cheered and began to file out.

The tube was just a meter long and wide enough for one person at a time to pass. They squeezed through and entered the mobilhab, a vehicle 2.5 meters wide and seven meters long. Some went up the tiny spiral staircase to the upper level for the better view; the others sat on the ground level.

“Welcome, welcome,” exclaimed the driver. “I am Lal Shankaraman, a geologist here at Aurorae and Treasurer of the Borough Council, so I am conveying the greetings of the Council and the residents.”

“Are your passenger seats in front taken?” asked Forest.

“No, not yet.”

“Good. Yoshi, come sit up front with me.”

The monk nodded and stepped forward. “Are you Yoshiyaki Suzuki?”

“That is correct. I am the head of the monastery.”

“Marvelous. Welcome. And you’re Dr. Forest Rivers, right?”

“Yes, President of the Green World Community.”

“Green World? I thought it was the Green Earth Community.”

“It was, but we’re on Mars now, right?”

Lal laughed. “Yes, exactly.” He looked at the passengers. “That’s everyone? Let’s get the airlock closed.” He stepped back from the drivers seat and closed the egress hatch in the mobilhab’s driver’s side, latching it tightly. Then he returned to the driver’s seat and watched a television screen that showed a worker detaching the tube from the shuttle

and retracting it back into the side of the mobilhab. He gave the all clear signal and Lal heard him confirm over the radio. Lal acknowledged and began to drive forward.

"So, that's Layercake Mesa?" asked Forest, noting a large flat-topped rise several kilometers in front to them.

"Yes. You landed on pad six; it's seven kilometers from the outpost, and south of the Layercake Mesa and Boat Rock. The Outpost is north of Boat Rock. Hold on a second." He stopped the mobilhab at a stop sign and looked both ways. "This is the sunwing runway. I know we don't have takeoffs and landings scheduled this sol, but it's regulation; we always stop and look both ways."

"Prudent," said Yoshi.

They continued forward along the dirt road. The landscape was flattish and littered with small rocks and occasional dust drifts, but as they moved northward it became more rolling and rockier, with occasional boulders. Lal pointed out a hundred-meter crater nearby that was the source of the ejected rocks. Looming over the landscape, slightly hazy in the dusty air, was the north escarpment, a wall of rock that blocked the lower part of the sky. Their eyes were constantly drawn toward it until Boat Rock and Layercake Mesa crowded it out. Both were studded with wind turbines on top that lazily rotated in a slight early morning breeze.

The road headed straight toward "the Notch" between the two buttes and passed between them. The road turned right and they approached the outpost from the west. Everyone began to watch very closely. Lal pointed. "That's Bangalore; it's a B-75, a dome 75 meters in diameter. The newest of our residential domes. I suspect many of you have flats there. It's followed by Columbia, an older residential B-60, then Colorado,

then Huron, a B-50. Behind them are Kauai, Dakota, and Shenandoah. East of Huron are our original two B-40s, Riviera and Yalta, with Shikuku and Catalina north of them. Yalta's our commercial center and the cafeteria's there; Riviera's the administrative center and Catalina has our school, university, and hospital."

"And the agricultural domes are north of the residential ones," added Forest.

"Mostly; Caribbean and Missouri, our huge B-160s, Oregon, a B-60, and Cochabamba, a B-75 residential," replied Lal. "We're already clearing the ground for two more B-160s. It's getting confusing to keep track of all the names."

Yoshi pointed. "I see the western sides of the domes are still covered; is that for insulation?"

"Yes, the sun's low in the east, so the western sides of the domes don't have to be open. The insulating blanket is silvered as well and reflects sunlight downward onto the plants and buildings; that helps make up for the lower level of insolation here on Mars."

Lal slowed the mobilhab, then turned left to head for Aurorae's Arrival Hall. He slowed the vehicle to squeeze it carefully into a vehicle airlock; it barely fit. The door closed behind them and latched tightly into place, then the airlock pressurized. A minute later the inner door opened and Lal drove the mobilhab into the arrival hall.

"Here we are; welcome, everyone, to Aurorae Outpost! As you file out, watch for your buddy, who should be waiting to greet you. He or she will escort you to your flat and answer any questions you have. You have the morning free. Lunch at the patio starts at 11 a.m. This afternoon you have an orientation at Mariner Institute of Technology in Catalina. Thanks, everyone." Then Lal rose and opened the hatch.

Forest and Yoshi, seated near the hatch, were among the first to step out. Shinji Nagatami was there to greet Yoshi and the other Zen monks on the flight, but Yoshi turned to Forest first. “My friend, enjoy the morning, take your time, and don’t alienate anyone.”

Forest smiled. “Do I alienate people? Don’t worry; I plan to talk to Elliott.”

“Do you have an appointment? I made one.”

“Well, I didn’t.” He smiled.

“Good luck.” Yoshi turned and walked over to Shinji.

Forest looked for Kent Bytown, the “buddy” for him, Victor, and their two companions on the flight. Bytown, a fellow Canadian, waved. The four of them approached him.

“Welcome to Mars,” he said. “Dr. Rivers, right? Welcome.” He shook hands with Rivers, then shook with the other three, identifying them by name each time.

“You’ve done your homework, Mr. Bytown,” said Rivers.

“Thank you; I always try to know the faces of the people I greet. I hope you had a good flight?”

“Not bad,” replied Rivers. “Rather crowded. We had some interesting animal species on board as well; wild turkeys, pheasants, quail, even raccoons!”

“Yes, for bioarchive. I hear they packed more people into the space this time. Don’t worry, we have a lot more space per person here. I’ll take all of you straight to Bangalore, where your group has its space. As you probably know, the Green Earth Community has six cylinders in that biome for living and working. We’re looking forward to having you join us here.”

“Thank you, though I suppose you know that we have land in Aram Crater; that’ll be our destination pretty soon.”

“So I heard. I’ve been through Aram twice and even have done some geology there; it’s a very significant place, geologically. It’s a good choice.”

“Thank you. I didn’t know you were a geologist; I thought you were in charge of security.”

“Not just security; all public safety, including control of the outpost’s environment. But everyone here has geology experience because all of us get cabin fever at one time or another and go out on an expedition. Most of us try to go out at least a few weeks a year. Some even use up their vacation time that way.” He pointed. “Shall we start?”

“Sure,” said Forest. Kent led them out the north side door into a long east-west tunnel, five meters wide and high.

“This is often called Main Street South,” noted Kent. “It starts at Yalta and runs all the way to Bangalore. Main Street North is about 100 meters to the north and parallel, but it isn’t complete yet. In a few more years we’ll have to start automated bus service to get people around; the outpost is already 650 meters long.”

“Excuse me,” said Forest, interrupting. He pointed to a side tunnel. “This is the passageway to Riviera, right?”

“Ah, yes,” replied Kent.

“I’ll join you later in Bangalore, if you don’t mind; I have some business here.”

“Well, I suppose; you won’t get lost?”

“Don’t worry, I’ve explored this place a hundred times in virtual reality, I know my way around.” Forest handed Kent his luggage. “Can you get this to my flat?”

“Sure, no problem.” Kent was startled by the request.

Forest headed up the side tunnel and passed through the airlock at the end. It took him straight into the biome’s south building; he walked across it and out the revolving doors into blinding sunlight and semitropical vegetation. After months of confinement in a space vehicle, the change came as a shock and he stopped for a minute to savor the verdure. Riviera Biome was beautiful; the plantings were over a decade old and trees mature. Forest was charmed.

But he was not to be deterred. He walked across the “yard,” as the space between the buildings was called, and into the North Building, then up the spiral ramp to the top. Commissioner Will Elliott’s office was a rooftop suite set in the midst of vegetable gardens. His door was open; there was no need for security, as there would be on Earth. Forest stood outside and knocked.

Elliott, 54, was seated at his desk opposite the door. He was a man of average height and build, with light tan skin and rapidly graying hair that still bore a trace of the original black color it once had. He looked up and did not at first recognize the figure in the doorway. “Dr. Rivers, I presume?” he finally said.

“Correct, Mr. Commissioner.”

“I apologize if it took me a minute to recognize you. My office is relatively dark and you are silhouetted against the bright sky outside. Please come in and sit down. Good sol and welcome to Mars.”

“Thank you.” Forest stepped in as Will rose and gestured to a round table near the door.

“Tea or coffee?”

“Oh, how kind of you. Tea, please.”

Will nodded and stopped at a hot plate, where he poured two cups of steaming tea from a slowly-steeping pot. “It’s mint tea; that’s Martian standard, you know,” he said. “Maybe the Green Earth Community will become our source of real tea. For some reason we haven’t devoted resources to that species yet.”

He carried the two cups over and sat opposite to Rivers. “Your shuttle landed less than an hour ago. You got settled quite fast.”

“I’m not settled yet; I saw Riviera Biome and thought I’d come by. We never were able to talk when I was on Earth.”

“No, we weren’t. It is difficult to get to know and work closely with a stranger by videomail or email. You really have to spend a lot of time with them. Every opposition I have all the Commission’s heads of staff meet in a day-long open channel conference, and in that spontaneous, long gathering we get some sense of each others’ personalities, but otherwise it’s difficult. So I have long found that it is better to leave most face to face meetings and negotiations to staffers on Earth; the communication is more effective. But now you’re here and we can indeed meet face to face.”

“And I appreciate the opportunity. I’ve found communication even face to face with your terrestrial representatives to be difficult.”

“And vice versa. There are cultural and ideological differences to overcome. I’m not sure anyone is even aware of them all. Would you say that’s true?”

"Perhaps that's one way of putting it."

"Dr. Rivers, why don't you tell me what your group wants out of a settlement on Mars. I'd be fascinated to hear, and maybe I can help."

Forest was startled by the suggestion. "Alright. The Green World Community—note that we've changed our name—is dedicated to understanding Nature and living in harmony with it. For us, the word 'Nature' starts with a capital letter, you might say, because Nature is as close to God as we can get. We stress this life over the next; the Community believes in reincarnation. We all are part of Nature and we all recycle, you might say, both the body and the soul. Furthermore, not only are we part of Nature, we are its brains, its mind, its consciousness, so we have a responsibility to understand, respect, nurture, and guide. I put the four obligations in this order intentionally; 'understand' means we must use science, 'respect' means we must behave ethically toward nature and each other, 'nurture' means we must love, and 'guide' means we must act responsibly. This philosophy is becoming increasingly popular in Canada, North America, and now all over Earth as well; our membership rolls have been growing fast for the last five years, and especially the last two years. Our original community in British Columbia has been duplicated in Tennessee, Nova Scotia, New Mexico, and now southern Spain. Aram will actually be community number six."

"Though it was the second one planned, right?"

"Yes and no. When we announced the plans to send 25 people to Mars, with more to follow later, we got tremendous publicity and an influx of members. Two of those communities had already been contemplated, but not actualized until the membership for them materialized. We also have 'lay members,' that is, people who do not move into one

of our communities. They visit and make retreats and are often assigned honorary membership to the existing communities. They also donate funds, which have been tremendously helpful in enabling our expansion."

"I can imagine. No doubt, you have heard from many of my people how we would immensely prefer it if your community settled here at Aurorae. Aram is a thousand kilometers from here; rescue and emergency support services will not be easy or cheap to provide. There is excellent land west of here and much of it is low in salinity and in poisonous rare elements like selenium. There are also evaporite deposits, just like in Aram. Finally, we can build a better Marsian society if we don't atomize into little subcultures and communities. We need to be in the position to dialogue amongst ourselves."

"I appreciate your vision, Dr. Elliott, but we are not 'melting pot' people; Canadians in general have long favored the 'salad bowl' approach. We—"

"You misunderstand me, Dr. Rivers. I'm talking about a salad bowl as well. What I'm trying to avoid is every vegetable in its own bowl; that's not a salad at all!"

Forest raised his hand. "We're in favor of a salad as well. We want our ideas to compete with those of others. Don't worry; my people will be visiting here and staying for periods of time, and we hope you and your crew will visit Aram. We have a unique vision of how to treat 'Father Nature,' as Mars has often been called by your own residents. We want to anchor terrestrial life in the very ground of this world; we plan to build lots and lots of biomes, as many as we can. Just as the Dutch drained back the sea, we plan to establish 'polders' of terrestrial life. Yet we also favor a 'red Mars,' one un-terraformed outside the domes; we favor respect of Father Nature by fertilizing him in

pockets with the verdancy and full diversity of Earth's Mother Nature. We look forward to learning, understanding, feeling, and respecting Father Nature. In a sense, 'He' is the complementary principle to the 'She' of Earth."

Will wasn't sure what to make of that. "I understand from Pete Theodoulos that your community has inquired about purchasing its own caravel. Are you contemplating a major migration to Mars?"

"Not of the majority of our members, but we do anticipate bringing many more people here in the upcoming decades; hundreds at least, maybe thousands, depending on how fast the price drops. But Mars isn't our only interest, Dr. Elliott. We'd love to find a near-earth asteroid whose orbit allows easy visits to Earth and Mars and whose composition has both water and precious metals. If it were, say, one or two hundred meters in diameter we'd even consider throwing a dome around it—with your B-160s this is just about possible already—hollowing out a cave inside to place a caravel for housing, and terraforming its surface. The Green World Community could have the first independent world beyond Earth."

Will's eyebrows went up. "An interesting idea to contemplate. Of course, any such colony would be immensely expensive and face massive safety problems, even if you could mine and export tonnes of platinum and iridium."

"I know, that's why we're diversifying our stock portfolio and investing it as safely but aggressively as we can. We hope to minimize our losses. We don't expect Aram to make a profit."

"How long will you stay here on Mars?"

Forest considered. “Personally? I don’t know. Maybe just two years, maybe more. We’ll see how everything goes here and on Earth. Now, Dr. Elliott, I understand that the B-160 we ordered can’t be ready for at least six months. Is there any way to decrease the wait? Because it’s simply too long. I don’t want us to hang around here all that time.”

“I can appreciate that, but we can only make them so fast, and everyone wants one. I gather the discussions about temporary work around here have been incomplete. There are many tasks your people can do, and we’ll pay them standard wages. Agriculture is an obvious example. Since the equipment you’re getting is similar to the equipment we already have and the procedures are the same, six months will give your people a lot of training in an environment where a mistake won’t be fatal. So the delay offers you important advantages.”

Forest scowled. “Well, perhaps, but I really don’t appreciate the delay; indeed, it looks intentional.”

Will shrugged. “It isn’t, and it really is hard to avoid. Mars had 364 people until this sol; in another 2 ½ months it’ll have 627. We have never had such an enormous, complicated expansion before. We have had to double our horticultural area in a two-year period. We have to double housing and work space, and as you know, construction on Mars is complicated; we have to lay concrete foundations in Martian conditions and construct airtight structures.”

“Well, you don’t need to double your horticultural and housing spaces, because we plan to build our own. We’re just asking for the materials that are needed to house and feed us so we can do the work ourselves. That’s fair, isn’t it?”

"Sure, but a B-160 feeds 100 people and you only have 24. The other 76 live here at Aurorae. So the B-160 is needed here."

"Well, suit yourself." Forest raised his cup and drained it. "Tea cools off fast here; but then, I guess it starts with a lower boiling point. It's good to meet you, Dr. Elliott. I'm sure we'll have more opportunities to talk." He extended his hand and they shook again. Then Dr. Rivers stepped out of the office. Will watched him go and wondered what sort of trouble to expect.

The three habitation modules of Lufthansa Space Express hit the upper atmosphere of Mars at 21,000 kilometers per hour and streaked across the planet's predawn sky. Inside the trio of spacecraft, forty-eight passengers and three crew were strapped into acceleration couches, enduring up to two gees of deceleration as the spacecraft dipped to within twenty kilometers of the planet's surface. In a minute and a half the vehicles rubbed off over 3,000 kilometers per hour, rising out of the atmosphere and into an elongated orbit around Mars.

Within hours they were closing on Embarcadero, Mars's interplanetary transit station. Sandra Smith, age 27, soon noticed the collection of vehicles and structures through her room's porthole. She called over her husband, Henry, 28, to see, and he called over their friends; six of the twelve Mormons on the flight were in their hab. The three young couples crowded into the tiny room and took turns looking out the porthole at a large structure floating in the distance.

"So, that's the 'Spirit of Mars,'" exclaimed Sandra.

“Mars’s Statue of Liberty,” agreed Henry. “I gather they just inflated it a month or so ago. They had to rush to have it ready for the arrivals.”

“Is it male or female? I can’t tell,” commented Bruce Cowdrey.

“It’s ambiguous,” agreed Henry. “Intentionally, I think. With a rocket flame under his or her feet and arms raised in welcome. Pretty impressive.”

“Especially as we get closer,” added Anne Morris. “But I’m amazed how many modules are at Embarcadero; I count a dozen.”

“Most of them come from Columbus 10,” replied Henry. He pointed. “That big, round, flying saucer is the caravel *Intrepid.* It had the two axial modules attached to it with four annexes each during the flight. That complex flew 116 people here; twice the number ever flown here before. The two annexes floating over there are probably the modules flown out by United Spaceways.”

“I thought the annexes were being flown to the surface to serve as housing?” asked Sandra, puzzled.

“Those are probably just the meteoroid shields,” replied Henry. He tapped the wall next to him. “These things are quadruple thick; three annex shells inside each other, each airtight, with a meteoroid shield on the outside.”

“It’ll take six months to fly all the annex bubbles down, though,” added Bruce. “The transportation system is stretched.”

“What’s that over there?” asked Sandra. “Another caravel?”

“I think it’s the caravel *Courageous,*” replied Bruce. “It and the *Intrepid* depart for Earth in a week to take the tourists home.”

Sandra whistled. “I am amazed at how complex this place is getting.”

“That’s why we’re here,” said Henry. “The Lord’s work and business opportunities.”

“The Lord’s work is going pretty slow, though,” said Bruce. “This is not a very receptive population.”

“Not yet; keep making friends,” replied Henry. “These are remarkable, intelligent people. And even one new member will energize the folks on Earth.”

“I just hope our businesses can be accepted,” added Alistair Morris. “We’re ‘parachuting’ into a completely formed society. Establishing businesses won’t be easy, either.”

“We’ve got a great support team, so don’t worry,” replied Henry. “It’ll all work out just fine. Just you see.”

2.

Welcomes

May 2055

The spaceport at Aurorae Outpost was busy every sol from ten weeks. Columbus 10 arrived on February 17 with 116 people; United Spacelines flew 24 more to Mars on April 15; and Lufthansa aerobraked with 48 more on April 28. Mars had three Hermes-class shuttles, each capable of flying fifty-seven people to the surface; its six smaller shuttles were configured to haul thirty tonnes of cargo per flight. Almost every sol a shuttle either took off or landed. One or more flights would bring down passengers, then the remaining staff at Embarcadero would prepare the pressure shells, life support systems, and furniture of the annexes for deorbiting. Every flight back up to Embarcadero was full as well with cargo destined for Earth, Earth orbit, or the moon: gold, platinum group metals, nitrogen destined for lunar agriculture or manufacturing, argon for ion engine propellant, Martian beef for tourist hotels in low Earth orbit, copper, deuterium, fossiliferous Mars rocks for science stores, and light manufactures. Thirty people, including a dozen tourists, flew up on April Fools Day. The next sol they set out on an eight-month flight for Earth via the inner solar system. They would be monitoring fifteen annexes that were transporting cargo back to Earth and completing one of he caravels. Three shuttles, returning to Earth for servicing, would serve as tugs in case crew needed to travel to any of the unstaffed vehicles in transit. The twenty vehicles flew back to Earth in a drawn-out caravan that took fifteen sols to launch and would take thirty days to aerobrake into Earth orbit. Monitoring all twenty vehicles, delaying the launches of any with minor problems and accelerating the launch of others, fueling and checking out the

lifters that propelled them to Earth, refueling the lifters at Embarcadero for another trans-Earth injection, and making sure all of them were on the right trajectory, exhausted the spaceport staff and stretched support efforts in Houston.

The last group of arrivals landed on Mars on April 30; many were geologists who had spent two weeks exploring Phobos and a week on Deimos, mostly to hone their skills and prepare for future asteroid missions. Among them was Sebastian Langlais, 63, the former head of Columbus 2, who had returned to Mars in his retirement. As the mobilhab carrying him and several dozen other arrivals approached the outpost's arrival hall, he stared in amazement at all the domes and buildings. When the vehicle passed through the airlock and entered the outpost he felt a rising tide of excitement.

The door opened and they all began to step out. Sebastian searched the crowd for his son Helmut, 33, and at first didn't recognize him. He had changed a lot in seven years.

"Oh, there you are!" he said.

"Dad!" exclaimed Helmut, a shout that could be heard across the room in spite of the din of the crowd and the thin air. He pushed through to his father and they embraced.

"You're a sight for sore eyes, dad."

"So are you. I can't believe how much of you've changed and matured. . . it's quite something." Tears streamed down Sebastian's cheeks.

"Come on, Clara's waiting with Charlie. Let me grab your stuff." Helmut reached down to take his father's big, bulky suitcase. They pushed through the crowd to the rear, where Clara stood holding their shy seventeen-month old son.

“Clara, it’s good to meet you face to face at last.” Sebastian embraced his daughter in law, then kissed her. He took his grandson. “This is your grandpa, Charlie; how are you?”

The little boy burst out into tears. Sebastian handed him back to Clara.

“He’s going through a phase of adjusting to strangers,” explained Clara.

“Oh, that’s alright. He doesn’t know me yet, that’s all.”

“Welcome to Aurorae; or maybe I should say back to Aurorae,” said Clara.

“Thanks. It’s really so different, it’s just about unrecognizable. We had no biomes back then; just three habitats and some greenhouses. In the middle of the mission we built the Geology Building and it was our first construction of native materials. None of this.” Sebastian looked around the large room, which was designed for vehicles to drive right inside for loading, unloading, and maintenance.

“You must have some sense of the place, though, with all the video,” exclaimed Helmut.

“Of course. I’ve done virtual reality walkthroughs a few times. But as good as that technology is, it isn’t the same thing as reality. I’ve been ‘in’ this room several times virtually, and it doesn’t look the same. And I didn’t recognize you at first, Helmut; the video image just isn’t the same. Your face has filled out.”

“I’ve put on ten kilos, I’m afraid.”

“I’m surprised that’s okay up here.”

“Well, we’ve all had creeping waistlines in the last few years,” replied Clara. “There’s more sugar in our diet now, and a bigger variety at all meals, not just nights and weekends.”

“How was the flight?” asked Helmut, repeating a question he’d asked before.

“Not bad. It was really special to see Deimos again; I was the first person to set foot there. I got to give a reminiscence one night to the crew. And I had never made it to Phobos on Columbus 2, so it was great to visit it. But flying over either moon, one is struck by the absence of areas lacking footprints.”

Helmut nodded vigorously. “Amazing, isn’t it? Someone has stepped on literally every hectare of both moons.”

“It’s a bit sad, but inevitable,” agreed Sebastian. “So, I have a flat near you.”

“The next cylinder over,” agreed Helmut. “Seconds away, but still next door.”

“That should work well. I don’t want to interfere.”

“Dad, we want you as part of the family, don’t worry,” said Clara. “Charlie will be real lucky, not many kids up here have grandparents.”

“Actually, he’s the only one!” said Helmut. “And God willing, if Kristoff makes it here on Columbus 11, he’ll have an uncle here as well!”

“It’s pretty likely, I think. Kristoff’s skills are strong,” said Sebastian. He looked up and saw Will Elliott approaching. He smiled. “Now there’s a sight for sore eyes.”

“Sebastian, good sol and welcome to Mars.”

“Good sol to you, my old friend.”

Will embraced him. “It’s been sixteen years.”

“We’re older and wiser. You look pretty good.”

“I have two soft plastic lenses in my eyes, but otherwise I’m intact. You’re doing pretty well, too.”

“I dye my hair,” confesses Sebastian. “Otherwise it’s all white. But my heart’s doing well, and I’ve had nothing cut out yet.”

“It’s all too common, isn’t it? Professional hazards. But it must be great to be with Helmut and his family.”

“It’s marvelous.” Sebastian looked at Helmut, Clara, and Charlie. “I guess I get my citizenship in my third country; Germany, then the U.S., and now Mars.”

“We don’t have citizenship yet, just residency,” replied Helmut. “But it feels like citizenship.”

“We’re so isolated,” added Will. “We may live to see this place become an official nation. I just wanted to stop by fast, Sebastian, and welcome you. Get settled and take your time; we can talk in a few sols.”

“That’d be good. I want to settle in, fill my wallet with some redbacks, overcome my culture shock, and get to know my grandson.”

“Good luck finding the redbacks; the ATM machine at Silvio’s store is always empty because everyone’s thrilled to be able to get them. We’ll talk about assignments in a few sols. I have an idea.” Will reached out and they shook hands. Then he headed across the room to welcome someone else, while Sebastian and his family headed for Cylinder 6, Flat 2B, Columbia Biome.

The next sol, May 1st, Mars had as many people as it would have for over a year: 632, including those in orbit and located at the outposts of Aurorae, Cassini, Dawes, Meridiani, and Thymiamata. Over 500 of them were at Aurorae and they gathered that evening to attend the gala welcoming dinner held every columbiad after the arrivals had

all landed. Yalta Biome was packed with tables and chairs filling the eastern and western courts and the "yard" between its north and south buildings; it barely accommodated everyone. The crowd was reminded of the location of the biome's four exits in case of emergency. The event was broadcast to the other outposts, to Embarcadero, and to similar gatherings in Houston, Paris, Berlin, Moscow, Tokyo, Beijing, New Delhi, and Brasilia; the terrestrial locations held offices of the Mars Commission and among its employees were many who aspired to fly to Mars on Columbus 11, due to arrive in May and June 2057. It was the first time meals were served simultaneously at the terrestrial locations.

"This is really incredible," said Madhu Gupta-Anderson, looking around Yalta. "There's never been a crowd in here like this! It's so tight there's no room for the food lines!"

"It's amazing," agreed her husband, Roger Anderson. "It's also clear that Yalta won't be large enough to feed everyone any more. If Aurorae gets any bigger, we'll have to have two places to eat, or one much larger cafeteria."

"We can't continue eating in one place forever," replied Érico Lopes. "But who would have thought the sol would come so fast! I remember when we finished Yalta and first moved in."

"Just a decade ago," agreed Carmen Lopes. "I never thought we'd outgrow it."

"Still, looking at the crowd, I have to confess to some uneasiness," said Érico. "It's the most diverse group we've ever had."

"Who would have thought that travel to Mars would have gotten cheap enough for the Gambia to send two people," agreed Roger. "Not to mention Bolivia, Jamaica,

Paraguay, Swaziland, Botswana, Cameroon, Tanzania, Tunisia, Jordan, Afghanistan, Kyrgyzstan, Burma, Bangladesh. . . it's really amazing."

"I must confess, though, I am worried about the religious diversity that the cheap tickets has allowed." Érico paused, then added. "No offense meant, Father."

"Oh, none taken," replied Father Greg, who was wearing his Catholic priest's collar that night, partly because he enjoyed the surprise when people saw a Catholic priest with his wife and two children, aged two and four respectively. "I must confess to some hesitation as well. The groups that arrived were the ones with the desire for publicity, notoriety, or the ones with strongly held views. This is to be expected, but it certainly will make interfaith devotions interesting, and dialogue complicated."

"Will we be including everyone?" asked Roger. "Like the Universal Church of Jesus Christ the Creator, and the Green World Community?"

"The Universal Church has so far declined our invitations on the grounds that praying with others could compromise the integrity of the true church," replied Greg. "I think in a few months they'll come around, though. The Mormons are delighted to be involved. The Zen monks will offer prayers and chants; they were very gracious. The Green World Community, interestingly enough, seems willing to view itself as a religion, sort of, and not just as a communally living society, and they've offered readings from Forest Rivers' 'Green Book.' It'll be the first time we'll be reading something roughly equivalent to scripture when the author is present!" Greg laughed, amused by the situation.

Roger was less amused. "I think it's a bit crazy, myself."

Greg shrugged. “Our interfaith organization has to accept something as a religion if the followers feel that is what it is, unless the organization is engaged in unethical behavior. The Green World Community is an ethical group. I doubt the interfaith group can expect some sort of commonly accepted definition of divine revelation from its steering committee, or a definition of what is a religion and what isn’t.”

“I know,” growled Roger, who was one of Mars’s leading evangelicals.

“I’d worry more about the ethical behavior of the Mormon group,” replied Érico. “Yestersol I stopped to talk to Bruce Cowdrey for a few minutes and he was so sweet and nice to me, I felt love bombed. And then when we talked about their plans, he said they’re going into agriculture and sales and they plan to open a store next week. So Silvio’s can expect competition.”

“Where will they open it?” asked Madhu, looking around.

“Not in here, obviously,” replied Érico. “That means the commercial zoning that restricts businesses to this biome will have to be amended.”

“Hum, that’s complicated,” added Carmen. “The Mormons don’t worry me much; I think we can handle them. But the Universal Church people are not well educated and have very narrow views about the Bible. I was talking to one of them two sols ago and she was quick to bring the subject around to biblical prophecy, as if anyone takes *that* seriously!” She chuckled. “Oh, no offense again, Father.”

“That’s okay.”

“I don’t mind them though,” replied John Hunter, their Lakota Indian geochemist, who sat at the end of the table with his Maori wife and their two children. “I guess I’m used to that sort of person, growing up.”

“So far, only the Zen monks appear to be universally cool,” added Father Greg. “That sounds like a trivialization, but I mean it sincerely; they really are nice people and easy to talk to, when they understand your English at least.”

“And what about the Shi’is?” asked Érico, turning his face toward a table nearby where sixteen Iranians sat. A few of the women wore head scarves; the rest had adopted the new Martian fashion of wearing large hats that disguised radiation shields, and they invariably had their hair tucked underneath them. Their clothing was modest, but was covered with anti-radiation layers as well. Attractively colored sleeves and pant legs modestly covered their extremities.

“I think they’ll be okay,” replied Greg. “They’re making an effort to fit in, and Ruhullah is spending a lot of time with them to help them adapt. They’re anxious to participate in interfaith activities.”

“It’s important to note that these five groups have no more in common with each other than with the rest of us,” said Anna Racan, Greg’s wife and a former nun. “The Green World Community is the biggest one, with twenty members. The Catholic parish here has seventy registered members. The Protestant groups together have fifty. Don’t count them up and say we’re getting sixty religious people. Columbus 10 brought more mainstream Catholics and Protestants than that.”

“And a lot of young people,” added Greg. “That’s what’s struck me about the arrivals; they’re young and enthusiastic. They graduated from university, came to Houston or another city with a major Commission center, worked for us and got their Master’s degree over four years, then applied to fly here. So here they are, 26 to 30 years

old, bright, educated, often married and ready to start a family; what a marvelous group to have come here."

"And this flight included two older families with children," added John. "That amazes me."

"The systems reduce the radiation exposure adequately now," replied Érico. "It's good to have the interplanetary routes open to children over age 14. I think we'll approve lower age limits in the future, too."

Will Elliott approached the table. "How are all of you?" he said. He looked at the crowd. "Isn't this something. This biome is actually getting stuffy. The crowd's putting out 50 kilowatts of heat and consuming twenty kilograms of oxygen an hour in here."

"Thank God Yalta has a half tonne of oxygen!" replied Érico. "This is a strain on our system, though."

"Environmental Control has the connections to Catalina and Cochabamba biomes wide open and strong fans circulating air back and forth, and all the CO_2 scrubbers are working overtime. They'll mist this place at 3 a.m., too, to wash smells from the air. That'll handle the strain. But I look around at the diversity in here and I am just amazed. Mars is now a real cross-section of humanity."

"Let's just hope we can manage our social relations," said Érico.

"Oh, don't worry, we'll do fine," replied Will. "This makes me feel very optimistic. But I've got to get on the stage to start the program. Talk to you all later." Will headed across the floor, squeezing between the tables, stopping to chat with friends and new arrivals, feeling more and more charged up. At one point he stopped to talk to Yoshiyaki Suzuki, who was sitting with the rest of the Zen monks. "I checked with

Alexandra. You did indeed get in your request for a dome before everyone else, including our own environmental management people. So the monastery will get the next one. It'll be ready in June."

"Remember, we want it without the floor, and we need extra plastic for the exterior pressure skirt."

"I know, and a hundred tonnes of water. There's no guarantee this idea will work. You may find your dome leaking downward so much that it just isn't worth the effort."

"Perhaps, but this will allow us to excavate housing downward and outward. It gives us nearly infinite possibilities in a relatively small space. And all the computer models, I understand, indicate that freezing the ground underneath the dome should reduce oxygen loss to ten kilograms per sol or less. We can make that much oxygen with our CO_2 reducing unit."

"True." Will sighed. "I wish you'd build the monastery down here, attached to the outpost. But I know your plans."

"The top of the escarpment near the Dacha should be quite safe, and much more conducive to our meditation."

"I'm sure. Well, I need to get to the stage." Will smiled and nodded, then headed on across the patio. His last stop was at the table of the Universal Church and Reverend Tuesday Nah. "Did you enjoy the dinner?"

"Yes, Dr. Elliott, it was delicious," replied Tuesday. "And I have talked further to Alexandra Lescov. I think all of us will be fully employed in construction and fabrication. We have some valuable opportunities to learn how to use the outdoor equipment."

"Excellent, I'm glad that's resolved. I told you it could be done. Well, I need to get on the stage." He continued across the room, then bounded onto the stage and walked to the podium in the middle. The crowd immediately began to quiet.

"Good evening everyone, and welcome to Mars," he began. "When I look out at all of you, gathered in this very crowded place, my heart swells with pride for what we have done for Mars, and I feel a rush of anticipation when I think about the future. The numbers alone are quite remarkable. Nineteen years and two months ago, six people landed here at Aurorae. When we thought about the future then, we speculated that perhaps Mars would have one hundred people by the end of the century. We could not have imagined that 100 would be achieved in less than fifteen years. A decade ago we might have speculated that 1,000 people would live here by the end of the century. But this sol Mars has over 600, it can anticipate about 75 births in the next two years, and with the arrival of 300 more on Columbus 11, Mars will probably have 1,000 people by 2057. No one would have believed that possible. How many will be here in 2100? Dare we speculate?

"The growth of the population on Mars has been matched by a shrinkage of workers on Earth. Columbus 1 had a work force of about 20,000; a ratio of 3,000 terrestrial workers to 1 on Mars. With Columbus 10, we have 600 here and 2,000 on Earth. The steady growth of the population here will be matched by a shrinkage there as more and more of the support jobs are moved here or phased out. We have far more experience and expertise here than we had ten or almost twenty years ago. Our people can do more. As a result we are designing our own spacecraft and biomes.

“We have sunk roots deeply into Martian ground. The greatest proof is our children. Marshall Elliott, our oldest, is now 15. Because a typical couple waits two or three years after they arrive before having their first child, and two or three more years before having a second child if they have another one, we can predict that many of the first children of Columbus 9—which involved 96 people arriving here—will be born in 2055 and 2056, as will some of the second children of Columbus 8, which brought 72 more arrivals. Our school now has grades kindergarten through nine, plus sixty people studying for Masters and doctorates at Mariner Institute of Technology. The gap between grade nine and grad school will soon be closed.

“Our economy has now grown sufficiently that we can actually speak about having an economy. The notion would have been ridiculous during the first six years here. Yet our operation has grown so complex that we have had to print ten million redbacks to provide everyone with the cash they need.

“The annexes and automated cargo vehicles returning to Earth are hauling back almost 500 tonnes of cargo, a new record for us, and a match for our record-high imports. The exports will be worth six billion redbacks and will completely cover the cost of our terrestrial operations, including the research and development we fund. Forty percent of that value doesn’t belong to the Commission, but rather to companies operating here under a contract with the Commission. But the profits they make are not lost to us either, because they plow some of it into research that benefits us indirectly, and their profits drive up the demand for Martian land. If our gross domestic product were thought of as six billion redbacks, we would be larger than many of the smaller members of the United Nations. It may be that Mars will join the United Nations in this century, who knows?

"Domestically, the average worker here earns a salary of 500,000 redbacks per year. A third of it goes into mortgage payments that stimulate the construction sector and another third goes to taxes and health insurance that helps pay for our schools and hospitals. Altogether, our domestic economy of a half million times 500 workers totals 250 million redbacks, a significant sum as well. Until now we have had very few businesses and very little production of consumer goods. The remaining third of our incomes was either squirreled away in bank accounts on Earth or spent on expensive consumer goods that were imported at high cost. But the arrival of five communities, from Canada, Iran, Japan, Nigeria, and the United States, will probably change that drastically, as many of them plan to open businesses.

"Our growing complexity makes it very difficult to state priorities for the upcoming columbiad. For a third of our people, the priority will be to adjust to a new world and figure out how to earn a living. Businesses will be started and some will fail. There may be bankruptcies. We may even see a business cycle emerge with unemployment. Some will be setting up an independent outpost. For the two thirds of us who work for the Commission, there will be other adjustments. Some of our work may be privatized. The overall result, we hope, will be greater efficiency without causing suffering on the part of all of us. Mars has prided itself with being a family-friendly place and we want to continue that, even improve it.

"You know the Commission's priorities, but they bear repeating. Exports will increase, especially of deuterium and platinum-class metals; the latter will increase five fold. Gold production should grow slightly even though the deposits being recovered are less concentrated than the earliest lodes. Two teams of twelve workers will build oases,

ten or eleven per year per team. The oases, every 700 kilometers along the Circumnavigational and Polar Trails, will greatly simplify further surface exploration and will allow children to accompany their parents into the field. Exploration goals focus on exploring neglected areas and pursuing specific research projects; we have now visited all major geological units on the planet and cleared dirt roads that give us access to every region.

"Construction and fabrication have two large projects to pursue: manufacture of domes and caravels. This columbiad we will complete the design of a B-160, a dome 160 meters in diameter, able to hold in a standard atmosphere. That will complement the low-pressure agricultural B-160s we've had for two years. We plan to erect six B-160s, three for farming, two for housing, and one for Bioarchive. We also anticipate completing two caravels this columbiad, one for us and one for NASA.

"The big exploration goal is the Ceres project, which leaves in two years, makes stops at two asteroids on the way, visits the largest body in the asteroid belt, then returns to Mars five years later, visiting several asteroids on the way back. The mission is ours, but it's in cooperation with three space agencies, all of whom are launching swarms of asteroid probes. This decade will see a wholesale assault on asteroids, with as many as twelve nations and two private corporations considering crewed expeditions to them. Most missions will not go to the asteroid belt, but Mars will be the departure or return point for those going to the belt. We will also play a role in expeditions to Jupiter and the other outer planets. So Mars is emerging as a key player in the exploration of the solar system. This is how it should be; we are a world of professional explorers.

"On earth, for thousands of years the basic unit of civilization was the village, a civil unit of 500 to 1,000 people. Mars has now grown to the point where it has a village.

In a decade it will have a city and several villages. In short, we have reached the point where we can legitimately claim to be a culture, society, and civilization of our own. Humanity is now a two-world civilization. Though we are still small, we have an immense potential. We have already been an example to millions that a truly international, peaceful, prosperous society is possible. Our contribution to humanity can only grow. How quickly it grows, and how influential it becomes, is partly up to all of us."

Will stepped down from the podium to powerful applause. At the two tables of members of the Green World Community, Victor McLeod leaned toward Forest Rivers, "So, we're not the only utopians."

Forest looked at him, surprised. "Of course not! Mars attracts utopians! We are a utopian community inside a utopian community! Utopia drives the settlement of this place! The b.s. about a family-friendly Mars is just middle class utopianism!"

"It's playing fairly well."

"Combined with massive government subsidies and the fortuitous discovery of gold. We're here because this place is utopian. Our community gets more publicity and is treated more seriously because it has people here. Wait till we get to Aram; then we'll have a real utopia."

"Too bad we can't get there before September."

"September! Hah! We don't need a dome to get started. No, I want us there next month. Next month."

3

Challenges

early May, 2055

Even though the next sol was Satursol, Will went to the office. He usually worked half a sol on Satursols, especially when it fell on a working day on Earth. That morning he was surprised by several videomails from his colleagues in charge of other planetary facilities. He was pleased to see a message from Rick Page, the head of the Lunar Commission. Rick had been a member of Columbus 3 fifteen years earlier.

"Will, good sol. You're good at gazing into your crystal ball! Your speech was well received. A lot of people are beginning to speculate about the future of the moon. I have to congratulate you; Mars has now decisively pulled ahead of us. Until six years ago we were bigger, but then gold gave you a surge and the worldwide depression sharply cut our tourism and water exports. We've now exceeded 200, but no one is a permanent resident, though we have some staff who have spent as much as two years straight up here. I suspect our population will decline to 150 over the next few years; lunar geological research is going through a dry period, water exports are more automated to compete with the declining costs of Swift shuttle launches, and tourism has plateaued. If we only had the nitrogen and carbon you have, we could manufacture plastics. On the other hand, our platinum extraction is producing a lot of waste nickel-steel, so we can expect growing exports to low Earth orbit. Demand for water will exceed a thousand tonnes this year.

"But I'm rambling. I hope all is well with you. Say hello to Sebastian; we miss him. We'll contact Yevgeny soon with an estimate of our methane needs. Bye."

Will hit reply. “Good morning, Rick, and thanks for the call. I’m still amazed Mars has over 600 people. It’s a miracle and means that social forces are in motion that the Commission can no longer control or direct. The time for rethinking the Commission treaty is coming in a decade or so; Mars will need more self-determination. Ruhullah and I have started thinking about devolution of more responsibility from the Commission to the borough councils or the Mars council. It’ll be hard to avoid once the Green World Community sets up its own borough at Aram, since there won’t be any Commission employees there. Let us know how much methane the moon needs; we’ll be glad to send it! The increased production of Phobosian liquid hydrogen for solid-core nuclear engines creates surplus oxygen that we burn with carbonaceous chondrite to make carbon dioxide, and we use it to make methane-oxygen propellant for export.

“I hope you and your family are well. We’re fine up here. Keep in touch. Bye.”

Will sent the message and turned to the next videomail, from Sheila Duchamp, Commander of Magellan Station in Venus orbit.

“Will, good sol. That was a great speech last night. I wish we could predict our expansion here. The Venus-Mercury Commission still won’t commit to buying a caravel, which in our opinion is what we need to raise our crew safely to twenty. We do the best pure science around; we’ve got a huge planet to explore remotely from orbit, and the technology to deal with the heat and pressure is finally getting pretty good. An automated base on the surface is our next goal, where we can use robots to repair rovers and install or remove nuclear power sources. But with a dozen folks, how much can we do? So push the sale of a caravel, please! I hope all is well. Bye.”

"Hi Sheila," Will replied. "I've been following the proposal for a robotic base on Maxwell Montes. It's a great idea. The robotic technology is now mature, especially if nuclear powered air conditioning reduces the temperature of an interior repair facility somewhat. Of course, the air conditioner will need a liquid sodium loop to remove the heat! Your serious, in-depth study of the mineralogy and petrology of the Venusian crust is discovering geochemical processes no one could have imagined. I was impressed by the spinoff papers on thermal metamorphic processes on Earth. We can probably predict that someday mining of Venus minerals will begin, especially if atmospheric deuterium harvesting gets cheap enough to be competitive. You should have some good gold deposits and tellurium extraction is promising. So I am very optimistic about the future of Magellan Station. Who knows, eventually it might even be economical and safe for people to land and explore.

"We've offered a caravel to the Venus-Mercury Commission twice. I suppose it'll buy one eventually; keep up your calls to politicians, they have to provide the money! It's a shame Venus research is regarded as an esoteric luxury; you need better public relations. Why not sell plots of Venus land to the public around the robotic base; you'd generate income and publicity. Good luck. Bye."

He sent his reply and decided to make it three for three; Patrice Dumkowski, Commander of Concord Station at the Mercurian north pole, had called as well. Patrice had been on Columbus 3 as a climatologist, an utterly useless background for Mercury exploration. But Patrice had fallen in love with the place, had no family, and had stayed two years so far. He hit play.

“Good sol, Will. I just wanted to congratulate you for a great speech; it had historical depth, futuristic vision, and was optimistic and uplifting. It should inspire the folks there. I can’t believe Mars has over 600 people. When you said that, I gasped. Concord now has eleven and we’ll reach fifteen in 2057. The two-cycle service term is working pretty well. Direct passenger flights from earth using solar-ion propulsion augmentation worked pretty well. I hope those flights have cleared the way for Mars cargo flights via Mercury. Come use our gravity well, please! Just leave us some nitrogen and argon in return.

“Not much to add. We’re telerobotically visiting a volcanic field in the southern plains next month with twelve rovers. The automated road-clearing unit is half way to the equator and should reach the south pole early next year. God willing, once it’s finished we’ll drive a crew down the road during a Mercurian nightspan all the way, setting up regolith-covered emergency shelters as we go, just like your oases. We’d like to have access to both poles, and eventually we want a network of north-south and east-west trails that give people access to everything at night or during twilight. Meanwhile, we’re bringing samples back overland and getting a pretty good grasp of what this world is like.

“Best wishes for the upcoming year. Ideas and advice welcome, as always. Bye.”

Will always enjoyed hearing from Patrice; they had started exchanging messages monthly. He hit reply. “Good sol, Patrice, and thanks for your call. I love to hear what you’re doing on Mercury. Just keep pushing the machines forward and pushing the politicians for more support. You’ve got more water and helium-3 than the moon and less cosmic radiation than Mars! The solar sailing cargo ships should make imports and exports cheaper. I’m sure Mercury has an important role to play in humanity’s future.

"We got an order for argon propellant just a month ago; we're glad to be working with you. Best wishes with everything and keep in touch. Bye."

He sent the message, then turned to other items in his in-box. Louisa Turner, the Mars Commission's Media Director, commented on his speech and the talking points, which they had discussed ahead of time. Press releases and human-interest stories were being scheduled to reinforce the main points; among the arrivals was a full-time assistant media director on Mars to improve coordination of the message.

There were reports from several directors or assistant directors of the Commission on Earth. He listened and acknowledged them. Rick Page called back with a question about the Mars Commission's review of a plan to set up a Gateway Commission to oversee the now dozens of vehicles and habitats orbiting around the Lagrange 1 point where the gravity of the Earth balanced that of the moon. The number of objects had grown large enough that they were occasionally shadowing each other's solar arrays, and debris was orbiting around slowly, threatening to collide with equipment. Will forwarded the question to the task force members; the Mars and Lunar Commissions were the two largest users of Gateway, but it was also the launching point for missions to Venus, Mercury, and the asteroids, and for most unmanned probes. Telescopes of various sorts residing at the Earth-Sun Lagrange 2 point, where the Earth's shadow shielded them from solar heat and radio output, were first assembled at Gateway and floated back years later for servicing. For the last year it had continuously had a staff of four.

When he looked up, he was surprised to see Sebastian Langlais standing in the doorway.

"Can I come in?"

“Sure, come on in. I was just handling routine messages.”

“Thanks.” Sebastian entered; Will pointed to the table and chairs near the door and rose from behind his desk.

“All I can offer you is mint tea. I don’t make coffee on Satursol mornings.”

“That’s fine; I like it. It makes me think of my visit to Morocco, as well as reminisce about Columbus 2.”

“It’s been the staple hot drink here since the beginning; mint is so easy to grow and is so indestructible, and comes in various flavors.” Will carried two cups to the table and sat. “Did you enjoy the cultural program last night?”

“Yes. I liked your speech and see it has gotten pretty good press.”

“This one was carefully planned, rather like a State of the Union address, complete with talking points and a schedule of follow-up publicity. On Monsol I’m scheduled to visit the caravel factory with our media coordinator and with two dozen reporters on earth tagging along via video link.”

“That’s smart. The cultural program after your speech will generate attention, too. I liked the Aurorae Oratorio; a nice piece of music. And the ballet was spectacular. I’m glad we now have a professional ballerina.”

“Well, we already had one, in a sense; Madhu had some ballet training. She developed the Martian modifications to make ballet work here, and it looks like they are being kept by Ginger. There’s a growing fascination with Martian ballet on Earth.”

“It’s our first art form. I had a great time dancing afterward; I think people danced until 2 in the morning! I haven’t had that much fun in ages!”

"It was great, though we had to leave a midnight with the kids. After midnight the families all leave and the atmosphere changes."

"Yes, it was a singles event after that time."

"Exactly. Which is fine, but Marshall wanted to stay, and we didn't want him to! He's too young."

"I agree. I think I saw he has a crush on Tabitha Cahill—"

"Yes, I think so. She's a bit older than him; almost 16. But he's never seen a kid his own age before, let alone a *girl*! So he's thrilled. But she's been standoffish."

"Ah, the trials of teenagerhood. I guess it's the same on Mars as on Earth."

"So it appears. I'm surprised you've come to visit so quickly. You just arrived."

"True, but I hate to be idle, and I can always start slowly. Besides, you said you had an idea for a job for me."

"Indeed, which isn't easy; you have a very impressive resume." Will smiled; Sebastian had been head of the Lunar Commission for twelve years. "Our asteroid effort is in disarray. It was never supposed to be an organized effort. As you know, from the very beginning, flights from Earth to Mars and back were timed so that they could either fly by an asteroid or land on one, and the Mars Commission soon acquired far more experience with asteroids than anyone else. Seven years ago we decided that our shuttles were reliable enough that they could be flown to asteroids that flew past Mars during the periods of slack demand, and we have visited four more asteroids this way. We've claimed Quirinus and sold its mineral rights to Muller Mining. We've sent automated probes to thirteen asteroids, including to two Mars Trojans. Then the United States decided to phase out its Project Argo and send people to asteroids via Project Odyssey,

which would involve larger crews and longer missions, as well as equipment designed to explore Jupiter and the outer planets. Then the United States decided to concentrate on sinking billions into construction of a whole new advanced propulsion system and cut the asteroid belt from Odyssey's goals. Meanwhile, we had launched a vehicle with an inflatable hab, solar panels, Prospector telerobotic rovers, a drill, and fuel making capacity to Ceres, where it lands next year, and we designed the caravel and built two. It looks like NASA will use caravels for their first manned flight to Jupiter in ten years. The Chinese will probably use them, too. NASA wants to test the caravels and Congress has barred them from adding asteroid missions to Odyssey, at least for now, so NASA has agreed to send American astronauts to asteroids on our caravels and pay their places. We suspect we can make similar arrangements with other nations."

"So what do you want me to do?"

"Head up an Asteroid Belt Commission, which will be located within the Mars Commission for now."

Sebastian raised his eyebrows. "A separate Commission?"

"Yes. If the Mars Commission establishes a 'Project Asteroid' or such, it'll be perceived as us running everything and selling seats to others. That has limited appeal. An Asteroid Belt Commission that brings contributors to a common table to plan projects will probably garner more support."

"That makes sense. How much money has Mars committed?"

"One billion redbacks. That doesn't sound like much, but as long as we are spending the money rather than giving it to NASA, we can use it more efficiently than

NASA can. Our commitment is exactly of that sort; caravel production, launching and controlling automated probes, mission support, etc."

Sebastian nodded. "Mars is the logical headquarters for exploring the asteroid belt; the energy to go there is half as much as from low earth orbit, and we're the closest major facility. We have an incredibly capable and experienced workforce, so we're ideal for support."

"Exactly. We'll have the same equipment as the explorers and we use it daily, so we understand it and can troubleshoot easily. We have ten new automated asteroid probes on the way from Earth right now. They were produced under contract on Earth at a very good price and they're all identical, so we can repair them easily. They use the standard technology of our satellites and prospectors. We'll be launching them to asteroids throughout the rest of this year and part of next; each one can orbit the asteroid, survey it thoroughly, land, hop about on springs to explore the surface, then leap off the surface and aim its ion engine at another asteroid. They can communicate to any node on the interplanetary internet, so communications are simple. With any luck, the ten vehicles will visit forty asteroids in five years. NASA could not have done that on a shoestring the way we did."

"So what do you want me to actually *do*?"

"How much do you want to be in retirement? I'd like the High Commissioner to be on Mars; I'd like you to take that position. There are two other key positions; mission planner and external relations. External relations will have to have a director located on Earth, but I know you have incredibly rich contacts on Earth and a sterling reputation, so I could easily see a commissioner located on Mars playing a key role in lining up support

among the various national space agencies. The mission planner could be located here or on Earth, but if the missions are departing from here, the planner probably should be here. Even the so-called Ceres mission badly needs a planner; it reminds me of the old joke that a camel is a horse designed by a committee. Ceres is at opposition with Mars in October 2056; that's seventeen months from now. But everyone has been running calculations on the trajectory and what asteroids can be visited on the way, and there are proposals for departures as much as six months early, visits of as many as three asteroids on the way, arrivals up to six months late, and delta-vs as much as 6,000 meters per second, chemical and ion. There is a similar range of proposals for the return trip, which normally would leave Ceres about June 1, 2059, and return here in early 2061. We're now thinking in terms of a five year mission; pretty long, but hard to avoid because of distances and delta-vs. Someone has to impose sanity on the plans and make sure they're reasonable and safe."

"And would there be another mission to the main belt during the Ceres mission, or would it wait until the first ends?"

"An excellent question. After Columbus 11 arrives here in June 2057, we'll have plenty of workers to build new caravels, and plenty of personnel we can spare who will want to go. We probably could launch another mission in 2058. There are launch opportunities every few months."

Sebastian considered for a moment. "A five year mission will require quite a different social structure than our usual missions. There will have to be arrangements for couples."

"Yes, and procedures for weighing the application from a couple fairly and comparing it to applications from single people. It may even be possible to accommodate children on the flight; we have to look at that question very closely. The caravel's magnetic deflector stops all solar radiation and some of the cosmic radiation. If a variable thrust ion engine is developed soon, it will have a powerful magnetic field that can be used as well."

"And who's coordinating all of this right now?"

"I am, and I don't have time! Asteroid-related activities are scattered among various Mars Commission departments. Érico Lopes is director of the spaceport and schedules launches and landings, so he has overseen our manned asteroid missions; we've treated them like missions to Phobos and Deimos. Mars Control is under him, with Rostam Khan serving as chief officer; Rostam coordinates launches of the automated probes and oversees their functioning and data gathering. Our exploration department, run by Roger Anderson, oversees exploration of Mars and its moons and has overseen the selection of asteroids based on their scientific interest and the dissemination and analysis of the data. Caravel development is coordinated by Alexandra Lescov here and Pavel Rudenkov in Moscow. You'll want to decide what positions to create and who to hire. Ask anyone here you want. A lot of my senior people have been in their positions for a decade or more and probably need a new assignment to be more productive."

"And there are lot of senior folks in the Lunar Commission who are looking for new assignments; Rick Page wants his own team." Sebastian nodded. "This has a lot of potential, Will. But do you think the Mars Commission should establish an Asteroid Belt Commission, appoint a Commissioner, *then* seek international support?"

"No. Let's start by calling it the 'Asteroid Belt Project' with you as Director. Then you and I get on the phone and seek support for a Commission. The evolution from Project to Commission will take a year or so. It sounds like we should hire terrestrial managers from among your contacts, since you know them well and can work with them in spite of the communications delays. I doubt anyone would object to you running the Project and Commission."

"Well, I have my enemies; every administrator does."

"Sure, but you have a solid reputation. So, what do you say?"

Sebastian smiled, then nodded. "I'll do it, but probably for only five years. I'm 63, after all. My health is fine, but I was hoping to do some real exploration for a while!"

"We'll see whether we can work more exploration into your schedule, then," replied Will. "Thanks. I think this is an exciting opportunity for everyone."

4

Challenges

mid May 2055

Érico Lopes entered the new reception area and was pleased to see Huma M'barak, the new receptionist, sitting at her centrally located desk. "Good morning," he said to her. "Welcome to the Mars Commission offices."

She smiled warmly; she liked to flirt. "Thank you. I am delighted. And so far there isn't much for me to do. The robotic secretaries do most of it!"

"Yeah, but they need someone to watch them. I find it a bit strange calling Will's old number and seeing the face of an imaginary secretary named 'Anisa' who asks me questions and sometimes even appears to take hand-written notes!"

Huma laughed. "I'm going to deactivate that feature or cut it back; Anisa shouldn't need as much time to process your sentences as the 'note-taking' suggests. The notes come to me by email and they are still not always very clear; we have to tweak the software."

"It'll learn, too."

"Yes. Do you like your office?"

Érico looked at the dark room to the right of Will's office. "I suppose I will once I move in; I think I'm scheduled for tomorrow or the next sol. Is Will available?"

Huma leaned over at a screen to see what it reported. "He's reading email right now and has no appointments for half an hour, and you can walk in anyway."

"Thanks. Will you know what I'm doing, too?"

She pushed an icon on the screen and it switched to Érico Lopes. “It says you aren’t in the office yet, so you aren’t doing anything. That means you must have time to visit the boss.”

Érico laughed. “Thanks!” He walked across the space to Will’s office, located on the eastern end of the building. He had a pair of large windows behind him looking across the park-like end of Catalina Biome and through the dome to parts of the old outpost, then at the Martian desert beyond. The northern escarpment was just visible on the left side of the window.

“Good morning. How’s the new office?”

Will looked up. “Good sol, Érico. I think I’ll like it quite a lot. Putting my desk against the right wall means I can see the door and the escarpment, and it gives more room for a conference table. Come in. How can I help you?”

“I have some data for you from United Spacelines.” He stepped in and closed the door, which was unusual. Will came over to the table and they sat.

“What are they up to?”

“Pete and I exchanged video messages with a rep of the company yesterday. They want to expand their Mars service next columbiad. They’re proposing to fly two pairs of annexes here with 64 people on a 130-day dash to Mars. The annexes would stay here a month and then fly back to Earth in 220 days. They think they can fly tourists for ten million redbacks, round trip.”

“How will they get them here that fast?”

“Lunar hydrogen and oxygen. The delta-v actually isn’t too bad from Gateway via a close-Earth flyby; about 3.5 kilometers per second, so the mass ratio is two. With lunar

fuel down to 700 redbacks per kilo, it's quite affordable. During the flight an ion engine will speed up the vehicles to shorten the transit time, then slow them down the last half of the trip to make the aerobraking easier. The annexes will have the new two-ring aerobrakes that were just tried out on Columbus 10."

"That's the only way to aerobrake at those speeds without crushing the passengers; start with a big heat shield, then fold the outer ring out of the way in the lower atmosphere," agreed Will. "Sounds like they have an impressive plan, though the annexes will be very crowded. I suppose if the flight's only 130 days, it's manageable. Their plan will kill the proposal for a cycler, though."

"Definitely; cyclers can't go that fast."

"And they're too expensive to maintain. Any indication how many tourists they expect to fly?"

"Their goal is thirty-six tourists and a fifteen million redback ticket; that would include a one-month visit to the moon and 1.5 million redbacks to us for a one-month tour of Mars. The accommodations back to Earth would be 'luxury'; the tourists would be the only passengers."

"Can we convince them to buy a caravel instead?"

"They're interested, but not for next columbiad."

"I suspect Lufthansa will have to switch to this faster trajectory, too."

"Yes. Some of our flights to near-Earth asteroids have offered relevant experience. And speaking of asteroids, is it true you've offered Langlais a position in connection with asteroid exploration?"

Will sensed that was really why Érico had stopped by. “It’s not public, yet; what did you hear?”

“Maybe it’s more public than you think. There’s a story on the web that you and Sebastian are starting an Asteroid Belt Commission; that he’s contacting governments with the idea.”

“Really? I suppose the leak came from a national space agency official. It’s basically true. Sebastian has incredible contacts in the various national space agencies; there are thousands of people who know him well, face to face. He’s the logical person to break the ground and propose an Asteroid Belt Commission, which we’ll initially run through the Mars Commission.”

“Who’s going to run the Asteroid Belt Commission?”

“I’ve. . . offered that job to Sebastian as well. Of course, it isn’t up to me to decide. The ABC will have a Board of Governors consisting of national representatives and a Mars Commission representative; they’ll decide who directs it. But Sebastian will be acting Director until the Board is formed and can meet.”

Érico nodded. He hesitated; there was anger on his face. “And why did you give the job to Sebastian without consulting anyone else or considering alternatives? The asteroid exploration project has been basically part of the spaceport for the last few years, so it’s been my responsibility. Will, I can’t begin to tell you how angry this makes me. I told Carmen I thought it was time for us to consider retirement and moving back to Earth. She calmed me down, but Will, we’ve been friends a very long time; seventeen years. I’ve been running the spaceport and near-Mars space for fifteen years. I enjoy the work,

but it's also a long time to be doing the same thing, even if the tasks have expanded about twenty fold in that time. I think you—"

"Érico, I'm sorry, I didn't know—"

"Didn't know? Well, I guess I know you don't know. First Ruhullah comes along and you bypass me to give the number two position to him. Then Pete comes along and you give him interplanetary transportation instead of me, and it would have been a perfectly logical expansion of my role—"

"Érico, I'm sorry. Ruhullah asked for responsibility and I asked him to be my assistant. I don't think you would have enjoyed that job; he was essentially my gopher. And he was incredibly good, so when my responsibilities shifted toward the Commission it made sense to expand the responsibilities he already was exercising. As for Pete, the most important tasks he had to handle involves face-to-face relations with people on Earth, and by definition you can't do that here. Furthermore, people there knew him; their contact with you was much less. The same applies to Sebastian; people on Earth know him very well."

"Will, all these jobs can be conceived two ways. One way involves very skilled and experienced assistants on Earth who have contacts. Louisa Turner does that for you, and we have other people with similar skills."

"Perhaps that's true sometimes, but there are some situations where the person in charge has to close the deal."

"And how have you been doing that in the last five years?"

"By videophone with people who have gotten used to working with me that way."

“A lot of people have gotten used to working with me that way, also.” Érico leaned back in his chair. “Will, I think you have a prejudice against Mars employees. The Earth employees are seen as more experienced and able to get the work done.”

Will was startled. “Érico, that isn’t true. Alexandra’s in charge of construction on both worlds. Lisa’s in charge of ecology. Yevgeny’s in charge of exports.”

“Then maybe your prejudice is against me.”

“Érico, I have no prejudice against you, and I’m very sorry if you feel slighted. I really do, and I apologize. It was not intended.”

Érico looked at him long and hard. He had always had a certain level of insecurity, but Will hadn’t seen it since Érico had decided to get married some fifteen years earlier. He had forgotten about his friend’s feelings. “Okay,” Érico finally said. “Thank you.”

“Look, let me think about the situation. There must be something new we can give you. I agree, after fifteen years even an exciting job gets stale. I don’t think I’d still be Commander of Mars right now if I hadn’t been promoted and become head of the Commission. It was beginning to wear me out. This place is twice as big and complex as it was just five weeks ago. Let’s both think about the issue and talk tomorrow or the next sol.”

“Okay. I appreciate that, Will, I really do.” Érico rose. “Maybe I can write up something for you to share. In and around everything else, of course.”

“Yes, the first ACVs arrive tomorrow. This is as urgent as you want it to be. I need a sol or two to think about the problem.”

“Alright. Thanks. Have a good sol; maybe tomorrow afternoon when the ACVs are safely in orbit.”

“Good.” Will watched his friend open the door and go out. Once Érico had left, Will looked out the window at the escarpment. Maybe he did have a prejudice for terrestrial employees. He’d have to think about that. He’d also have to think carefully whether something new could be given to Érico without offending Ruhullah or the other senior staff, all of whom yearned for promotions.

The worry agitated much of his morning, but he had a lot to concentrate on: it seemed that half of the arriving employees of the Commission wanted to change their work assignments. Some hoped to get out of kitchen or agricultural work, usually viewed as the lowest skilled, in favor of more prestigious occupations. Others had fallen in love or had a falling out with someone and were anxious to be reassigned to a different outpost; the other four outposts together had less than half the population of Aurorae, which meant the shopping and the social life were much less interesting, but the possibilities for promotion were sometimes greater. There were a few requesting transfer to or from a mining company as well; some liked the 1.5 million redback annual salary, while others resented the seventy-hour work weeks. As long as the traffic in both directions was equal, it was easy to approve.

Then it was time for lunch. Will hurried to the Patio and braved a crowd to get his food. It was hard to find Ethel and harder to sit with her. The kids preferred to eat lunch with their schoolmates, so the best Will managed was to wave quickly to his offspring. A constant stream of visitors to his table made eating difficult. Stirring the conversation were flyers—made of real paper!—on each table announcing the opening of Deseret, a

“hypermarkette,” Satursol at noon. Many asked simply what a hypermarkette was and how they had missed the term on terrestrial television.

Will ended up coming back to his office early. There were two urgent messages from Lisa Kok. “Will, call me as soon as you can. The Green World Community has been setting up its own agricultural area in Bangalore on land it rented from us. That’s not a problem, but we just found out they violated quarantine and imported their own seeds. I think we’ve stopped them in time. I anticipate a lot of trouble. Bye.”

“Anisa, call Lisa Kok,” he said. A moment later he heard a dial tone, then ringing.

“Kok.” There was no video, which meant she wasn’t at her desk.

“Lisa, it’s Will. Shall I come down?”

“Yes, to Bangalore. I’m almost there and the Green World folks know I’m on my way.”

“Okay, I’ll be right there.” Will closed the line, grabbed the attaché, and dashed out of his office.

Bangalore was not next door; there were three big biomes in between. He started to lope, a sort of running hop, which was the fastest and easiest way to make one’s legs move in Martian gravity. Even so, in the thin air—the outpost interior had the same oxygen level as the Earth’s atmosphere at two thousand meters altitude—he was panting when he arrived.

He blinked for a moment when coming into Bangalore. It was 2 p.m. and the silvered insulation blanket had gone up part of the eastern side of the dome, reflecting brilliant sunlight downward onto the plants and habitats. The crowd gathering in the western end was quite unmistakable. They cleared to let him in as he approached.

“Dr. Elliott, we have a signed contract to plant 400 square meters of ground here,” insisted Dr. Rivers. “And we demand the right to fulfill that contract.”

“No problem,” replied Will. “As long as the things being planted don’t violate the quarantine. Any agricultural materials brought from Earth must go through rigorous examination and screening before use. Have the materials gone through such screening?”

“We have very high organic standards of quality of our seeds; no genetically modified species, no diseases, no stray species—”

“Are your standards the same as ours?”

“We have our own standards of quality and they are higher!”

“Then don’t plant your seeds in here; there are genetically modified species in here that can contaminate their genes. And we must be absolutely assured that your seeds have no stray bacteria, viruses, and other undesirables. A microscopic examination of each seed accompanied by special surface sterilization techniques and spot examination by scanning electron microscopy will guarantee the safety of our ecosystems.”

“There’s no time. We have contracts with Deseret to supply vegetables and other foods.”

“That may have been premature. Lisa, how long will the seed screening take?”

“We can assign a team on Earth to assist with the imagery. We can get some seeds through the process in four sols. Screening all of them depends on how many there are.”

“We’ve got fifty kilos of seeds,” replied Rivers.

“That’ll take a month or two to screen, and will cost a lot of money,” said Kok.

“It’s a shame we didn’t have the entire flight out to do it,” said Will.

“Dr. Elliott, it won’t be necessary to screen all fifty kilos because we plan to use most of the seeds at Aram, not here.”

“Then we have to worry about agricultural products from Aram bringing contaminants to Aurorae,” replied Lisa.

“It all has to be screened,” repeated Will. “That’s the regulation. Lisa can tell you exactly how many species of terrestrial life can be found here. She can show you a list. She can tell you which were intentional transports and which were accidental contaminants.”

“And I can tell you how many terrestrial species we have found outside the domes,” she added. “The spores were dormant, by and large, but they were there, carried out by boots or contamination on the surfaces of pressure suits.”

“Do any terrestrial life forms grow outside?” asked Victor MacLeod.

“Of course,” replied Lisa. “Around Aurorae the humidity is higher because of pollution from the biomes; there’s some frost at night. There are some uv-resistant species out there slowly growing. And there are a dozen species at the Hellaspontus fumeroles that have been there for sixty-five million years.”

“Dr. Rivers, we’ll get you your first batch of seeds on Wednesol next week,” concluded Will. “You can start planting then. That isn’t much of a delay.”

“Whatever you say, Dr. Elliott,” replied Rivers with a slight growl.

The next morning—Frisol—a few people gathered on the Patio at 6 a.m. for a very early breakfast before the sun rose. The silvered blanket on the dome was rolled back because the first automated cargo vehicle was scheduled to aerobrake into Mars orbit at that hour.

It was a spectacular event; the vehicle hit the Martian atmosphere at six kilometers per second, enough to make the heat shield blaze brightly within seconds. The ACV had to dip within fifteen kilometers of the surface to encounter dense enough air to decelerate significantly; it then flew back out of the atmosphere in a matter of two minutes. Embarcadero was a bright star moving overhead at the time; it circled Mars on a highly elliptical orbit once per Martian day, and its low point occurred just before dawn over the cratered equatorial highlands just north of Aurorae Outpost.

When the ACV began to glow like a meteorite, someone shouted and everyone stopped eating to watch. The kitchen staff turned down the patio lights so they wouldn't wash out the view. The cone-shaped ACV moved quickly across the sky like a meteorite, west to east, leaving a faintly glowing trail behind it.

When the vehicle was high in the northern sky and apparently at its brightest, it began to pulse. "Oh oh; trouble," exclaimed John Hunter.

"I think it's tumbling," added Vanessa.

"Yes," agreed Kurt Hollingworth. He stood up to watch.

The course bent northward and sparks seemed to break off the ACV, leaving a trail of sparkles behind it. The brightness greatly increased as the ACV fell into deeper air than expected and its entire velocity rubbed off. The vehicle began to fade in brightness as its speed decreased to a mere two or three thousand kilometers per hour; not enough to keep the heat shield hot. The faintly glowing vehicle continued to head for the ground north of them. Then it was gone.

"Oh, shit!" said Kurt. "Forty tonnes of cargo, smashed into the Martian desert."

“Something went wrong,” agreed John. “The long-range cameras should have caught the whole thing.”

“Mars Control must be going crazy,” said Kurt. “We better get the big screen t.v. back on.”

In Mars Control, alarms had gone off as soon as the ACV entered the Martian atmosphere. The computer called Will immediately; he was in the control room in his pajamas not long after the ACV smashed into the surface. Within five minutes the emergency backup crew had arrived as well. The dozen personnel immediately began to analyze the scanty telemetry that had gotten through the plasma sheath surrounding the vehicle.

By 9 a.m., Forest Rivers and Yoshiyaki Suzuki were in Will’s office. “We still can’t tell you what happened,” Will began. “We’ll probably figure out the anomaly in a few sols or weeks, though. We can tell you that the ACV lost control over its orientation and tumbled, which probably caused the fairing to disintegrate. Most likely some of the cargo blew off the vehicle and was scattered across the desert. The rest impacted about three hundred kilometers southeast of here at about three thousand kilometers per hour; that’s about 850 meters per second. We can assume a total loss of contents.”

The other two men were silent a moment. “I see why you recommend spreading out one’s cargo among as many vehicles as possible,” exclaimed Forest.

“I’m very sorry for both of you and your operations. The loss of this ACV represents only a tenth of the total cargo, but I gather it’s two thirds of the Green World Community’s and half the monastery’s. Did you both have insurance?”

"Of course," replied Yoshi. "Is there any possibility of a replace flight from earth?"

Will shook his head. "We're six months after opposition. If we could launch replacement cargo tomorrow, it'd have to take a 570-sol trajectory through the inner asteroid belt to get here and would arrive barely a month before the next opposition. By the time another cargo could be assembled—two months from now—the launch window for this columbiad will be completely closed."

"We insured the cargo and the vehicle," said Forest. "Not that it will do us a lot of good for the next two years."

"On the contrary," replied Will. "First, you'll get your money back. Second, the insurance company will conduct an investigation of the loss, so that means we'll be pretty sure what happened. If the Commission is liable, we'll pay."

"It may be Lufthansa Space Express," said Forest, "It was a used ACV, and I always had my doubts about its reliability."

"They should be reliable right now; Lufthansa's rebuilding its reputation after some scandals three years ago," said Will. "Third, we're all in this together; there are only 600 of us on Mars, so we can't just say 'sorry, too bad.' We pull together. The loss represents ten percent of imports, which in turn are much less than half our total assets, so this is a loss of three percent of our infrastructure. I think we flew up two mobilhabs, two conestogas, and four rangers as replacements for vehicles that are wearing out; our current fleet includes six, ten, and twelve respectively. The Green World Community had one of each, if I recall, and the monastery had two conestogas, one of which is coming on an ACV next week. I am sure we can get Green World at least three vehicles, reliable

new ones, because you'll need three in Aram. We can probably can get you one of each kind. Yoshi, I'm thinking maybe we can rent you a second vehicle during your construction phase; possibly a third one as well. Since you'll be just a few kilometers away, if anything breaks we can fix it quickly, so we'll all have pretty good flexibility. Possibly you won't need two conestogas once you have everything set up."

"I think you are right, but we'll have to look at schedules," replied Yoshi.

"Thank you, Dr. Elliott, you've relieved my mind," added Forest. "We had planned to rent equipment from the monastery at times as well, so this is a double loss for us. We have some items that will be difficult to replace; lathes and metal working equipment, for example. Agricultural equipment."

"Discuss the list with Alexandra and Lisa. No one person will know what we have, but they'll have a pretty good idea between them. We can get the inventory people on Earth involved as well. Humans have been here on Mars for nineteen years and in that time we've imported equipment, used it up, and either stored it or tossed it in the dump. If there are salvageable things in the dump, they're yours for free. Outside nothing rusts or goes bad; it just gets cold and dusty. Reverend Nah has already had his people combing the dump and they've been rescuing old stuff we tossed and figuring out how to reuse it. Other equipment is used and sitting in storage at the western ends of our two long underground corridors. Yet other things have been sold to individuals for their small businesses and if the price is right, they'll sell them to you. Let's post a list of the lost items on the website. There are folks on Earth who follow us really closely and remember reading about equipment we once had. I think we'll manage to replace a lot of it."

"We also had inflatable shelters on the ACV," noted Forest.

"We can sell you replacements. They're locally made and not as sophisticated, but will be cheaper than an import anyway. You already had planned to purchase an oasis from us. Now you can buy two or three."

"When can we get them, though? We'd rather not wait a year."

"This isn't like buying a B-160. They're big, complex, and slow to make. We always have oases in stock. You can have two oases tomorrow and vehicles to move them in a week or two."

"That's very generous; I'm relieved, after the dispute yestersol."

"Whatever you want to call it, the principle yestersol was agreed on by everyone: we protect our ecosystems from contamination. This sol is another sol, and the principle we agree on this sol is that we pull together." Will shrugged. "That's the way it is here."

The residents of Mars talked about little else the rest of the sol; *Mars This Sol*, their multimedia web site, based in Houston, covered the ACV loss almost continuously. The next morning—Satursol—a second ACV aerobraked safely to everyone's relief. By noontime, when everyone was ending their work, a team of two conestogas and eight personnel were approaching the crash site.

But few were waiting to hear the results over live television; they knew that nothing of any size would be found on the bottom of Mars's latest impact crater. Attention shifted to the Deseret Hypermarkette, which was opening that afternoon in Cochabamba Biome.

"I feel a bit guilty going to their opening," said Ethel. "I feel we should be loyal to Silvio."

“He’s run a good store for a number of years and I’m sure he’ll continue for years more,” replied Will. “But now there’s competition, that’s all.” He pushed open the airlock door and the family entered Cochabamba.

There was already quite a crowd, and it was growing fast. As they entered, the Cahills walked by. “Hi Tabitha!” exclaimed Marshall, excited to see the older girl. She turned, smiled, then turned away without speaking to him.

“Well, at least she smiled at you,” said Ethel.

“I guess,” Marshall replied, disappointed.

“You see her in school every sol,” said Will.

“She and I are in the same English literature, geology, and algebra classes, but even though the classes have four or five students she never speaks to me.”

“There’s an older boy in your classes too, right?” asked Will.

Marshall nodded. “Ron; he’s in lit with us. He takes his science and math at MarTech instead. Sammie says he’s seen them walking together and that she has a crush on him.”

“There you go; that’s the problem,” replied Will. “Don’t worry about it.”

Marshall nodded, discouraged. Will looked at his lanky, pimply son and had to smile.

They approached the tent. There hadn’t been adequate space to rent anywhere in the Outpost—housing would be short for several months because of all the arrivals—so the business group had set up a tent instead and had spread carpets over the grass. The store extended into two courtyards between housing cylinders as well.

“Toblerone!” exclaimed Will, surprised by a candy display nearby. “I haven’t seen or eaten any in twenty years!”

“Five hundred redbacks for 350 grams; how can they sell them so cheaply?” asked Ethel, surprised. “Oh, I see; they’re on sale.”

“It looks like most things are!” added Will.

They wandered into the store further. The perfume section was nearby and Ethel was startled to see so many fragrances.

“I haven’t heard of half these colognes,” noted Will.

“They’re counting on the women to buy the colognes for their men, dear,” replied Ethel. Her eyes lit up. “My God, look at all the cosmetics, Lizzie!”

“Let’s take a look,” said the twelve year old. The two females headed for a series of shelves packed with lipstick, eye shadow, facial creams, and related materials. Will looked at Marshall, slightly mystified.

“Dad, they have basketballs,” said Marshall. He pointed. “Can we buy one?”

“Let’s look.” They walked over and picked up one. Will hefted it. “God, it’s been so long, I can’t tell how this feels. It must feel too light.”

“Dad, it’s only five hundred.”

“Only! I can see I’ll be spending thousands this sol.”

The women returned a few minutes later. Marshall frowned. “What do you call that wagon?”

“It’s a ‘shopping cart,’” replied Ethel. “It’s not quite as nice as the ones on Earth, but it’ll do.”

“Silvio doesn’t have anything like that,” said Marshall.

“I don’t know how they made these,” said Ethel. “I’m surprised.”

They walked deeper into the store. The dress rack tied up the women for fifteen minutes while Will and Marshall looked at golf clubs, the three bicycles, and microwave ovens. Then they all walked into the restaurant area filling a courtyard, where a snaking line of tables was already crowded with customers. Two cooks were occupied.

“Wow; a tilapia, rice, and vegetables special for 42 redbacks; that’s a deal,” said Will.

“With fresh apple pie! Let’s eat!” said Marshall.

“Okay,” agreed Will. He pointed to a tangled mass of shopping carts. “We can park our thousands of redbacks of stuff right here.”

They went through the line, then hunted for seating. Henry Smith, who was running the whole operation, saw their dilemma. “Over here, Dr. Elliott,” he said. “Four seats have opened up.”

“Thanks. And we can leave the shopping cart there?”

“Of course, that’s what the space is for. And push the cart home with you, in order to get your purchases home. Anyone who pushes one back gets a five redback credit.”

“Really?” said Marshall, surprised.

“Sure. In fact, we’re looking for help; are you interested in a job? We need people to wait on tables, help at the check out, greet people arriving, and return carts here.”

“I’ve already got a job at the Patio kitchen.”

“Good, you’ve got experience. How much do they pay? We’ll pay fifty an hour.”

“Fifty! I’ll think about that! The kitchen pays me thirty!”

“There you go,” said Smith.

“It looks like business is booming,” observed Will.

“Yes, we’re having a great opening sol. It was worth waiting a month and making sure we were ready. The inventory’s going fast, but we have some on every single ACV that arrives, so we should be set for the rest of the columbiad.”

“I think you did some excellent marketing research; the choices of products are new and exciting.”

“We put a lot of thought into it. The cosmetics are flying off the shelf, as we thought they would.”

“Your facility’s working out adequately, also. I’m sorry no rental space was available.”

“I don’t think we could have managed an opening sol like this inside anyway. The cylinders are so small and confined, and I wouldn’t want to have hundreds of people in them. Cochabamba’s one of the few biomes that can handle a crowd of this size safely, and the outdoors has an airiness and brightness. I wish we could get the borough to define fire regulations, though. The tent’s flammable.”

“They’re working on regulations. Clearly, you’ll need a special building.”

“Exactly, and we’re working to design one.” Smith smiled. “Thanks for coming.”

“Thank you,” replied Will. And the four of them walked over to the four seats Smith had identified for them.

“Silvio’s in trouble,” said Ethel, looking around. “This is a scale and sophistication he can’t match.”

“There are six of them working on this operation; he has no one,” replied Will. “It’s as if someone dropped a mall on Mars.”

“Well, it isn’t that big; this is a ‘hypermarkette,’” noted Ethel. “But it will have the scaled down equivalents of a department store, a supermarket, and a restaurant.”

“They already have jams and containers of tea for sale!” said Lizzie. “And I guess they’re making new products all the time.”

“I figure we have almost 10,000 redbacks of stuff in our shopping cart,” said Will. “That’s 2,500 per person. Let’s assume the 500 people here in Aurorae all spend 2,000 this sol. That’s a million redbacks in one sol. Let’s say they manage a quarter of that in a typical week; that’s twelve million per year. That’s actually not much money; they’ll be lucky if a quarter of it’s available to cover salaries, a mortgage on a space, electricity, water, etc.”

“Sounds like a lot to me,” said Marshall.

Ethel shook her head. “And consider that the food sold here and a lot of the clothes are Mars made, so they’re a fifth as expensive and generate much smaller profits. I can see why they like the cosmetics; small, complex, have to be imported, brand recognition. . .”

“Good profits,” agreed Will.

They ate their lunch and talked among themselves and with their neighbors; Marsians talked to everyone, since it was a small, safe society and everyone knew everyone or at least had mutual acquaintances. The buzz about the store pushed the ACV crash from everyone’s minds.

Then Marshall stopped listening and stared. Tabitha was walking from table to table carrying coffee and tea pots, offering free refills. One never saw that at the Patio, where there were practically no employees and everything was self-service. When she came to their table she smiled at him. “Do you want more coffee or tea?”

“Sure, I’ll have coffee,” said Marshall, pointing to an empty cup in front of him. He had wondered why the cup had been there; he almost never drank coffee.

“Here you are.” She smiled and filled the cup, then refilled Will and Ethel’s cups as well. She headed on down the table, Marshall’s eyes following her. Will tapped his son on the shoulder.

“So, are you taking up the job offer?”

“I think so!”

Will chuckled. “Good.”

Monsol morning, Will was late to his office. Érico was already in his new office looking at a video of the crash site. Will stuck his head in to say hello and stayed to watch.

“There’s nothing left.”

“Nothing,” agreed Érico. “The ACV made a crater three meters deep and ten meters wide. The biggest fragments are about six centimeters across.”

“Mars has a new meteor crater. When does the emergency team come back?”

“They plan to spend another sol at the impact point to pick up some pieces, then find the heat shield fragments so we can determine why the shield peeled off. It looks like negligence to me, but it’ll take a few months to be sure. The trajectory was spot on and the density of the upper atmosphere was predicted correctly, so it isn’t our fault.” Érico

looked at Will. “Needless to say, this weekend I haven’t had more time to think about our conversation or write up any ideas.”

“I’ve had a little more time than you to think about it, and I have a proposition for you,” replied Will. “The operation here has doubled in size. That means almost permanent occupation of Embarcadero Station and frequent visits to Phobos and Deimos. There are now six outposts on the Martian surface, which means more oversight and coordination. Once upon a time there could be a single Commander of Mars operations who was also commander of Aurorae Outpost. We now have an appointed Commander of Aurorae and an appointed Governor of Mars. Ruhullah Islami started out as my assistant when I didn’t have time to be full-time Commander of Aurorae, then became Commander of Aurorae. Maybe the time has come to appoint a Lieutenant Governor of Mars Operations to assist me as Governor.”

“What would the Lieutenant Governor do?”

“Coordinate anything the Governor asks him to coordinate. I was thinking of the following: first, coordinating a new Mars Spaceport Authority, which will run Aurorae Spaceport and establish spaceports at Dawes and Cassini; second, coordinating Mars space, which means coordinating Embarcadero and the moons; and third, maintaining the system of trails and airports and regulating interoutpost commerce. The other responsibilities I have as governor are the health system and the university. I plan to retain the development and coordination of the outposts, which means establishing environmental management regulations and oversight in particular. That’s the other big new task that needs to be done.”

Érico thought about the idea and smiled. “It’s basically a promotion and expansion of my existing responsibilities.”

“It’s a rethinking of it. The Coordinator of the Spaceport currently runs Aurorae Spaceport, Embarcadero, and near-Mars space, but has no responsibility over Dawes and Cassini Spaceports. Both need proper spaceports and the outposts themselves have started to develop them. There’s a turf battle to fight there. I think it’s better that all spaceports be coordinated nationally, as it were, rather than locally. The time has come to establish an Airport Authority, a Trail Authority, and an Oasis Authority to maintain and expand those aspects of our infrastructure as well, and that will keep the Lieutenant Governor busy for a while. The oasis authority will also involve a turf battle, since it falls under Roger Anderson and the Exploration Department right now.”

“It sounds like we’ll have to have some meetings,” said Érico.

“Yes. So you’ll take it?”

“I will. And thanks, Will. This is exciting.”

5

Departure

late June 2055

“I just wish all three of you wouldn’t go,” said Sebastian between bites of his turkey wrap with carroway cheese, courtesy of the Deseret cafeteria. “Is it really that safe to take Charlie all the way to Aram in a conestoga?”

Clara rolled her eyes. “Dad, this has already been reviewed and discussed by professionals a hundred times. The conestogas are set up to accommodate kids. They have an extra tonne of water shielding against radiation in several key areas; enough to reduce even cosmic ray exposure. Within a week of arrival ours will be parked in a radiation-proof tunnel anyway and will often be attached to a second vehicle.”

“And Charlie knows what to do in case of depressurization,” added Helmut. “Sure, at age 19 months he can’t explain it and we can’t be sure he’ll act correctly, but someone will be with him at all times anyway.”

“He knows if the alarm goes off and the red lights start to flash, run to the green light and go inside,” clarified Clara. “The conestoga computer opens doors to evacuation areas automatically in an emergency, so he can run in, and it’ll close them afterward.”

“And he’s gotten used to wearing an earpiece.” Helmut pointed to Charlie’s right ear. “The computer is programmed to give him instructions in simple, clear language, and of course it knows where he is and what his heart rate and blood oxygenation are.”

“You actually put him through a depressurization test?”

“We did, yestersol. It was perfectly safe; the agricultural biomes have enough oxygen pressure so that a person can survive at least ten or fifteen minutes before lapsing into unconsciousness. But the pressure drop was real and made the test realistic.”

Sebastian nodded; he had been through the obligatory annual depressurization drill just a week earlier. “And he ran into the shelter?”

“Of course.”

“Good.”

“Dad, this is also my first command,” added Helmut.

“Yes, and I am very happy for you; congratulations again. I’m not sure Rivers will let you command, of course.”

“We’ll see. He and I had a conversation this morning. My authority extends over safety and training. He’ll decide where and how to build.”

“Fair enough.” Sebastian shook his head. “These Green Worlders are. . . green. I can’t believe they plan to go off into the wilderness lacking training.”

“That’s one reason they consented to stay here longer. They had wanted to head to Aram in early May. Here it is late June. The loss of their ACV was a delay, but the real delay was caused by their work in construction and agriculture and the safety and exploration courses. And in return for their extra month of work here, they get a construction support team to help them build their oasis.”

Sebastian turned to Clara. “But do you have to go, too?”

“Dad, I’m the one who agitated for the policy of including children! I could leave Charlie with you and go without him for six weeks!”

“No, that might be more than either Charlie or I could handle.”

“Dad, I’m a member of the exploration corps. I have to keep current in at least three skills to keep my active status rating. Construction and repair are two of my areas.”

“You won’t be going to space together for a few years, so is it necessary to stay current in all four of your areas? You can always revive your status later.”

“Don’t worry,” she replied, exasperated.

“Alright.”

“Dad, you should come out for a week or two,” added Helmut. “There are automated trucks running through Aram weekly, so it would be pretty easy. It’s an intriguing area; the crater’s outlet canyon is dramatic; it has spectacular views from the eastern rim; the eastern floor has a big evaporite deposit with hematite, carbonates, sulfates, even a few borates; the central plateau is a sedimentary layercake, relatively salt-free, with some nice delta deposits and a few remnants of wave-cut terraces; the western edge is chaotic terrain with some spectacular radial canyons. And don’t forget the rain and snow-cut gullies in the northern rim.”

“It’d be pretty interesting. I worry a bit more about the possibility of uranium ores in the center. Maybe I can get away. The ABC is really tying me up right now.”

“How’s the diplomacy?”

“Slowly yielding fruits. Most major national space agencies are on board and some have committed funds. I think we’ll have thirty billion redbacks committed over the next decade, which will give us quite an ambitious exploration plan.”

“How many caravels?” asked Helmut.

“That’s hard to say because it isn’t just about caravels. We’ll probably need three and they’ll go on missions of up to four years. We’ll also send out about 30 automated

orbiter/landers and setting up a network of ten automated oases. We're paralleling the Mars exploration model. The oases will have fuel-making units, solar power, robotic rovers, emergency supplies, and fueled lifters. The lifters can fly rescue missions to stranded crews or can fuel to automated orbiter/landers so they can move on to another group of asteroid targets. We also have to work our way out; we'll probably target the Jupiter Trojans for landings in a decade or so. The ABC may have a role in near-earth asteroids as well because everyone is planning missions to them anyway and someone has to coordinate the work."

"And all this can be done without nuclear-electric propulsion?" asked Clara.

"That's a big issue. The U.S. is holding out for a major commitment to nuclear electric; they want the customers. The Chinese want to develop gaseous-core nuclear engines and are trying to convince everyone they can handle the environmentalists. Most are skeptical and the U.S. is terrified the Chinese will try it, so they're obstructing the efforts as much as possible. The Mars Commission advocates launching missions from Embarcadero where hydrogen, methane, and oxygen propellants are available for 300 redbacks per kilogram. So far the Canadians, Europeans, and Indians favor that approach as environmentally safe and cheap."

"Do you think that'll happen?"

"For the first missions, but maybe new propulsion systems will be available in a decade or so, and they should be used. Advanced propulsion is essential for Mars Mercury, and the outer solar system. The time to develop them has come. I told Will we need to push the development of gaseous core nuclear engines on Deimos, where Earth

can't be contaminated and where hydrogen is abundant. The Commission has been thinking of arguing the case for some time."

"That'd be great," said Helmut. "Something else to develop this world."

"And a better direction than we're going in right now." Sebastian shook his head. "All these religious and ecological fanatics worry me. They're hard working, but they don't compromise easily and they can be unpleasant to deal with. I've always thought it was premature to encourage private migration to Mars."

"The Zen monks are very nice," said Clara. "Of course, half of them don't speak English!"

"It's crazy! Why do we have Zen monks on Mars? The answer is, they have money, but what sort of answer is that, and what does that say about us!"

"The hope, I think, is that they will bring something to this place, though," replied Helmut. "Not just something. . . spiritual. Their monastery will provide a retreat service, and since they'll be up on top of the escarpment near the dacha they'll have an incredible view. They're also looking at specialized agriculture."

"So we need Japanese tea and sake, and a place to meditate?" Sebastian shrugged doubtfully.

There was a moment of silence. "So, dad, will applications for the Ceres mission open next month?" asked Clara.

He looked at her. "Well, if there were any change in the schedule I couldn't tell you, but there's no change. Are both of you really planning to apply? I don't know whether we'll rate the caravels child safe."

"Dad!" exclaimed Clara. "They were designed to be child safe!"

“No practical amount of shielding can prevent most cosmic ray exposure. Even when solar activity is the most active, the solar magnetic field won’t reduce cosmic radiation exposure a bit in the asteroid belt. We can shield against the worst solar radiation. Children can take cosmic radiation for a year, but for four years?” He shook his head.

Clara, upset, looked at Helmut. He said “Dad, the water tanks and other mass does produce an area in the ship where cosmic ray exposure is greatly reduced; large enough for several children to sleep and play. And when the caravel is landed on an asteroid, the asteroid cuts the exposure in half. The doctors think a three to four-year mission is reasonably safe if the child is subsequently in a place with an excellent medical facility that can watch for cancer.”

“That’s one opinion, yes,” said Sebastian. “There are others who look at the same glass and say it’s half empty. And we don’t know what cellular damage will be done to a five year old that will cause cancer twenty or forty years later. It’s a very risky proposition.”

“Well, the three of us are applying,” said Helmut.

Sebastian shrugged. “It won’t be a decision for me to make; we’ll have an outside committee, probably on Earth, screen the applications.”

Madhu Anderson had her eye on more than just the stockings and deodorant when she came to Sylvio’s store. She looked at the entire space, the colors of the walls, the placing of items, the decorations and lighting. The store’s appearance needed an update.

She went to the checkout area near Silvio's open office door. He was busy dictating an email about bank deposits to his computer; he nodded to her but did not come out to assist. She and Roger ran their items through the scanner and swiped a credit card. Then they waited outside the door until Silvio finished.

"How are both of you?" he said as soon as he finished dictating the email. He stood up and came out to visit.

"Pretty well; how about you?" asked Madhu.

Silvio shrugged. "Not bad. The bank seems to have perpetual problems with converting currency; I have to work my way through to a solution every sol, it seems."

"How's the store?" she asked.

"We're managing alright."

"We're here buying things to support you," said Roger.

Silvio smiled. "Thanks, I appreciate that."

"Is business down?" asked Madhu.

Silvio hesitated. "Business always goes way up and down in the months right before and after the arrival of new residents. That makes it hard to say what the long-term situation is. But I can say that business was really, really good for the first month after Columbus 10 arrived; then Deseret opened and business dropped to thirty percent what it had been the week before. Now it's beginning to look like business is stabilizing at seventy percent last year's level."

"So it's down thirty percent after the outpost has doubled its population?"

Silvio nodded. “That seems to be the trend. Of course, Deseret probably will run out of goods, and I’ll still have mine, so people will have to come back and buy from me eventually. Unless I decide to close the store and sell everything to Deseret.”

Roger looked alarmed. “You wouldn’t do that, would you? Because your store and the cafeteria anchor the businesses in Yalta. If your store closes, people will go to Deseret to buy things and will eat their meals there as well. So the cafeteria would suffer. People would come here just to get their hair cut and a few other minor things.”

“What can I do? That’s what competition does.”

“But you can do something,” replied Madhu. She looked around at the store. “Refurbish this place, spruce it up so that it’s contemporary. That’ll help. Deseret has a tent; you have a real store!”

Silvio smiled. “Madhu dear, I have no sense of decoration! Look at this place. It looks like an old country store. That’s the best I can do.”

“I’ll help, Silvio. “I’m an independent artist; I don’t have a 55-hour per week job. I have ideas for the walls; I can paint them. But I think we can do some rearranging of the stock, get nicer shelving—they make better stuff now—add some attractive signs. . . you’ll have to pay for the materials, but I’ll donate my time.”

“You will? That’s very kind of you! I’d better accept your offer!”

“Thank you, it would be an honor to do this job for you. You’ve been here for twelve years, after all. We’re friends. I don’t like the idea of a bunch of upstarts arriving and destroying our existing commercial infrastructure.”

“Well, I’m not sure we can stop that. Deseret has made arrangements to open a store in Dawes and I hear Smith is now in Cassini negotiating space there. They’re

creating a chain! They already have agreements with the Green World Community for vegetables and GWC isn't even producing them yet."

"You need to buy more home-made items to increase your inventory," said Roger. "More and more folks are producing things at home for sale. The Nigerians are very good at it. Madhu and I have been interacting with them quite a lot; we've attended several of their church services."

"You have?" Silvio looked alarmed. "They seem like Bible fanatics to me!"

"Silvio, we might seem like that as well, if we were to tell you what we believed," said Madhu gently.

"No, you and Roger are discrete! They wear their Bibles on their sleeves!"

"We're working on that, Silvio. They are Bible-believing Christians. So are we. Madhu and I are fairly comfortable at their services; their theology is similar. They tend to be anti-evolution and anti-science, which is ironic considering they're here! We're meeting with Reverend Nah next week to discuss some of his views, which are more or less synonymous with the views of the church. If people associate with them, befriend them, are patient with their biblical pitches, I think everyone can get beyond the differences."

"You're more optimistic than many people."

"Yes, but that's because we're working on them," replied Madhu. "Our dialogue is making progress. I'm hoping we can get them involved in the interfaith programs; so far they have refused to pray with non-Christians. I think that will change. But let's get back to the store. You need staff here, Silvio. We were all used to a store with no service; we come in, find what we want, ask the computer for help, find the item, scan it, slide our

credit card, and walk out. Go to Deseret and watch the reaction of the residents when someone greets them after they enter, offers to help, walks them to the right shelf, and helps them purchase the item. Service is one reason people are going there."

"I tried to hire someone last week. I visited Deseret and saw the impact of service. So I approached Reverend Nah, because I heard a few of his people were still looking for work. He told me that there was one man looking for work, but his wife was working for the Zen monastery on construction and they can't provide any health insurance. Well, neither can I."

"That is a problem." Madhu thought about it.

"Well, you can always employ Sam," said Roger. "He's fourteen and a half; a bit young, but he is very capable, and he's jealous that Marshall's got a job."

"We didn't come in here to get him a job," added Madhu.

"Oh, I'm sure of that. Don't worry. I could use the help, that's for sure. Okay, bring him in and I'll interview him."

"We'll do that," said Madhu. "Shall I bring you some designs in a few sols?"

"Excellent. And I can afford to spend a reasonable amount of money to redesign this place."

"Good. Good sol, Silvio."

"Ciao," replied Silvio.

Madhu and Roger walked out of the store with their items. "I'm glad he agreed to let me do some decorating. The place can be ten times nicer than Deseret's tent."

"More than decorating. He agreed to a redesign."

"That's true." Madhu stopped and looked at the patio and the kitchen beyond. "This place needs a face-lift, too."

"One job at a time, my dear."

"You're right." They continued across Yalta Biome and headed into Shikuku, where they lived. "But the health insurance issue is another big one."

"We need to talk to Reverend Nah about it."

"We need to talk to the Mars Council about it! We need universal health insurance. Health care here is heavily oriented around prevention. We can't wait until people get sick."

"Well, you're on the Council, so that's easy. Talk to Will first."

"Yes, I'll do that too, after talking to Eve Gilmartin and finding out Mariner Hospital's view."

There was so much dust on the Zen monastery's new dome, it was twilight underneath. "Those regolith movers kick up a lot of dust," Will observed, looking up as he emerged from the entrance tunnel.

"Yes, but they're quite effective," replied Yoshi Suzuki over the spacesuit radio. "In two sols we've placed half the regolith on the dome skirt that it needs."

Will nodded silently. He looked around the hundred-twenty-meter crater the monks had covered over with a B-160 dome. It was a typical bowl-shaped depression thirty meters deep, but had the distinction of possessing a rugged set of cliffs about ten meters high all the way around where the meteor impact had punched through a dark, hard, basalt flow. "This has a lot of potential. Are you planning to plant it?"

“Yes. We’ll grow tea on the slopes and flowers on the crater floor. Beyond the rim we’ll have a strip averaging twenty meters wide for agriculture; it’ll be invisible from down here, though. We are planning Zen rock gardens outside the dome, but they’ll go on top of the ten meters of fill we’re placing over the skirt.”

“It’ll be interesting to see how this open ‘polder’ concept works,” said Will.

Yoshi smiled. “Everyone’s using the Green World Community’s term!”

“It’s useful. I think it can be predicted you’ll lose tonnes and tonnes of gas downward into the ground.”

“For the first few months. We’ll keep pumping in compressed Martian air; trapped solar energy will heat it above freezing and it’ll escape downwards, warming the regolith. Once the top three meters has thawed we’ll introduce water vapor. It’ll freeze underneath and block the pore spaces. Only then will we add oxygen.”

“That’s the theory. And since Aurorae’s agriculture produces a tonne of surplus oxygen a sol, we can afford to waste some.”

“The Green World Community plans to do the same thing and they’re a thousand kilometers away; I don’t know what they’ll do to maintain their oxygen supply.”

“That will be a challenge. If nothing else, they can buy beamed power from us, dissociate water, convert the hydrogen to methane, and sell it.”

“I suspect that’s what they’ll do.”

“You’ll need a lot of water to make this work, Yoshi.”

“Over three thousand tonnes in the next year, or ten tonnes per sol. But you have plenty of spare water. We’ll plant low-oxygen plants as soon as it’s above freezing in here at night for at least two weeks and the pressure is 0.07 atmospheres. The computer

calculations indicate that'll be reached two months from now. We'll create a little pond in the center of the crater. Two weeks from now we'll have the regolith skirt buried and we'll dust off the plastic protective sheet over the dome. At that point it should be sunny in here, and there will be enough pressure so that we can wear partial pressure suits instead of these full pressure suits we have to wear now."

Will nodded. "I particularly want to see the tunnel you've started."

"Sure, come on down." Yoshi started down a ramp following a natural break in the cliff; when they reached the bottom they moved out of the way to let a small buggy pulling a trailer full of broken blocks of dune sandstone to pass. They walked to the tunnel, which was being excavated southeastward in the dune sandstone stratum lying about five meters below the basalt cliffs.

Will paused at the tunnel entrance to squeeze an exposed surface with his gloved hand; the rock crumbled very slightly under his pressure. He took his rock hammer from his belt and broke off a piece, which proved fairly easy.

"Rather lightly lithified."

"Yes. This is an almost perfect medium for excavation; it's hard, it can be shaped, it doesn't crumble, but it isn't so hard that it exhausts workers and breaks equipment."

"I'd worry that the sandstone is too soft. We can't afford cave-ins."

"Tests have shown that caves excavated in this material will stand up. The rock is harder overhead because the lava baked it. We'll spray the walls with a plastic coating to minimize air leakage. We plan to duplicate the basic layout a twelfth-century Zen cave monastery."

"You'll have better radiation protection than anyone else."

“For sure. We plan to extend this tunnel all the way to the escarpment, so that we can place a meditation area on a ledge there.”

“The escarpment? That’s five hundred meters away!”

“Five hundred twenty, to be exact. We just started excavating the tunnel and we’re already managing five meters a sol. Most likely, with more experience we’ll do six or seven, so we’ll reach the escarpment edge in about three months. The jack hammers do an excellent job; we can literally cut the sandstone into blocks and remove them. Many of them would make good building stone, too. The basalt layer anchors the base of an overhang at the escarpment, and the dune sandstone has eroded back to some extent, so we’ll reach a natural ledge where there are partial caves. It should be a good spot.”

“How many pressure doors will you install?”

“That’s a controversial subject. We want to install three, but Alexandra Lescov, who’s in charge of safety, wants at least five. If the tunnel depressurizes suddenly, the soft sandstone could spall off or even explode inward if it’s full of gas or water under pressure. So we’re planning to coat the walls with plastic very thoroughly, monitor leaks carefully, and monitor the gas pressure inside the rock. We hope that will be sufficient.”

“We may add a six-hundred meter tunnel to the Dacha, eventually,” added Yoshi. “That will give both places an emergency evacuation route.”

“That would be a wise precaution. I had no idea you monks were such tunnelers!”

Yoshi smiled. “We have many talents. Our monastery will be a haven of peace, a place where people can come to reflect about their lives, their intentionality, how and why they do everything. Even tunneling can be done in a Zen way; it is an opportunity for seeing reality as it is and responding to reality according to your true nature. Even our

Christian workers are beginning to understand that." He indicated two Nigerian Christians who were toiling with two monks in the tunnel.

Will was surprised and had to smile. "Something they are not likely to learn in Nigeria, I think. I very much appreciate your vision, Yoshi; I think your monastery will bring something we all badly need here. We are working so hard all the time, we're so frenetically busy, that we lack peace in our lives."

"And peace lies within you; it is not hard to find!" Yoshi laughed.

Will walked ten meters down the tunnel; as close to the workers as it seemed practical. The tunnel had widened from two meters to about four. "Why is it getting wider and deeper?"

"There's going to be a chamber here about ten meters in diameter and five meters high, with a concrete-cased steel support pillar in the middle. It'll be our dining area, and there will be hallways off of it leading to bedrooms, a library, kitchen, etc."

"Very nice. You all could build an entire city down here!"

"And it'll be much cheaper than your buildings!" added Yoshi. "This is the advantage of open-ground construction. Your system imposes an airtight plastic membrane between your biomes and the Martian ground, a membrane that can't be ruptured. That means you can't build down, and the dome allows only so much building upward. But now that Mars has almost unlimited supplies of water and oxygen, leakages can be tolerated much better. That makes the polder concept practical."

"Probably. We'll see," replied Will.

"Dr. Elliott, let us have some tea," said Yoshi, with a smile. "I can offer you better hospitality in the shelter than out here in pressure suits."

"Thank you, it would be a pleasure." Will followed Yoshi out of the tunnel, up the crater rim, out through the dome's underground entrance, and into one of the monks' two shelters. After a pleasant half hour of discussion over green tea, Will headed back to the outpost. He set the ranger on autopilot so it would drive down the Little Colorado Canyon Road at a standard speed while he checked his messages. He found that Madhu had called him, so he called her back on the videophone built into the dashboard.

"Will, I want to propose reforms to our health care system to the Mars Council," she began. "Silvio can't easily hire help because he'd have to pay health premiums, and he needs staff if he'll ever complete with Deseret."

"That's a problem with our current system," agreed Will. "No one really knows how much to charge for health care here because the vast majority of our immense costs are research-related. We're spending 700 million redbacks per year on medical research and health care. We've got ten physicians and ten more medical support personnel on Mars, two hundred million redbacks in medical equipment, we import thirty million redbacks of supplies and equipment every two years, and about 700 professionals on Earth are doing support research or consulting. Everyone gets a full body scan or sonoscan twice a year and if anything is found, it's scanned every month or two. We perform almost 150 biopsies per year of anomalies. The data is so thorough it's impossible to find a comparable population on Earth. We're getting all sorts of grants to study precancerous conditions; we're setting some of the standards for how to manage the care of them. Different cost accounting models have offered wildly different estimates of the costs of routine treatment versus medical research, and no one has agreed on which to use. Furthermore, when the mining companies first arrived here nine years

ago they agreed to pay their share of the entire medical bill because it was cheaper than flying in new people."

"But that's over a million redbacks per year per person."

"That's right. The Deseret-Mars Company is picking up the bill for the Mormons. So are the wealthy sponsors of the other groups. I agree it's an absurd figure; even with the increased costs of health care in the United States, it's much higher. That's why every family here tries to have one member employed by the Commission, to make the Commission pay the entire medical bill."

"Then it's creating economic distortions. The Deseret Store isn't covering its real costs because its medical care is subsidized by someone on Earth, but Silvio's costs aren't, placing him at a severe competitive disadvantage. Will, I want to propose to the Mars Council that we set up a universal health care system for everyone here, that we arrive on a formula to allocate expenses fairly, and we inaugurate a combination of taxes and fees to cover them. This gives the Council a major responsibility, too."

"Its first major task. That would be good; a few are complaining their elected proto-national body does almost nothing. This is a good time to give health care to the Council. But I'm not sure others will agree with the switch. The mining companies and the Commission could benefit; their expenses will go down. But that means Deseret's will go up, and they will oppose."

"Well, that's the purpose of a political process, right? The Council meets in a few weeks."

"Right before reelection? It might be good to postpone the discussion until after the election."

"Or make it a part of the 'future of Mars' discussions we have before every election. That'll give us an issue to discuss, one that involves imposing taxes to get a benefit."

"That should be interesting," replied Will, doubtfully.

Eighteen members of the Green World Community and sixteen Commission personnel, in three mobilhabs and six conestogas, accompanied by a portable nuclear reactor and two robotic trucks, drove to Aram Crater in thirty-one hours. The Meridiani Trail left Aurorae Outpost in a north-northeastward direction along the base of the escarpment until the valley narrowed and became Hydraotes Chaos. As the sun set the trail turned easterly and skirted the head of Tiu Vallis, then traveled southeasterly for several hundred kilometers through Hydapsis Chaos, twisting and turning to follow valleys and canyons, over landslide deposits and past scores of old lakebeds. Just before the sun rose the caravan headed up a branch canyon and climbed a ramp onto the battered ejecta blanket of Aram Chaos; a bouldery, rolling terrain. Two hours later the trail began to pass cliffs dropping down into deep canyons; finally the trail itself wound down a landslide scar, crossed a canyon, and went up the other side.

"Welcome to Aram," Helmut said to Victor MacLeod, who was riding with him in the lead vehicle.

"This is Aram? Where's the crater?"

"You're now in it; sort of. The rim is almost completely eroded away on the west side and the floor is filled with hundreds of meters of sedimentary deposits, which then dewatered and cracked; the cracks became drainage channels and were eroded wider,

then landslides and eolian activity modified them. The route across this drainage channel was the toughest challenge when we built the Meridiani Trail; it took four weeks to complete a crude crossing, and two months more of follow-up work later to improve it."

"How much farther?"

Helmut considered. "Another hundred kilometers across the western chaos, then onto the central plateau, which is about 150 kilometers long and 40 wide. We have to go to the far eastern end. So we have maybe seven or eight hours more."

Victor nodded, satisfied.

The next few hours were slow ones as the vehicles twisted and turned around obstacles. Finally they crossed a low area of chaos and followed a long ramp onto the central plateau, which was relatively flat. "Good agricultural land," Victor said.

Helmut had his doubts anyone could determine that by eye on Mars, but didn't comment. "Yes, this is your area. It's all fine-grained sediments laid down in a slightly brackish lake. The reg isn't too salty, and it's rich in clays and fine-grained sands which make reasonably good farmland. And you don't have to go far to see of the best geology on Mars, either."

"Outside Marineris?" asked Victor.

"No, in general. The geology isn't spectacular in terms of views, though it can be pretty rugged and interesting. Aram has most of the major forces that shaped the planet's geology: cratering, ground water, precipitation, and the wind. This crater filled up with sediment, then the deposits disintegrated when the water drained and much of the sediment eroded away to leave chaos, except for the central plateau. The eastern end even lost most of the chaos and was filled with evaporites. There are quite a few classic,

textbook field stops in Aram; we did a virtual field trip of the area for a hundred geologists on Earth seven years ago. This is the area of Mars I know best, except for the northern polar layered terrains of course."

"Your dissertation topic."

"Exactly, if I can ever finish it!"

They turned back to the windows, but it was now flattish and boring, except for an occasional canyon they skirted. About 2 p.m. they stopped for an hour at Aram Oasis, a facility consisting of an emergency shelter, a 150-kilowatt solar power unit, six windmills, a water well, an electrolyzer to convert water into hydrogen and oxygen, a cryogenic refrigerator, fuel cells, a Sabatier unit to convert hydrogen and atmospheric carbon dioxide into methane, and tanks to store water, oxygen, and methane in liquid form.

After draining the fuel and oxygen supply completely, the caravan resumed its southeastward roll. The trail widened greatly and was smoothed to a high degree, so that sunwing aircraft could land on it.

In two more hours they reached the eastern edge of the central plateau, where the trail descended the cliff face and crossed ancient salt flats. Beyond the flats the trail headed due east toward Aram canyon, a deep gash that formed when Aram Lake suddenly drained into Ares Vallis, creating a catastrophic flood. Forest Rivers, however, ordered that the caravan leave the trail and turn southward just before they reached the edge of the plateau. They pushed across barren, fairly flat, mostly rock-free terrain two kilometers to a spot where a peninsula of sedimentary deposits extended like a high finger into the lower salt flats. An old crater 120 meters across and twenty-two meters

deep wounded the little peninsula at its base. The salt flats below were punctured by a larger 500-meter crater that was nearly one hundred meters deep.

"This is the spot," exclaimed Forest over the common channel. "The omphalos of Mars. Let's all get out for the dedication ceremony."

"'Omphalos'?" Helmut said.

"Navel; belly button," replied Victor.

"I didn't know Mars had a belly button."

"He's speaking symbolically," replied Victor, a bit irritated. "The 'center' of Mars."

Helmut decided not to dispute that claim, either. He helped Victor pull on his suit. Clara watched them and held Charlie; they would observe the ceremony through the mobilhab's big front windows.

The mobilhab's other five inmates also headed out with Helmut and Victor. Forest Rivers was already out and was walking along the rim of the crater. The crowd gathered up there on a flattish spot where they had a good view inside. The crater had crumbling cliffs of sandstone and shale in a few spots and was half-filled with wind-blown dust of great age; it had consolidated slightly into a very soft rock and was undergoing slow erosion.

"Could I have everyone's attention!" exclaimed Rivers over the common channel, snapping Helmut back to the present. "This sol marks a major event in Martian history; indeed, in the history of the human race. This sol the ideal society is born on Mars. This sol the commingling of Mother Earth and Father Mars begins. This sol the first work to transform the omphalos of Mars—Aram—begins with the transformation of Genesis

Crater, the omphalos of Aram. This sol we dedicate Genesis Crater to terraformation. This sol we dedicate ourselves to building a new borough on Mars, a new kind of human community, and to making a new start for humanity. From this place, where a circular dome will cover Genesis, line after line of biomes will reach to the north, south, and west, eventually covering this entire plateau with the green gift of Mother Earth. The greenery will then flow outward, under domed canyons and in domed craters, to cover much of this world.

"That is the promise and potential of the dedication we are about to make. Let us gather and water this world. All are welcome, whether a member of our community or not. Please come!"

He beckoned all to approach him and specifically beckoned to Helmut. Hesitating, Helmut stepped forward and joined the line.

Forest opened a large container, revealing a dozen liters of ice water. Helmut was startled to see the water, but they were in an area where liquid water could exist, though it was cold enough outside to freeze it pretty quickly.

Suited figures moved forward in line, taking cups of water that Forest filled for them with a ladle. Some poured it on the ground, watching it bubble on the warm regolith, then freeze. Others tossed it high into the air and watched the semi-frozen sleet fall to the ground. Most said something in dedication.

Helmut had found the speech silly, but the water dedication was different; it moved him. He filed forward and took a cup of water from Forest, who handed it to him with a smile. Helmut walked a few paces toward the crater rim's edge and poured it into Genesis. "To the greening of Mars," he said.

6

Selection

September 2040

Helmut practically skipped from Will Elliott's office to his flat in Columbia Biome. He pushed the revolving door with extra pizzazz as he entered the cylinder and bounded up the spiral ramp to their third floor flat. He exclaimed "Open!" as he approached the door and heard it click. He pushed it open.

He and Clara didn't have much. The flat occupied an entire floor of a ten-meter in diameter cylinder. Subtracting the ramp well, they had seventy square meters. But that was enough for a master bedroom, a small nursery for Charles, a bathroom, and a room that was partly kitchenette and partly living room. By custom it was called 'the parlor.' As he hurried in, Clara was sitting with Sebastian.

"It must have gone well," said Sebastian.

"Oh, it did! I'm a bit amazed. I was afraid he'd be upset that we stayed an extra three weeks when we could have been back here working on Jersey Biome, but Elliott said the good will we had built with the Green World Community was worth it."

"This way, they owe us a favor," said Sebastian.

"More than that; the sixteen of us had some impact on the eighteen of them," added Helmut. "I think they understand and appreciate the Commission and its procedures better. I certainly have a better feel for GWC's customs."

"The six people who stayed here and worked in agriculture have been shaped by the experience, too," said Sebastian. "What else did Elliott say?"

"That I handled Rivers well. And he and I did get along. It was a strange situation; I'm 33, he's 41, and he's practically viewed as a prophet. So I insisted on having final say over all safety related issues, including life support loads on vehicles, length of work assignments, and who did what with whom. He didn't like that much, but I let him decide what order we would do the various tasks. That caused the three week delay; after we got the shelters set up, Rivers wanted the cable footings installed for the B-160 rather than setting up the windmills and moving the old oasis. I gave him that authority and agreed we'd give him more labor, and he was thrilled. After that, he and I got along well."

"It was a good tradeoff," agreed Sebastian. "Did you actually install the dome?"

"Virtually. Once the cable footings were installed, the cables and the B-160 were finished here and shipped down. They arrived two weeks ago. We placed the dome, installed the cables, inflated the dome to 0.03 atmospheres, anchored the skirt minimally with reg, and adjusted the cables so that the tension was even. They plan to inflate the dome to 0.25 atmospheres gradually over two or three months, adding water vapor to freeze the ground underneath, and they're gradually adding regolith over the skirt as well."

"And the old oasis?"

"We move only parts of it: the solar power unit, the microwave rectenna, the hydrolysis and sabatier units, and half the methane, oxygen, and water tanks. We installed solar panels to give the place minimal power. What's left is fifty klicks from Genesis; they'll move the rest gradually over the next few months. We cleared a two kilometer road to Genesis Crater so that robotic trucks could drive over to refuel. GWC will also clear a new ten kilometer length of Meridiani Trail so that vehicles will drive

straight to Genesis, and the new length of trail will be wide and smooth to serve as a landing strip for sunwings. They're going to do our work later and we helped them get their urgent work done faster."

"We bought good will, I guess," said Sebastian. "I'm starved; let's get supper."

"What does Deseret have tonight?" asked Helmut.

"Never mind. The Patio has a pasta special and they have linguini with real clam sauce and a fettuccini primavera with alfredo sauce!"

"Oh? They've spruced up their fare?"

"They had to! Competition with Deseret is hot. I don't know where the clams came from; maybe they'll be impossible to find in the sauce. Prices have fallen ten percent, too. And wait till you see Silvio's."

"Then let's go." Helmut and Sebastian stood up. Clara had been trying to prevent Charlie from napping; she handed the boy to Helmut, who patted him on the back and let him sleep.

They all headed down the ramp and across the biome to Main Street South, which took them straight to Yalta. "It was interesting being at Aram during elections," continued Helmut, as they walked. "They watched the debates here on t.v. with some puzzlement. Ultimately, Rivers said they were in favor of universal health care through the Mars Council and everyone's opinion crystallized in favor, and that was that."

"The debate here was a bit strange, and more contentious than any we've seen so far," said Sebastian. "The Mormons were against the change, the Commission was neutral, the hospital finally came out against—because it feared a gradual loss of subsidies from the Commission—and the old timers were strongly in favor, because they

are in the best position to cut back their hours and start businesses. The Mormons, rumor has it, tried to influence people behind the scenes."

"Yes, we read that on the *Mars This Sol* website," said Clara. "It isn't true?"

"Who knows. The vote finally was sixty-five percent in favor of universal coverage; a pretty solid number. Those who favored it were elected to the Borough Council and the Mars Council. Who was elected at Aram, anyway?"

"That was interesting," replied Helmut. "The three person Council for Aram Borough is Rivers, MacLeod, and Alves; in other words, the prophet and his two assistants. Rivers made it clear he did not think it appropriate for someone of his exalted rank to sit on the Mars Council as a peer with others, so MacLeod is their rep."

"Predictable," agreed Sebastian. They opened the airlock door leading from the Main Street tunnel to Yalta and entered. Sebastian pointed. "You've got to stick your head in Silvio's first."

"Okay," replied Helmut. He entered the store. The original space had been about the size of a convenience store; now the entire first floor of the building, thirty meters long, was wide open, with pastel patterns on the walls and large signs hanging overhead.

"Wow!" he said.

That elicited a big smile from a Nigerian named Simeon standing nearby. "Welcome to Silvio's. How can I help you?"

"Oh, I'm just looking; I've been away two and a half months and heard this place was transformed."

"Indeed it is. We have a whole new line of furniture; just go down the stairs to the basement level. Our armoires are on sale this week for only 5,000 redbacks. We also have

a paperback book special this week: buy one and get one free, limit six. We need an hour to manufacture each book. And we have a buy-back special on used books this week; we'll pay half the original purchase price."

"Really?"

"Yes. The specials are listed on our website three weeks in advance."

"Thank you." He looked around again. "Wow."

"It's something, isn't it?" said Sebastian. "Let's go, I'm starved." Helmut nodded and stepped out of the store. "Silvio now has two full time employees and one part time," Sebastian continued, as they crossed the crowded patio and headed for the food service area. "Sam Anderson's the part time help. One of the full timers is an accountant and marketing guy living in Dhaka, Bangladesh; he tracks sales and inventory, recommends specials, designs the marketing materials, and uploads everything to the website. He's even got the Mars lingo down."

"Pretty good." Helmut looked at the food service area with great interest as they entered. "Wow, this is painted and rearranged, too! Very nice!"

"The glories of competition." Sebastian picked up a tray and headed down the line, filling his plate. Helmut followed, balancing his son in one arm and a tray with plates for both of them in the other. When he put his tray through the pricing unit he was pleased to see the total for him, Clara, and Charlie was only 250 redbacks; meals had indeed gone down.

They found space at a table with John Hunter and his two children; Vanessa was in Elysium doing research on Martian microfossils for a month. Helmut helped Charlie eat and managed some of his own supper as well while talking to everyone.

"How is integration of the different groups going?" he asked.

"Depends on who you talk to," replied Sebastian.

"The Nigerians are now coming to interfaith services and praying with non-Christians, so that's progress," noted John. "Two Sunsols ago I did a peace pipe ceremony and they actually seemed interested."

"They've been a good addition, overall," added Sebastian. "They provided much-needed semi-skilled labor in areas where we have always had shortages and they live in the same housing as everyone else. They aren't set apart."

"The Mormons are okay, also," added John. He pointed across the Patio. "Sometimes they eat here, sometimes at Deseret."

"How have they responded to the competition?" asked Clara.

"They're planning a big store and restaurant in Cochabamba," replied Sebastian. "About twice the size of Silvio's and the Patio. They'll need the space in a few years anyway, if Aurorae keeps growing. Yalta is simply too small to be our commercial center much longer."

"The Iranian Shi'ites have worked out, also," added John. "Ruhullah apparently vetoed a few candidates, so really extreme people were not sent. All twelve of them are very capable professionals. The women are more 'liberated' than most people had expected; I think only one of them covers her hair. Two are accountants and one is an attorney, and we needed those skills. One teaches history, literature, and wants to teach religious studies at Mariner Institute of Technology."

"What about the monks?" asked Helmut.

“They’re the most controversial group right now,” replied Sebastian. “Alexandra Lescov says that a dome with no plastic bottom is dangerous and should not be rated for habitation, nor should tunnels that are simply spray-painted with a plastic sealant. The monks disagree, but so far she has refused to budge.”

Nigel Stanfield approached the table. Helmut saw him and smiled. “Dr. Stanfield, I thought you were at the pole.”

“No, I’m back for a few weeks. When did you get back?”

“Just a few hours ago. We were in Aram for nine weeks.”

“A long time. So, are you a member of GWC now?” Stanfield said it humorously, but there was seriousness in his voice as well.

“No, but they’re someone we can work with. I’m glad you’re here; maybe we can meet tomorrow to talk about my dissertation?”

“Sure, anytime in the morning. I’ll be in my office. Just stop by.”

“I’ve been working about 70 hours a week, so I have at least a month off coming; it’s a good time to get some writing done.”

“Finish the analysis first! I’ve been pushing you for six months about that. The core sections you’re studying will reconstruct the climatic history of the Oligo-Noachian, and based on the stratigraphy exposed in the central Marineris valleys, it was a pretty active period. We need your data.”

“I’ve got to finish up the thesis soon,” agreed Helmut. “I’ll talk to Roger about taking a leave of absence so I’ll have the time to write it up.”

“Especially since the Ceres mission’s staffing will be announced in two weeks. If you’re on that mission, training starts in January. You’ll want to have the thesis done by then.”

“I agree. There’s now evidence of ice deposits at the Ceres south pole, too, so my expertise will be relevant.”

“Not to mention your geological experience here, on Phobos, Deimos, and two asteroids. You’ve got talent, Helmut.” Nigel smiled at Sebastian as well, who smiled back; no question that he was proud of his son. “So get your dissertation done and become Dr. Langlais!”

“Okay, it’ll be my priority for the next few months,” Helmut agreed.

“Good. See you tomorrow. Ciao.” Stanfield turned and walked back to his table.

“He’s right; you’ve got to finish the degree. It’ll make your credentials even better,” said Sebastian.

“Besides, I want to pursue a management degree, and the time to start has come,” added Clara. “And I can pursue it halfway to Ceres as well as here or on Earth.”

“I know; enough said!” exclaimed Helmut, with a smile. “What else is new around here, John?”

Hunter shrugged. “Garbage pickup. It starts next month once they can make the plastic garbage bags.”

“Really? We’re becoming a consumer society.”

“With throwaway packaging,” added John. “It’s a byproduct of the competition between the stores.”

“There’s another push to shorten the work sol, too,” added Sebastian. “Fifty-five hours per week is a lot. I think the Commission will at least drop Satursol mornings and move to a five-sol, ten-hour work week.”

“What will that do to your work?” John asked Sebastian.

Sebastian shrugged. “I don’t know. The Asteroid Belt Commission doesn’t have much staff here, and I already work more than fifty-five hours per week. Crew in flight training or in flight will work all sorts of strange hours anyway, and—.”

There was shouting two tables over that interrupted Sebastian’s reply. They all turned to watch as Jeff Duncan, a Commission employee, rose from his seat and point his finger at Tobin Chalmers, one of five members of the Green World Community still residing at Aurorae. “Why don’t you just go to Aram and create your stupid para… para. . . paradise rather than trying to spread nonsense about Father Mars around here!”

Chalmers rose. “Your problem is that you can’t stand a serious intellectual challenge and seek to dismiss everything by calling it a name!”

Duncan suddenly swung a fist at Chalmers. He dodged it and swung back, hitting Duncan in the face and enraging him. They both began punching each other.

“Break it up!” shouted Will almost immediately, while dashing over to the problem. “Restrain them both! Break it up!” He imposed himself physically between them and the two men immediately stopped swinging; Elliott’s presence was a sharp reminder of reality. Others jumped forward to grab the men in case they were still violent, but fortunately did not have to lay hands on either of them.

“Get rid of these people!” exclaimed Duncan angrily, but he slurred his words a bit as well.

“Have you been drinking?” asked Elliott.

“Commander—Commissioner—it’s Frisol evening!”

“Just because it’s Frisol evening doesn’t mean you can lose control, and there is no excuse at all for resorting to violence, either of you! I suggest you calm down and wait very patiently, because Constable Bytown’s on his way.”

“Bytown!” exclaimed Duncan.

Will nodded. “Both of you are under arrest, because six years ago the Borough of Aurorae swore me in as a deputy, so I am authorized to place people under arrest. Both of you are under arrest.” He pointed up. “And the cameras up there capture all activity here in this public area. As soon as the imagery arrives in Houston, it’ll go to the Security Division. Anything viewed by those cameras is admissible as evidence in the Borough Court. Both of you will have an appointment with Judge Diponte tomorrow.”

Just then Kent Bytown hurried into the biome; he had been at home when the Outpost’s environmental management computer, sensing the emergency in Yalta Biome, called him. He saw the crowd and hurried over.

“What do we have?” he exclaimed. He saw Will.

“I’ve placed them both under arrest for fighting; they both took swings at each other. There may be alcohol involved,” replied Will.

“I see,” replied Kent. “Well, gentlemen, you both look sober and serious enough right now. It sounds like we need to make a trip to the hospital to get some breathalyzer tests. By then we’ll have a videotape. I suggest you say nothing to me or anyone else right now about the incident, because you may regret your words later. Judge Diponte will view the tape and ask you some questions. Will both of you cooperate with me and

do as I tell you, or should I handcuff you both and deputize some people here to come along to maintain control?"

"No, I'll cooperate," replied Duncan sheepishly.

"Me, too," agreed Chalmers.

"Very well," replied Kent. "Let's go to the hospital and get those tests." He pointed toward a particular exit and led the two men in that direction.

The entire Patio had become very quiet. As the men walked out, everyone started to talk. "Wow, that was something," commented Sebastian.

"We haven't had anything like that happen for six or eight years," added Helmut.

"I guess it answers your question about how well everyone's getting along," said Sebastian.

"It also means we'll all have to take a class on diversity sensitivity and tolerance!" noted Helmut.

Helmut's prediction proved true; the next two weeks were filled with emails and classes about tolerance and a lot of informal discussion about why tensions had gotten so high that a fistfight had broken out. Many people—including some Commission employees—came forward with stories about how they had felt marginalized because of their race, cultural background, religion, gender, or sexual orientation. It caused soul searching, cynicism, and some changes in attitudes.

"I hope we don't have to do this again soon," Will said to Alexandra Lescov one afternoon, after she sat at the table in his office. "It's so exhausting emotionally."

“I think it might have been easier to just punish the two for fighting and leave it at that,” replied Alexandra.

“But we did punish them; they both spent a sol in jail and were fined a month’s salary. That wasn’t enough for many people, who were rightly concerned about structural and cultural causes.”

Alexandra shrugged. “The cause of the problem was a strong difference in outlook and worldview. We can expect that Mars will have that and that it will cause tension. Add some alcohol to the tension and you get a bloody nose. That’s all that happened. I don’t think we can expect people to suppress their emotions about differences. In fact, I think it’s good that people feel passionate about their beliefs; it’s natural. GWC holds to a lot of beliefs about Mother Earth and Father Mars that those of us with scientific training find to be nonsense. It’s even bad myth! They have to get used to that reaction, and we have to get used to their holding these weird beliefs. But if anyone goes beyond private smugness and uses their fists, that’s inappropriate behavior and should be punished.” Alexandra slumped back in her chair. “But that’s a politically incorrect position, Will; I can say this to you, but not in public! And that’s frustrating.”

“Well, I disagree with some of your points, but I will defend to the death your right to express them, even in public! I think there is something else going on than just a clash of passions; there’s a polarization, a we-versus-they that is set up. We’re still a comparatively small population and we have to be able to pull together in an emergency. We can’t afford polarization, disaffection, a breakdown in community. That’s the point of the emails and classes.”

"Hum. I don't know; maybe you're pursuing an elusive ideal, a dream. At any rate, Columbiad 11 is bringing 350 people and even more diversity, right? With a population exceeding a thousand and with so many separate domes, I don't see us facing a major emergency, and I don't see a village mentality persisting. Community will have to change."

"You're probably right about the trend," said Will. "Columbiad 11 is looking even more diverse. The Saudis can't stomach the thought that Mars has more Shiites than Sunnis, so they're sending twenty. The women will be veiled and won't appear in public much. But they're undergoing intensive training in all sorts of skills they can use via a women's cooperative, such as embroidery and various handicrafts. So they will be profitably occupied and we will see yet another increase in high-quality, locally made consumer goods. The men will have some very useful skills in science, engineering, and business. GWC is sending another 24 folks to Aram. The Universal Church will receive ten more and there may be a few more Mormons. The Chinese government is sending twenty-four staff to their South Pole Station and the Americans are sending twenty to their North Pole Station; their staffs are mostly transients in training for the Jupiter missions. They'll be replaced every columbiad, and both governments have promised that eventually they will turn over the facilities to us to maintain. So that's positive. I think the Chinese will allow and expect some of their people to stay, which will boost their representation here and counteract the growing Japanese influence."

"Is the Zen monastery receiving more monks?"

"Maybe four or five; they can't afford sending more people here. The ones probably coming are receiving some specialized industrial training in mould making."

“We could use that!” said Alexandra. “It’s too bad they can’t send a dozen mould makers. I’m amazed that all the seats haven’t sold.”

Will nodded. “I’m surprised, but they’re still relatively expensive; five million redbacks per person, one way. Lufthansa and United Space Express are both adopting the new fast 150-day trajectory so they can get their equipment back to Earth and use it to fly tourists to the moon. This puts the moon on a rather unusual cycle of fourteen months when tourism and other passenger traffic is slow, then twelve months when it is faster and heavier, but that rhythm will also allow for refurbishment and expansion of facilities. With equipment used constantly, costs will decline; Columbiad 12 may see round trips costing seven million redbacks.”

“I’m skeptical. I’ve heard about the idea I don’t think the moon can handle the fluctuations in demand. Furthermore, Lufthansa and United may find other private carriers undercutting them. Have you heard that Lufthansa is buying a caravel for Columbiad 12?”

“Yes, and congratulations about the contract for the outer structure of the new LEO Hilton. That’s cool.”

“We’re pleased. We can get forty-tonne pieces to LEO; the Swift shuttle just can’t do that! Any progress with the proposed new Magellan Station?”

“Not yet; they don’t have the funding in place to raise the crew to twenty-four. A lot of government officials are just saying ‘why?’ But Venus science will eventually win the day. The contract will include a massive cosmic radiation shield of water tanks. We may get a contract for an expanded Mercury surface station first.”

“Really?” Alexandra smiled.

Will nodded. “The public has become interested in Mercury science and American scientists are beginning to complain loudly that they’re largely shut out of the work. So I suspect the U.S. government will raise its profile in the Venus-Mercury Commission, and that means an infusion of American cash and an expansion of the facility to accommodate American astronauts.”

“Good!”

“But I didn’t invite you here to debate about diversity or future construction contracts. Alexandra, we have to resolve the issue of rating the monastery’s dome. They finished it almost two months ago, they’ve had it inflated to standard pressure for a month—they’ve even inflated it thirty percent above standard—and they’re tired of walking around inside in pressure suits. I know there are some valid issues about the reliability of ‘bottomless’ construction. I’ve heard people predict that in a deflation event, the ground could explode because of trapped gas or vaporizing underground water. But that hardly strikes me as an objection against the mode of construction because if one of our domes depressurized, the ground above the underskirt could do the same thing. I don’t want us to compromise safety, but I also hope we can think clearly about what the safety issues are and set a timetable or some sort of expectation.”

“Will, you never heard the worry about exploding ground from me. That’s a possible danger in our domes, too, but people will be out of harm’s way long before that can happen. My problem is determining what sort of safety standards to set. Our first dome was designed through an eighty million redback investment by the Mars Exploration Society, and we’ve had to reinforce it twice when new studies revealed possible design flaws. Our biomes represent an accumulated investment of over two

billion redbacks in design and safety. But there's a total of fifteen million redbacks of investment in this new bottomless design. We haven't equipped the new dome with sensors so that we know how much air and water is leaking downward into the ground, at what rate solar heating is penetrating into the ground and thawing the ground ice, at what rate ground ice is forming, whether the ice 'ball' under the dome is uniform in thickness or whether it has long protuberances into the ground along persistent leaks. . .in short, we know nothing about the mechanism holding in the air. The dome may be perfectly airtight for months and then suddenly fail catastrophically if a potentially major leakpoint, sealed by a small plug of ice, opens up suddenly because the ice melts from accumulating solar heat. So how can I say the dome is safe for people without suits?"

"I understand the point. What can we do about it? We have sensors; could we drill around and under the dome and install some? Could we use a steam injector and create an ice curtain around the dome down to about thirty meters or so? They've already spread a plastic cover over the ground within fifty meters of the dome; could we require the zone to be bigger? Should we install sensors under the ground cloth to detect slow leaks? Inside the dome, could we require some safety procedures like working within thirty seconds of a safety shelter?"

Alexandra hesitated. "Will, I'm not against the 'bottomless' design, but I think we need a few months to design the safety procedures. I'm not sure the monastery wants to pay for a bunch of sensors, either."

"Maybe we should ask? Because this doesn't just effect the monastery. We can do something about the monastery because it's just a few kilometers away, but the dome at Aram is outside this borough. It must operate under the same safety restrictions as the

monastery's but how will we enforce the rules a thousand kilometers from here? Furthermore, the GWC has ordered twenty-six thousand square meters of straight-chain polyethylene plastic with an ultraviolet coating for delivery over the next two years. They're planning to erect cylindrical domes thirty meters wide and a hundred fifty meters long, separated by thirty meters of buried membrane. They want to extend the line of cylinders almost indefinitely across the Aram central plateau! They plan to use this system on a massive scale. If the system has defects they could have a serious accident, and they're a thousand kilometers from here."

"Then stop them, Will! I think we have an obligation to maintain safety anywhere on Mars, not just in Aurorae Borough."

"Alexandra, we will have to safety rate their domes, but they could choose to ignore the safety rating and if they have an accident we will still have to help them, and we'll still look sloppy. I'd rather see us pursuing this actively than moving slowly and slapping on restrictions that may get ignored."

"So what do you propose?"

Will paused. "I want a plan from you; you're the expert and have access to the experts. But the plan could involve elements like these: we'll install and pay for the sensors under and around the monastery's dome because we want to do the research; we'll image the ice barrier under the dome periodically using radar or sonar; we'll install a partial pressure curtain around the dome through steam injection and compare leakage on that side with leakage on the side without the curtain; the dome can be used without pressure suits or partial pressure suits if the users can evacuate within one minute; the

dome can be used if an emergency oxygen tank is installed, or an emergency CO2 tank is installed to maintain air pressure. . . these are the sorts of possibilities I had in mind."

"They'll cost us money."

"Yes, they will, and we can bargain to recover some of it. But we are the ones who need the data because we're responsible. We knew they planned to cut up the bottom of the dome and convert it into an exterior skirt. Furthermore, if this 'bottomless' construction works, we will have to try it. If Aram can construct farmland at, say, a quarter the cost of our farmland, they can raise food more cheaply and sell it more cheaply. Do you want that? They could get a big chunk of the Bioarchive contracts that we have been unable to fulfill properly to date."

"Hum." Alexandra thought about that a moment. "Frankly, I wish that were a reason to ban this form of construction; I don't trust it or like it. Properly manufactured multilayer plastics can hold air in reliably; clay and ice cannot!"

"How do you know, Alexandra? Air can leak laterally through the ground and escape, but how much will that happen if an entire square kilometer of ground is covered by buried plastic sheeting? If we were a small outpost with two or three domes and a few dozen people, we couldn't afford to lose fifty tonnes of oxygen a year into the ground; but we're big enough now to accommodate losses much bigger than that. We've got twenty thousand tonnes of liquid water in the reservoir and enough installed electrical capacity to electrolyze ten tonnes of water a sol, if need be. The issue driving everything is how to save money, not how to create a completely closed ecology. We have to function in a new commercial, cost-competitive market, and frankly we're getting killed right now."

“Killed may be the operative word, too!”

“I agree, there is more danger of a serious accident on Mars, or on the way to Mars, than ever before. And at the same time there are new forces driving cost reductions that promise genuine, permanent, and safe savings. I need you to be looking at innovations critically, rigorously, and free from prejudice either for or against them. I don’t like hearing an idea criticized because you don’t ‘like’ it. And I don’t want us to look indecisive. Give me a plan for safety rating the monastery dome that will tell the monks what they can do.”

“Okay! I get the idea. I agree, it’s important. If we could start building downward under our domes, we could acquire a lot more usable space, and we badly need it. Preparing for Columbiad 11 will demand over half our construction capacity and I’d like to reduce that as much as I can. I’ll prepare a draft of recommendations in two weeks.”

“Fair enough. We’ll need cost figures for a monitoring program so we can negotiate with the Zen monastery and GWC.”

“I think safety drills showing they can evacuate the dome in one minute will be sufficient to allow use. The B-160s can’t depressurize very quickly; they’re just too big! Regulations for the use of tunnels under the dome are more tricky, though, and may take longer. I gather they aren’t planning to move into their cave habitation for six months or so.”

“Let’s try to have some safety rules ready before then, though. Start with the dome, but give me draft regs for the tunnels in four to six weeks; is that doable?”

“Yes, I think so.” Alexandra rose. “I’m not happy about it, but I can live with it.”

"Me, too. Life is never predictable and it doesn't always go the way you want it to. There are outside forces at work on us and we have to accommodate them sometimes." Will saw a flashing icon on his screen. "Oh, and speaking of outside forces, I see the Asteroid Belt Commission has just released its flight roster for the Ceres mission. Shall we look?"

"Oh, yes. Thank God Yevgeny decided he was too old and settled to go gallivanting across the asteroid belt." Alexandra walked around the table to Will's side while he clicked on the link. They scanned the 24 names, smiling.

"A lot of congratulations are in order," Will said.

Helmut, Clara, and Sebastian sat around the table in Helmut and Clara's flat waiting for the email. When it popped into Helmut's in box precisely on time, they all took a breath.

"Click on it," said Clara.

Helmut did, and they scanned the crew roster. Then Clara squealed. "There we are!"

"We made it!" said Helmut. "Wow!"

"Congratulations!" exclaimed Sebastian. "I guess I'm happy for both of you. I feel really torn; I don't want you going, but I'm proud the task force selected you!"

"Thanks, dad." Helmut hugged his father. Clara kissed him on the cheek.

"Don't worry about Charlie; he'll be fine," she added.

"I'm alright with him going along; I really am. The radiation task force looked at the question of children on board extra carefully. There are four crew quarters that are located under the liquid hydrogen tanks and snuggled against internal water tanks. A

child residing there will have reasonably good protection against cosmic rays and full protection against solar radiation. It's not an ideal situation, but it appears to be manageable from a health point of view."

"Dad, it may be better than staying on Mars," added Helmut. "Studies on lab rats over at the hospital have proven that airborne dust is a low level carcinogen, and there are still some concerns about trace elements in the Martian soil. The cancer rate here is somewhat higher than the radiation models predict and no one is sure why. The caravel may be just as safe for him."

"Perhaps," said Sebastian. "Let's hope so."

7

New Years

late Dec. 2055 and early January 2056

Helmut looked around the room at the twenty-five other human beings. Except for two-year old Charlie Langlais and almost eleven-year old Caitlin Vickers, everyone was between 32 and 48; Clara and Helmut were the two youngest. The team was male and female and from a multitude of races, nationalities, and religions. They were all immensely well trained and experienced.

He looked at Clara excitedly. She smiled at him, excited as well. Charlie felt the energy in the room; he was bouncing up and down on his mother's lap. Helmut looked at the banner in front of the classroom with the logo of the Asteroid Belt Commission on it. It had a whole new meaning for him now.

The door opened and Sebastian Langlais entered the room. Commander Charles Vickers immediately stood; the others followed him, showing respect for the Commissioner of the Asteroid Belt Commission. Sebastian smiled and walked to the front of the room.

"Please, be seated," he said. "I apologize I'm slightly late; if any of you know me, you know I am punctual. I received an unexpected political videomail; maintaining our cash flow requires constant vigilance. I have very little to say here because Charles—Commander Vickers—will do most of the talking. I want to welcome all of you to this mission, ABC's first, and thank you for your service to the ABC.

"The Asteroid Belt Commission is not a Mars project; it's humanity's project. The Ceres 1 Mission is supported by the United States, European Union, Russia, China,

Japan, the Mars Commission, Brazil, Kenya, and India, in that order. We happen to be based on Mars, but the ABC may send out missions from Earth as well. Some of the crew members are newly arrived residents of Mars who have extensive experience on the moon, near-Earth asteroids, and Venus orbit. We've already opened the application period for a Vesta mission launching in 2060 and we're receiving hundreds of applications from Mars, the moon, Earth, even from Mercury! I emphasize this because we are not going to the asteroid belt for Mars; we are going for all of humanity. The fact that the mission is being launched from Mars and that Mars has so many extremely well qualified and experienced residents who can serve as crew speaks highly of the role of this world in humanity's exploration of and expansion into the unknown.

"If all goes as expected, you will visit four worlds. You'll spend a year on Ceres, which has 2.8 million square kilometers of surface; almost half the size of the continuous 48 states of the United States. If things go better than nominal, you will return with more scientific knowledge than any single exploration project ever launched. If something goes wrong, some of you—maybe all of you—will die. It is virtually impossible to launch a rescue mission. Our equipment is very safe and reliable, but it can never be safe and reliable enough.

"So I thank you for your courage. I wish I were young enough to go along. You can be sure that when you return—and I am confident you will—we will all celebrate your success." He turned to Charles. "And now I turn the floor over to Commander Vickers."

Charles rose. He was 44 years old, slightly balding, with prematurely graying blond hair. “Greetings to all of you,” he began. “We’re starting early because all of you were so anxious to meet! Training begins after Christmas, New Years, and Equinox.

“We’ll start January 5 by moving into a cluster of four cylinders. Ceylon Biome has just been pressurized; the land will be barren for the next three or four months. We’ll set up and finish three cylinders, which will provide us the same amount of housing space as we’ll have on our caravel, the *Giovanni Piazzi*, named for the discoverer of Ceres. In February and early March we’ll stay at South Pole Station and explore the area together. March through May will be devoted to study of the asteroids we’ll be visiting and what’s known about the belt; everyone will have their research assignment. In June we’ll fly to Embarcadero, spend a month setting up the *Giovanni Piazzi*, and launch our advance supply vehicle to Astrea. We’ll take the caravel on a shakedown cruise to Deimos, where we’ll maintain the fuel manufacturing equipment and drill a special research shaft all the way through the moon. We’ll return here in September and October for more study, to assemble our supplies, and wrap up our lives here. In November we’ll fly to Embarcadero and set up the *Piazzi*, fueling and provisioning it. In December we set off for Astrea.

“The seven-month flight will be dominated by completing the setup of the *Piazzi*, refining our plans to explore Astrea, and setting up of our advance equipment there. Our six-month stay will include a complete study of Astrea and manufacture of two hundred tonnes of fuel for the next leg of our trip. We’ll leave Astrea in December 2057 and continue on to Ceres, which we’ll reach, if all goes on schedule, in August 2058. About October 2059 we’ll leave Ceres, and after short visits to Hebe and Flora, we’ll reach Mars in late 2060, four years after our departure.

“It’s a long time to be away from home. We’ll return to a very different place, with more than double its current population. My daughter Caitlin will be sixteen. Charlie will be seven. Three automated vehicles will be returning with very used drilling and fuel making equipment and up to five tonnes of samples. We’ll receive three resupply vehicles. We’ll have three abort opportunities to Earth and one to Mars.

“Dharmapala Peres is chief science officer; Lin Chen is the chief engineer; Sophie Chen is the chief environment officer; Juliette Delafontaine is the ship’s chief physician. All of you will be working with two or three of them at one time or another, since all of you are highly qualified to do at least three tasks. Questions?”

Jack Alberghini raised his hand. “Once we move into Ceylon together in January, how much will we be mixing with the rest of the outpost?”

“Good question. Monsol through Frisol, not at all; we’ll eat all meals together and no one will be able to join us without my permission. Weekends you’ll be able to go to the Patio or Deseret and stay in your old flat. We have to become a team, so we have to know each other well and develop a sense of solidarity. That’s why we’re going places together and building things together.”

“Commander,” said Clara. “Should we plan to bring Charlie along to Deimos?”

“Yes, he’s part of the crew. He has to learn how to handle life on board, weightlessness, and engine firings. Caitlin’s coming along as well.”

“Could any of us be disqualified by the next year of exercises?” asked Zach Hersey.

“The purpose of the training is to make us cohere closely as a team, not to disqualify anyone. But it is possible someone will resign. We have several alternates.

Other questions?" There were none. "Good. Enjoy the holidays! At least, everyone but Helmut; he defends his dissertation next week. Come 2056, our work together begins."

The Deseret Cafeteria was brightly decorated for the holidays. Will was pleased to see the wreath of artificial pine branches and stopped to feel it.

"Come on, dad!" said Marshall.

"I'm coming. I wonder how they made these wreaths."

"Good sol, Dr. Elliott," said Henry Smith. "Did you have a good Christmas?"

"Good sol, Henry. I suppose we did, but for us it was an ordinary sol."

"I'm surprised so few people celebrate Christmas up here. Sales are definitely stronger this week than last; most people exchange gifts on New Years."

"Well, it's more international, I guess. But remember, we're Bahá'ís, not Christians."

"Oh, that's right. I'm sorry. How's your assembly doing?"

"Well, thank you; we elected a nine-person local spiritual assembly for Aurorae more than half a year ago. Mars now has thirteen Bahá'ís; we've received two new members this Gregorian year."

"So I heard. Are the two of you sitting for lunch?"

"Yes."

"Over here, then." Henry pointed to a counter with relatively few people. He raised his attaché. "What would you like?"

"Our usual."

“A hamburger with french fries and a salad for Will, a cheeseburger with fries and beef-vegetable soup for Marshall,” the attaché said in reply.

“Exactly. Make it so,” exclaimed Will, knowing that phrase would cause the attaché to send the order to the kitchen.

“Thanks, Dr. Elliott,” replied Henry. He reached down and removed the electronic paper menus on the table and stood them up where they were out of the way. The customers could talk to the menus or click on them as well to order. “So, anything new?”

“New? Just the continued strong terrestrial economy and the steady weakening of gold prices.”

“A problem for us, I know. At least it reflects the drop in terrorism.”

“The currency negotiations are driving down the gold prices, too.”

“If they’ll ever go anywhere,” said Henry. “I doubt the Europeans will let the Russians into the euro zone or that the South American cone states will really establish a common currency.”

“Even so, there appears to be momentum toward larger economic units. That’ll force much tighter economic integration, and that drives political integration.”

“I suppose America has no choice but to participate; as long as New York and Washington get some of the new institutions. So, that’s driving down gold prices.”

“Probably. Economic integration reduces financial uncertainty, and that decreases the desire to hoard gold. I’m worried about the result.”

“I can imagine. Dr. Elliott, I want to change the subject. I have a theoretical question for you.”

“Yes, what is it?”

“How easy would it be for a group of us to buy some land inside the Outpost? Not a building, but a building site.”

“I suppose it’s for sale just as much as the buildings themselves.”

“Good. That’s what I thought. I want to talk to a group of us about purchasing land for the eventual construction of a Mormon temple.”

“Oh; well, there’s no requirement to use land in a certain way when someone purchases it. The borough does have some zoning restrictions, so you’d have to talk to them. Land’s expensive if it’s pressurized.”

“I know. What do you think the public reaction will be?”

“I think you can guess. Some will be jealous, some will feel it’s a terrible waste of land and space, and some won’t care.”

“What do you think?”

“I think we live in a place where people can make choices how to use their resources, and that’s the sort of place we should live in.”

Henry nodded. “Thank you, Dr. Elliott. That’s good advice.” He turned and headed to another new customer.

“Where can twelve of them get the money to build a temple?” asked Marshall.

“The Mormon Church is worth billions, and so are a few Mormon businessmen. If they build a temple here, they’ll get a lot of publicity and the faithful will feel proud their religion is flourishing on Mars, so the faithful will teach others more and will tithe more.”

“I get it. So, why don’t we build a Bahá'í temple here? There are more Bahá'ís here than Mormons! Actually there are more than thirteen Bahá'ís here, dad, because you only included the adults! What about the kids and youth?”

“Sorry; you’re right, there are seventeen Bahá'ís here, not thirteen.” Will contemplated. “You ask a good question; why not a Bahá'í House of Worship? I suppose one answer is that I doubt the Marsian Bahá'í community ought to ask for support from Earth. But we could probably build it ourselves. We have a lot of financial resources, the seventeen of us.”

“Especially our family?”

“Yes, because the longer someone’s on Mars, the more wealth they have. The six hundred people here on Mars have something like 3 billion redbacks of net worth.” He didn’t add that he and Ethel were worth 60 million of that. “And if we borrowed money, we could pay for the building over twenty years or so.”

“A mortgage.”

“Exactly. I think I’ll ask to meet with the Spiritual Assembly. It’s worth considering. Or maybe the time has come for us to purchase a small building to serve as a Bahá'í Center. We’re now holding events twice a week; we could use a permanent space.”

“No one else has a space, either, but maybe they need it. Sammie goes to church on Sunsol, Sunsol school, and Bible study. The Catholics have a lot of events, too. The Universal Church is always doing all sorts of things.”

“Exactly, and all these churches are getting bigger and wealthier. I suspect they’ll all want buildings pretty soon. But it might be a good idea to avoid a big building boom right now; half the people here will be turned off by it.”

There was a small commotion at the entrance to the cafeteria as Helmut, Clara, Charlie, and Sebastian entered. They looked very excited. Will smiled and rose. As they walked in, he walked over. “Dr. Langlais, I presume?” he said. Helmut nodded.

“He did a great job!” exclaimed Sebastian. “It was a public defense of his dissertation. Stanfield had some pretty difficult questions, too, but he answered them all!”

“Ask me anything about the Oligo-Noachian,” commented a smiling Helmut, referring to the third of the six divisions of the Noachian, the earliest epoch of Martian geological history.

“What’s the dating of Candor Lake 2?” asked Will, joking.

“Oligo-Noachian Estival Twenty-six, assuming the classic study by Underwood and Shankaraman is right; there is now some contrasting opinion. My cores from north of Korolev, in the middle of Olympia Planitia, have a particularly prominent layer from the twenty-sixth.”

“Okay . . . what does *estival* mean?”

That stumped Helmut. “Hey, this is a doctorate in climatology and stratigraphy, not Greek!”

“*Estival* and *hibernal*: from the Latin words for summer and winter. Various terms were tried and rejected, but these have stuck, for better or worse.”

“What an *estival*?” asked Marshall, puzzled.

Helmut replied quickly. “When Mars has a high axial tilt, the polar layered deposits sublimate, the atmosphere thickens, the greenhouse effect gets somewhat stronger, and Mars has an *estival* or planetary summer; then the tilt heads back to zero, much of the atmosphere freezes out, and Mars has a *hibernal* or global winter.”

“Still, Martech should teach the meanings behind the words!” exclaimed Sebastian. “We’re too scientific and technical and not sufficiently oriented to the humanities!”

“That’ll change,” replied Will. He offered his hand. “Congratulations. MarTech has produced another fine alumnus. We’ll miss the two of you, but you’re embarking on a very exciting adventure.”

“Thank you, Will,” replied Helmut, shaking hands. It was the first time he had called the Commissioner by his first name. “We’re thrilled to be going, too.”

“I can imagine. Sebastian and I are both jealous, right Sebastian?”

“Yes. I considered resigning as High Commissioner of the ABC in order to apply, actually. But I’m too old.”

“And where will this one go?” asked Helmut, tapping Marshall on the shoulder.

“Saturn or beyond,” replied Marshall. “Triton sounds really interesting. Of course, dad won’t even let me go outside with Sammie yet!”

“Hey, regulations are clear,” replied Will. “You and Sammie can go outside together when both of you are sixteen. You’ve got a month to go and he’s got almost thirteen months. Meanwhile, either of you can go outside with an adult.”

“I’ll go out with you some time,” volunteered Helmut.

“Will you?” asked Marshall. “With Sammie, too? We want to climb to the top of the Tower.”

“That’s a bit ambitious, though the trail’s safe enough. I was on top once; the geology’s good all the way up, and the top’s interesting. Okay, maybe Frisol, if all parents agree.”

“Is that okay, dad?”

“Sure,” replied Will. “You have no school all week. It’d be a good way to spend half the sol. But let’s not bother Helmut right now; he has some celebrating to do.”

“Congratulations, Helmut.”

“Thanks, Marshall.”

Most of the Outpost had the rest of the week between Christmas and New Years off, then January 2 and 3, because the latter was the northern autumnal equinox. Equinox was Mars’s own holiday, complete with a contest for the most elaborate costume, a parade of the contestants, great dinners, and a concert. The holiday season included holiday sales in both Silvio’s and Deseret, which was a new phenomenon on Mars. Helmut found the time to take Marshall and Sam outside twice. Will used the time to write a geology article he had been thinking about for several months.

But everyone was back to work on January 4th. Will arrived in the office to find a backlog of work. The face of his imaginary secretary, Anisa, soon appeared on the screen of his attaché. “You’ve got an email from Ludwig Collins in Environmental Management Audit, Seville, saying that the data about Aram’s enclosures stopped coming. They were getting it steadily from Genesis and never got any from the other two domes, which

should be set up by now. He asked three times for a status report and finally checked a satellite photo and saw all three were inflated. He thinks you have to get involved. GWC has sold forty tonnes of methane to Aurorae Spaceport in the last three months, which means they've manufactured about one hundred sixty tonnes of oxygen, probably to make up for losses. Unless the Commission threatens to cut off services, it appears GWC won't cooperate. There's a videomail from Sally Chines of the Budget Office with the latest financial projections, and they are looking worse and worse. The price of gold continues downward. She recommends some drastic budget cuts or some conversations with governments. Louisa Turner asks about the wording of a statement about the Commission's finances; she's gotten queries from two media outlets. She thinks the January and February media themes may need to be reconsidered because the financial matters will push routine themes aside. Alexandra already called about the 10 a.m. meeting with you and Lisa; she wants to reschedule to 10:15. You also have routine hellos from Concordia Station, Mercury and Aitken."

"Give me Ludwig's email, please," Will replied. It appeared on the screen with the current time in Seville displayed in a chronometer box; Anisa's face shrank to a small square in the lower right corner. Anisa had summarized the request quite well. "Okay, Ludwig, I'll call Forest Rivers right away," Will said when he finished reading. "Anisa, send that as an email to Ludwig, and now connect me to Rivers in Aram, please."

She nodded and the screen went blank. He could hear Rivers's video communications device ringing. "Good morning, Dr. Elliott," exclaimed Rivers a moment later, his face appearing on the screen. "What can I do for you?"

"It's good to talk to you, Dr. Rivers. I hope you had a good new years?"

“Yes, though we’ve decided not to celebrate it, and to stick to Martian seasonal events. We did mark the terrestrial northern winter solstice, though. How about you?”

“We stayed up to participate in the celebration in Yalta Biome. I’m calling because I note that you’ve sold forty tonnes of methane to the spaceport here in the last three months. It appears you’re leaking a lot of oxygen at Aram.”

“No, I wouldn’t say that. We’ve had some leaks, but we’ve mainly been building up our reserve supply. The leakage has started to decrease significantly in the last few weeks, as predicted.”

“I’m glad to hear that. Environmental Management in Seville has sought data from you several times in the last few months. The regulations call for continuous data transmission, once a dome is inflated, from your environmental management controls to our center in Seville, for a backup audit of procedures and a review of developments. Genesis has been inflated for months and we helped install the sensors. We’re still getting nothing, which is a cause of grave concern for the Commission.”

“I appreciate your concern, Commissioner, but we are managing our affairs quite well down here and really don’t need to be audited or reviewed. You’re welcome to come personally to inspect our facilities any time.”

“Then perhaps I’ll send a team down. This is a serious matter. Let me put it this way, Forest: you have a month to comply. We will start to fine Aram if we don’t get live data by February 1st. I hate to be hard nosed about this, but that’s the way it is. Preserving human life is a responsibility of all of us and we can’t let this matter slide.”

“I see. Will, we really do appreciate your concern. But this is our borough and our colony, not yours—”

"And it is on the planet I am responsible for. February 1st, Dr. Rivers. I'm not going to change my mind about this. I'll get back to you about what the daily fine will be. If we have nothing by March 1st, the daily amount will increase. This request is not technically complicated. It is a routine matter; talk to Yoshi. We monitor the Zen monastery's environmental management systems and they've gotten extremely capable as a result."

"Mr. Commissioner, perhaps I should go to court about this matter, then."

"Feel free; we have plenty of lawyers, too. February 1st; I'll have an email drawn up summarizing our position. Have a good sol."

"Thank you, Mr. Commissioner."

"Goodbye."

"Goodbye." Will closed the line. "Anisa, forward this conversation to Huma, so she can draw up a summary for my review, then it would go to Rivers, Collins, Islami, Kok, Messier, and Turner. Let's see Chines's videomail."

"Acknowledged," replied Anisa. A moment later, Sally Chines's face appeared on the screen.

"Good sol, Dr. Elliott," she began. "The income projections are looking significantly worse because of the continued decline in the price of gold. We're now projecting it to be below 500 redbacks per ounce by the time Columbiad 11's gold reaches Earth; that's seventeen million redbacks per tonne. Production estimates are also down: 320 tonnes. That means, after the take of the mining companies is accounted for, we're projecting an income in 2057 of 2.8 billion redbacks. That's a billion dollars less

than we hoped and half a billion less than we planned for, which means our 2057 budget goes from a half billion dollar surplus to a half billion in deficit.

"We've informed Pierre and he's already started lining up visits with several national representatives to the Commission Board, but as you know, the U.S. really wants to cut their support rather than increase it and Europe is committed to the burgeoning expenses of the Mercury mission. So we're facing a realignment of priorities. If you can canvas the people up there, we'll have a better idea what to expect. We want to push the sale of caravels, but the Mars crew is already working at capacity and output is lower than expected. More land could be released for sale, but the revenue is always unpredictable and the impact on the value of existing plots could be adverse. The biggest research we could cut on Earth would be the silane and diborane production and utilization project. The biggest program we could cut on Mars, besides exploration itself, would be advanced aircraft research. We could ask the Asteroid Belt Commission to pay higher fees for some services and could raise the interplanetary freight costs. We're preparing a list for your review. Advice would be appreciated. Bye."

Will stared at the screen for a minute after Sally's message ended. Money was a perpetual problem; Mars wouldn't be self sufficient for some time. During the Turanistan War of the mid 2040s, the loss of American and European support had been covered by a tripling in gold prices. Mars's platinum and iridium output was still small because of the immense costs of extracting them from nickel-iron meteorites. Dependence on government subsidies carried many political liabilities that had to be handled with extreme delicacy. Mars faced the classic problems of economies dependent on the export of raw materials, and it was still too small to diversify its industrial base.

"Thanks Sally," Will replied, without bothering to tell Anisa to send the reply; she would figure it out. "I'll schedule a heads of staff meeting up here in the next week and I'll ask Pierre to schedule one for the heads of staff down there. We have cash in the bank that we could use. Thanks for the list of options. Bye. Anisa, please convert Sally's options into a list; Huma can help if you get stuck. Give me the budget summary for this year and next, please."

He scanned the two-page budget summaries, reminding himself of their plans and how the expenses had been going. Not sure what to do, he decided to let his subconscious work on the problem, so he called Yoshiyaki Suzuki up at the monastery.

"Good sol," said Yoshi, answering the ring with audio only.

"Good sol, Yoshi, this is Will Elliott. How are you this sol?"

"Quite well, Will, and you?"

"Fine. Enjoying the return to work."

"Few people can say that, usually, but I know you love your work. How has the switch to the five-sol workweek gone?"

"It's too soon to say; the first free Satursol comes up later this week. But everyone seems to be very pleased with it and they are planning what they will do with a real weekend. And everyone's asking when we'll cut the work sol to eight hours from ten, but I don't see that happening soon; with cafeterias to provide quick food, robotic laundry and house cleaning, and no commute to work, we can afford to work ten hours per sol. How's everything up there? How are your plans for transporting more people and cargo?"

“Reasonably complete. We’ll be importing six more monks and of course we’re replacing the cargo that burned up. The insurance payments have been adequate.”

“I think we’ll initiate a sale to sell the last thirty places on Columbus 11. If so, I’ll let you know. You may be in the position to import a few more monks.”

“Yes, let me know.”

“How’s the dome holding up?”

“Very well. The sensors and the radar imaging have given us a very thorough knowledge of the ice table underneath. As heat works downward and melts the ice, so far the water has migrated downward and frozen closed any new cracks. We’re losing five tonnes of gas per month, but that’s a manageable rate. We’ve planted most of the interior of our crater. You should come up and see.”

“I’d like to do that. Say, Yoshi, do you talk to Forest at all?”

“Maybe once a month I call him or he calls me. Why?”

“We’re very concerned about safety issues at Aram. We have no idea how well they’ve developed their three pressure enclosures and we are getting absolutely no data from them, so we don’t have any feel for how safe their efforts are. A major depressurization looks bad for all of us and could be a disaster for them. Pretty soon we will have no recourse but to fine them daily. I can appreciate their concern about independence, but in this case it’s a question of auditing each other’s procedures to maintain everyone’s safety. Their environmental managers will get to review our procedures as well.”

“Rivers has a very strong concept of independence. It’s unfortunate you haven’t been able to place sensors there. We’re acquiring definitive knowledge of our dome and the ice curtain underneath, and that breeds confidence.”

“It does. Yoshi, I’m not sure how to request this; could you say that to Forest? He trusts you. My concern is not to make life difficult for him or to take away the freedom of his utopia. My concern is with lives. Maybe their domes are safe; more likely, they are less safe than yours, they don’t know it, and we don’t know it. If they have an accident, people might die, they’ll lose prestige, it’ll cost them a lot of money, and it might cost us money and prestige as well.”

Yoshi considered. “I’m not sure Forest trusts me; in a sense he doesn’t trust anyone but himself because he’s a prophet. Human prophets can have a problem with cravings. They may not see things as they are. But perhaps I can say something to him that will help him see things rightly.”

“It sounds like you want to rise to the challenge.”

Yoshi laughed. “Perhaps; one of my cravings is to reform people! I’ll call him.”

“Thank you. I owe you a cup of coffee, Yoshi, so next time you come down to the outpost let me know.”

“Or bring some coffee up; sometimes I get tired of our tea. That reminds me, we’re having a special tea ceremony in two weeks and we’ll be sending you an invitation. It’ll be taped for broadcast on Japanese television; we tape a ‘reality’ show here weekly that’s very popular back at home. We would be honored if you’d participate.”

“It would be my honor, Yoshi. As soon as I get the invitation, I’ll check my calendar and see whether I can make it.”

“I hope you can, Will. I hope you can take some time this sol to slow down, close your eyes, relax, breathe slowly, and open your mind. It will be better for you and for your work.”

“I’ll do that, Yoshi, right after the call ends. In fact, I need exactly that kind of mental state to tackle a particular problem. May this sol bring you many opportunities to serve others.”

“Thank you. Goodbye.”

“Goodbye.” Will closed the line and looked out the window at the dome and the escarpment beyond. He could almost see the site of the monastery. He sat up straight in his chair, closed his eyes, and relaxed for a few minutes. But it was harder to relax his mind; it tended to seethe with ideas and tasks. Yet when he calmed the surging sea of thought, whenever he let it loose it tended to toss useful ideas out.

It was now 10:18; he was late for the meeting. He hurried to the conference room down the hall. Lisa Kok, Alexandra Lescov, and Tatiana Petrovna were already sitting together scrutinizing a huge piece of electronic paper with the plans for Andalus Dome. Ruhullah Islami walked into the room at the same time. “You’re late, too,” he whispered.

“I was meditating,” whispered Will.

The three women—the director of the environmental management, the director of construction, and the head interior designer respectively—were looking at a specific building inside Andalus, a large five-story rectangle eighty meters long and forty wide that ran from the dome edge to Andalus’s off-center public square. The square was surrounded by buildings and had several short streets.

“Let me see the food court area again,” said Lisa.

Tatiana nodded, touched an icon on a corner of the schematic with her finger, and outlined the building. The exterior view was replaced by a blueprint. “This is the bottom floor of the mall,” she said. “It opens onto Andalus Square through a series of pillars with concealed pressure door tracks, so we can close it off in the event of a depressurization. The grand entrance is two stories high; very impressive and attractive. The food court itself has seating for 1,000 people, not counting tables on the square. There will be kitchens and cafeteria lines for the two eateries we currently have and accommodation for Silvios, Deseret, and a dozen small stores and boutiques. The square will accommodate dozens more. The food court will have an alcove with a dance floor that can serve as a nightclub. The square will have a section with small portable kiosks for small businesses and a flea market. The second, third, fourth, and fifth floors are for storage, future commercial expansion, a theatre for showing movies and for our Satursol Night Show—which is now becoming reasonably popular—Commission offices, and apartments. Altogether the building has 16,000 square meters; it’s very large.”

“My main objection, which is a huge objection, is that you’re making the cafeteria an equal partner to Deseret Café,” said Lisa.

“No, we’re not,” replied Will. “We’re making it one of many food outlets, which is worse than you thought. But let’s look at this dispassionately. There’s no reason for the Commission or the Borough to be in the restaurant business. This is an operation that can be easily commercialized. Competition will increase variety and lower costs.”

“Easy for you to say; I have an entire staff worrying about their jobs.”

“Encourage them to start their own businesses,” replied Ruhullah. “In another year and a half Mars will have a thousand people; Aurorae Outpost alone will have about

750. Two years later we'll have several hundred more. We don't need a centrally managed cafeteria any more."

"Or break your operation down into a series of mutually reinforcing subgroups," said Will. "Create an Italian food outlet, an Oriental food outlet, an Indian food outlet, etc. You've got plenty of time to talk to your people and develop a plan."

"These are painful and complicated changes," replied Lisa, shaking her head.

"How big is this dome, in terms of population?" asked Ruhullah. "I don't see how you can complete it in eighteen months."

"The interior will take a long time," replied Tatiana. "It can hold at least 500 people; enough for the eleventh Columbiad and part of the twelfth."

Ruhullah shook his head. "That's risky. Too much housing in one facility."

"We plan to construct Cathy Dome next year and build housing there, as a backup. It'll have a square as well, which will be as close to Andalus's as possible, and they'll be connected by tunnels. In both cases we'll start by constructing the buildings right around the squares, to define the central space, then fill in the buildings around the edge of the dome later."

"And you've planned four domes, right?" asked Will.

"Yes," said Tatiana. "All four are named for areas on Earth where cultures came together and mixed. Al-Andalus, or Muslim Spain, brought the Muslim, Christian, and Jewish cultures together. Cathay was Marco Polo's name for China; it represents all of East Asia. In 2057 or 58 we'll start on Punjab Dome; the Punjab in what is now northern Pakistan and northwestern India was the cradle of Indian civilization and a major contributor to Hinduism and Buddhism, though this sol it is also the home of Muslims

and Jains and is the cradle of the Sikhism. In 2059 we'll build Zanzibar, named for an island in the Indian Ocean off Tanzania where Arab, Indian, Chinese, and African cultures blended. Together the four will hold at least 2,000 people; more if the interdomal areas are filled with underground tunnels and buildings."

"And each will be accompanied by three B-160 agricultural biomes," added Lisa. "Enough to feed and recycle all the wastes of the 500 people. Without plastic bottoms."

"What?" said Alexandra. "Why shouldn't they have plastic floors?"

"Oh, come on, Alexandra. It's clearly not necessary. The Zen monastery's dome has proved the concept. As long as the thawed soil has a water table below it, if a crack opens in the underlying ice lens, liquid water gets pushed in and it refreezes."

"But a B-160 has 20,000 square meters of floor and needs at least 10,000 tonnes of water to form a stable, airtight ice lens and water table, assuming the water doesn't flow from some areas and pool in others, producing spotty protection."

"It's cheaper than excavating a hole, installing a floor, putting the soil back, and putting the trees in big pots," replied Lisa. "Not to mention that when the plastic membrane leaks, we either perform very expensive repairs or create a water seal anyway."

"It's not a tested technology," exclaimed Alexandra. "Maybe it will be, but it's still risky."

"So what?" asked Lisa. "Mars now has 50,000 square meters of pressurized space. We can afford to take chances with units of 20,000 square meters. Where can the air go? Every B-160 we add will be built against the outpost, which will seal part of the ground around it against leaks. I favor the system they're using at Aram of creating long

north-south cylindrical enclosures that aren't too wide, to keep the forces from pressurization at a minimum. Pile regolith between them to hold an interdomal skirt down and keep leaking air in. Make the interdomal areas the right width so that the domes' reflection blankets aren't stealing light from each other every early morning and late afternoon, only from the interdomal areas. Let people build underground housing under the interdomal areas opening on the cylinders if they want. Connect everything together with pressurized underground roads. Let the outpost expand over the Aurorae Valley."

"Alexandra, I hope you aren't planning to put a membrane down under Andalus," exclaimed Tatiana. "Because it really isn't necessary. Andalus's our first truly urban space. The entire floor will be covered by buildings, streets, or the central square; it'll all be concrete and stone. We'll have to install the dome, partially pressurize it with Martian air to create conditions adequate for pouring concrete, then oxygenate it for workers and buildings. The best way to do that is to drive circumferential piles, steam-wet the reg, let it freeze, soak the ground to freeze up the central area, pressurize with oxygen, and build. With Andalus, the piles have to go down sixty meters."

"I was planning to install a pressure membrane."

"Don't bother. We have plenty of water to freeze the ground now. We didn't when the outpost got started."

"Tatiana, that's not your decision, it's mine."

"Or mine," exclaimed Will. "The data from the Zen monastery has been very persuasive. A lot of cheap water is available and it makes an excellent airtight seal. And we have to save money. I just heard from the Budget Office that our 500 million redback surplus for 2057 is projected to become an500 million redback deficit instead because the

price of gold is falling to prewar levels. We've got to stretch out Martian jet aircraft research, silane production and utilization projects, and expand exports. The 'polder' concept can save ten or fifteen percent of labor costs, right?"

"More," replied Tatiana.

Alexandra shook her head. "I'm not convinced the savings are worth the risks."

"Have you seen the latest report from the Mars Construction Institute in Moscow?" asked Lisa. "They say the polder approach is potentially *more* safe if each dome is surrounded by a vertical airtight barrier and has at least thirty meters of buried plastic sheeting around it to allow recapture of leaking air. The self-sealing nature of the water table underneath is a big plus."

"I haven't seen it, no."

"Well, plan on reading it," said Will. "Tatiana, is this urban center approach cheaper than our current designs?"

"Definitely. This is a new approach; a sort of pendulum swing, but an important swing. The first phase of outpost construction involved small, crowded habs and small agriculturally intensive greenhouses. Then the pendulum swung and our housing became a sort of American suburb, with apartment buildings set in tiny parks and intensively farmed gardens. It was much more open, airy, verdant. Then we began to build larger domes and raise the population density somewhat, but they still felt suburban. Aurorae Outpost now feels like a bunch of suburbs in search of an urban center. Andalus, Cathay, Punjab, and Zanzibar will provide an urban focus, a 'downtown.' It'll solve the problem that Yalta is way too small to serve as our commercial center any more; it'll become the home for our elementary school, allowing Mariner Institute of Technology to expand.

The high population densities in these four domes will make them relatively cheap per person to build, and the polder technique means we can install new foundations and buildings as we go."

"So, what else will go around the square?" asked Will.

"A Borough Hall for the local government at the eastern end. I'd suggest a Commission headquarters building on the western side; you'll need the space soon."

"What about some places of worship?"

Tatiana was surprised. "I suppose we could include them."

"Public spaces have always included churches and mosques," agreed Lisa. "That makes sense."

"I know of at least two religious groups wanting buildings," said Will. "I suggest we open up the design of these domes to the public and let businesses and groups purchase land and build their own structures. These four domes will make Aurorae into a city, and that's an exciting development."

"If the time to privatize restaurants is fast approaching, when will we privatize construction?" asked Lisa.

"It's a matter of time," replied Will, to Alexandra's scowl.

8

Emergency

March 2056

For the Ceres crew, January was a month of construction in Ceylon Biome and team bonding. At the end of the month they boarded two shuttles for a forty-five minute ballistic hop to the South Pole.

The Chinese South Pole station was theirs for two months. The departing winter crew of four Chinese, two Americans, a European, and a Japanese showed them around and oriented them to the equipment, then boarded the shuttles to fly to Aurorae. In early March, before the dust storm season started, the shuttles would return with the summer crew and fly the Ceres mission back to Aurorae for a rest before they tackled their next assignment at Embarcadero.

South Pole Station was too cramped for all twenty-six of them—it was designed for sixteen—so their first task was to set up a permanent expansion to the facility, pressurize it, and cover it with two meters of snow. Robotic trucks delivered the parts for three windowless nickel-steel Quonset huts, each ten meters long and six wide, which they welded together and pressurized. In four weeks they had a fairly comfortable space, and the station was larger.

While setting up the expansion, the team accomplished a major drilling project. Ten kilometers from the station was a particularly thick point in the accumulation of dry ice, ice, and dust in the center of an ancient crater. They began a shaft to penetrate to the early Noachian basement sediments. As the sun rose higher in the sky sol by sol, they

made longer and longer trips across the layer terrain, extending the trails cleared by previous explorers, searching for meteorites and exploring the exposed layers of deposit.

One sol is mid February, Helmut ran the driller. Driving back to the station with two sols of sediment cores—some fifty meters—he stopped twice to admire the beauty of the polar scenery, which was an ever-changing spectacle of rising mists and shifting fogs in the golden horizontal light. The station had been built on an ancient crater rim that stuck up through the billions of years of deposits and had quite a vista around it. He went inside reluctantly. He had responsibilities; he and Clara were responsible for supper that night. Besides, he had become aware of a dull ache in his lower abdomen.

"How was the trip?" asked Charles, who was suiting up to go outside as Helmut came in.

"Fine. We got all the cores and set up the driller to drill fifty meters deeper."

"The bit isn't dull yet?"

"No, the ice content is still pretty high. It's cutting through the deposits like a knife through butter. I think we can speed it up, to 37.5 meters per sol, and change out the oxygen and methane tanks every 36 hours instead of every 48."

Charles considered. "Yes, let's do that. We've only got two more weeks. We might as well drill farther down, even if we're drilling in basement. For all we know, the basement rock might be interesting as well."

"Okay, I'll turn up the drill rate before going to the kitchen."

"Anything to avoid the kitchen!"

Helmut smiled, a bit embarrassed; he was known to be a reluctant kitchen worker. "The mission should have a full time cook. Are you on your way to Akansha Cirque?"

Charles nodded. “We’re going to shoot a few outcrops with the laser, to compare the spectra with samples from the base of the cliff. There’s a particular unit—probably mid Noachian—that appears to have evaporites in it, and we’re trying to pin down the composition so we can find a sample at the base.”

“Mio-Noachian Estival 15 is the really big one in the northern deposits; there’s evidence of lakes, so we should find it here as well. We’re really lucky the impact uplifted such early deposits.”

“I’ll show you what we find. Say, you look a little pale.”

“Really?” Helmut considered the remark. “I have a stomach ache.”

“Well, rest if you need it. Ciao.”

“Ciao.” Helmut headed into the station via the control room, where he adjusted the drill’s power output and speed. Then he headed for the kitchen.

“Where have you been?” asked Clara. The tone was more curious than accusatory; she kissed him quickly right after saying.

“Charles authorized some adjustments to the drill rate. What do I do?”

“Check the breadmaker; it’s got ten loaves rising that should be ready for the oven soon. Then batter and bread the tilapa.”

“I wish they’d send us tilapa that were already breaded!”

“On the *Giovanni Piazzi* we’ll be raising tilapa and cleaning them, so don’t complain. I‘ve got the soup going and the potatoes are almost ready for mashing. After you finish the tilapa, help me with the green beans. I think there’s enough ice cream left from the batch Thierry made last week, so we don’t have to worry about the dessert.”

“Just a week’s worth of bread,” replied Helmut. He turned to the bread maker, a highly automated unit that had a computer screen displaying the bread’s progress. He didn’t have to open the door to look; there was a camera. So he pulled out the ingredients to make the batter. Yet the pain in his abdomen did not fade into the background noise of sensations; it remained dull and constant, and even began to throb a little.

At suppertime they put everything out and enjoyed the usual compliments as people filled their plates. The crowded refectory filled with laughter and stories about the sol’s work. Martha Vickers brought Charlie from the daycare area and the three Langlais sat together at the end of one table, enjoying a bit of privacy. The Ceres crew had clicked well; there were a few personal rivalries, but by and large the crew members liked each other and worked together well. Charles Vickers was a constant presence in the room, almost unconsciously monitoring relations, encouraging people, and taking the temperature of the various personal interactions. Martha, ever the maternal psychiatrist, sat with him, seemingly interacting with Caitlin but in fact remaining as alert to personalities and behaviors as he.

“If you have any questions about your work assignments for tomorrow, ask me soon; I’m going to bed early tonight,” said Charles as everyone began to pile their dishes into the dishwasher. Then some people drifted out of the refectory, heading for their personal quarters, while others began to watch a movie on the big screen in the front of the room. Helmut and Clara headed back to their room because it was Charlie’s bedtime.

“Boy, this ache is getting worse,” said Helmut after Charlie went to sleep. He rubbed his abdomen on the front right side.

“What’s the problem?”

"I don't know; a sort of stomach ache. But it's beginning to bother me."

"Maybe you should go see Juliette."

"No, it's not that bad."

"Suit yourself." Clara headed for the bathroom.

They watched a bit of t.v., then went to bed. Helmut awoke before dawn because the pain had gotten much worse. He lay in bed shifting positions to find comfort. Finally Clara said, "Does it hurt that much? You're making it impossible for me to sleep."

"It's hurting enough to wake me up from a sound sleep."

"Then call Juliette. I'm sure she can see you right after breakfast."

"I guess." He dreaded the thought because he suspected it was his appendix. Helmut headed to the bathroom to wash and get ready for the sol. By then it was 6:30 a.m. He headed to the refectory, but had no appetite. He came back to their room and got Charlie ready for the sol, then called Juliette. She could see him in ten minutes.

"Probably appendicitis," she said after a quick examination. "Let's get a scan."

"Okay."

She set up the body scanner; Helmut called Clara. She arrived when he was in the machine. Charles Vickers arrived about the same time as well. Helmut joined the others clustered around the image on the screen.

"You see it?" said Juliette, pointing to the appendix. "It's severely inflamed. I'm afraid it has to come out."

"Really?" said Helmut, with dread in his voice. "Where? Here, or the Outpost?"

Juliette looked at Charles. "There's no question that we can do it. I'm trained to be able to do almost everything. I took an appendix out at Shackleton and had to do

various minor surgical operations at Magellan. Martha's trained to assist; she could do the operation if she had to."

"This is a laparoscopic procedure?" asked Charles.

Juliette nodded. "Yes. It's a small incision. Recovery's pretty quick."

"And it's a safe operation?" asked Clara.

"Oh yes."

Charles looked at Helmut. "We can do this, and we need to be able to do operations like this on the flight. But we can get you to the Outpost if you prefer the hospital."

"I wouldn't recommend a ballistic flight to Aurorae," said Juliette. "The gee-force could cause the appendix to rupture. I think it's unlikely, but it's a possibility. Every hour we wait, the more likely a rupture could occur."b

"And the more painful it'll become," said Helmut. "Let's not wait. Let's get this over with."

"Okay," said Juliette. "Don't worry, this is pretty routine."

Will was almost ready to leave Deseret Cafeteria as Sebastian was coming in. He waved and Sebastian walked over.

"Good sol; how's Helmut?"

"Oh, he's fine; resting and recovering from the surgery. It was routine and had no complications. The appendix was more inflamed than they thought and was about to rupture, Juliette said."

"It's a good thing they caught it when they did."

“I wish Helmut had said something twelve hours earlier; they could have flown him back here if they had more lead time. But I guess it’s just as well. This could have happened half way to Ceres. Better that it be part of the training exercises two hours from a good hospital than two hundred million kilometers from anything.”

“Definitely. It sounds like the team has cohered well. They’re doing some excellent geology.”

“Charles has done an excellent job of building a team. This is one of the best teams I’ve ever seen, and we’re just three months into training. All the science and construction they’ve done has been first rate. The Chinese are very pleased by the addition to their station.”

“It’ll make it easier to share the place with the Americans. I’ve got to go. I’m calling Charles when I get back to the office. If there’s anything new I’ll let you know.”

“Thanks, Will.”

Elliott nodded and headed out of the cafeteria. As he left the tent housing the store, Henry Smith saw him. “Good sol, Mr. Commissioner. I hope the lunch was good.”

“Yes, the chicken piccata special was excellent. I hope the Patio copies the recipe.”

“I’m sure they will! We innovate and they follow.”

“What do you think of the plans for Andalus Dome?”

“The mall will be a great improvement over the current situation. I sent some suggestions to Tatiana; I don’t like the design for our space, especially the kitchen, and I’m still not sure how the tables in the food court will be covered.”

“The menus will be standard electronic paper; push an icon and the customers will connect to any menu on the web they want. The computer people told Alexandra that it wouldn’t be hard to set them up so that people can order straight from the menus by pushing icons or speaking to them.”

“Good, I was hoping we could set up direct customer ordering. Wait staff is just too difficult to retain.”

“I know, and between voice recognition and robotic delivery, it really isn’t necessary. If you have any suggestions about Andalus, videomail them to me; I’m playing a personal role in the project.”

“Okay, Mr. Commissioner, I will.”

“Thanks. Ciao.”

“Ciao.”

Will headed out the door and across Cochabamba Dome. It was a two-minute walk through a tunnel, across Shikuku, through another tunnel, and into Riviera Biome where Mars Control and his office were located. Back in his office, he called Charles Vickers.

“Good sol, Charles. How’s Helmut Langlais doing?”

“Good sol, Will. He’s fine. I just visited him after lunch. He’s awake now, a bit weak and nauseous from the anesthetic, but he’s recovering fine. Juliette says he can resume regular duties in ten sols.”

“In time to fly back here, then.”

“Exactly. The shuttles arrive here in eight sols with the summer crew and fly us back to Aurorae in ten.”

“I’m relieved he’s doing so well and that the appendicitis was caught before it progressed any farther. Please congratulate Juliette and Martha for me, for acting so swiftly and effectively. From everything I’ve heard, you’ve done an incredible job, so congratulations to you as well.”

“Oh, don’t congratulate me! We’ve got Mars’s best. These are incredible people. We’re wrapping up our work here and we’re looking forward to some shore leave, then two months of study of asteroids before we head for Embarcadero.”

“The workers in orbit are looking forward to turning over the finishing work to your folks. The best way to know a vehicle is to build it. It’ll be good to see you here, Charles. Let’s have lunch.”

“That’d be great. How’s everything at Aurorae?”

“Oh, pretty good. The big problem is balancing next year’s budget. It looks like we’ll be slashing Martian aircraft research, which is a real shame. The shuttles are a very expensive way to move people and a little cargo from point to point, surface transportation is cheap and slow, and the sunwings are cheap and rather slow. Silane-powered aircraft are better. What we really need are nuclear powered aircraft, but we can’t afford to fund that and no one else will. How has Caitlin adjusted?”

“Oh, pretty well. She misses her friends, even though she sees them every sol by video at school. We may try that all the way out to Ceres.”

“Tell her Marshall’s jealous. Well, I’ve got to run. Have a good sol. Ciao.”

“Ciao.”

Will closed the connection and turned to his email. There was yet another message from Ludwig Collins of the Environmental Management Audit Department in

Seville that the Green World Community had postponed their compliance with safety regulations another month, and that they had offered a long term contract to sell Aurorae Spaceport two hundred tonnes of liquid methane over the next year, an offer the spaceport had turned down because it could not obtain the seven hundred tonnes of liquid oxygen needed to burn it as shuttle fuel. That was the last straw. With a growl, Will called Forest Rivers.

"Hello?" said Rivers, activating his videophone.

"Good sol, Forest; how are you doing?"

"Well, Dr. Elliott; our agriculture is doing really beautifully and our domes are greening very nicely. You should come visit us some time and relax for a few sols."

"Thank you; if I can spare the time I might. Say, Forest, I thought I'd let you know that I have made a very important decision regarding safety matters up here. As of March first, if we haven't started receiving environmental management telemetry from Aram, there will be a fine of one million redbacks. The fine will be a million redbacks per month until May first, when it increases to two million redbacks per month. I thought you'd like to know before this is announced publicly."

Rivers was startled, if not shocked. He leaned back in his chair. "Dr. Elliott, this is grossly unfair; it's unjust!"

"Unfair or unjust, that's my decision. Sometimes I have to make unpopular or difficult decisions; as the head of a community, you know how that is. You'll note that I'm not raising my voice or anything, just letting you know that this decision is final and there is no appeal. We look forward to receiving the telemetry soon."

"And you will, I am sure."

"I'm sure also. Have a good sol, Forest."

"Good bye."

"Good bye." Will closed the circuit and spoke to his attaché. "Anisa, please transcribe the last video conversation with Dr. Rivers and copy it to Ruhullah Islami, Lisa Kok, Pierre Messier, Louisa Turner, and Ludwig Collins."

While Helmut recovered, the Ceres expedition packed for their flight back to Aurorae. The shuttles brought the Chinese summer crew and they began to move into the station. At Aurorae, a major expedition headed west, up the Valles Marineris system to probe various side canyons and explore the nearly infinite amount of exposed strata in the canyon sides. Regolith-moving equipment began to clear the ground for Andalus Dome.

Then at 4 a.m. March 1st, emergency alarms began to go off at Aram Outpost. Forest Rivers, who slept a half dozen meters from the control area, was immediately awakened and dashed in, pajama-clad. "What is it?" he demanded of Victor MacLeod, who was in charge of the controls that night.

"Depressurization!" replied Victor. He pointed to a screen. "Dome Eika; it must be a huge leak, too, it just started and I think it's accelerating!"

"Wow!" said Forest. The lines on the graph were turning sharply downward; the thirty by one hundred-fifty meter dome was quite large, but was losing air with incredible speed.

Just then, communications beeped. "Hey Victor, what's happening! Our ears are popping here!" It was Victorino Alves.

"Where are you?"

“In the agriculture preparation area.”

“Oh, no,” said Forest. Ag Prep was a large area of still-empty rooms between Eika Dome and Dva Dome, to the west of the former. Genesis Crater, where the control room was, on the other hand, was east of Eika, and there was no way between without walking across the depressurizing dome.

Victor hit reply. “How many are there? You need to get out immediately, Eika’s losing air! It’s already down a tenth of an atmosphere!”

“Victor, that’s too much, we can’t cross!”

“What’s the pressure in Ag Prep?” asked Forest. Then he turned to another computer screen and called up the data. “Where in hell are the Ag Prep sensors?”

“There’s only one on line so far.” Victor reached over and pushed a button. It showed a sharply down-trending pressure line.

“Why is the pressure dropping?” demanded Forest.

“I don’t know!” snapped back Victor. “The bulkheads separating the interdomal area between Eika and Dva are air tight!”

“Obviously not! The bulkheads are crossed by pipes, ventilation shafts, and other potential breaks in the pressure seals.”

“We never had time to check them all for leaks.”

Forest shook his head and turned to the communications. “Victorino! Everyone in the interdomal area must get out immediately! Do you copy that? How many of you are there?”

“I’m not sure. I think Linda and Mick are in their future apartment, and I know Jim and Rachel are in theirs!”

“I don’t have data from any of them!” exclaimed Victor, looking for personal data on yet another screen near him. His own ear piece was in place because he was communicating over it, but Forest had left his ear piece in his room. Many GWC members had not acquired the habit of wearing them to sleep or even keeping them with themselves.

“Intercom?” asked Forest.

“We can try it, but we haven’t installed most of the speakers yet.”

Forest nodded grimly and pulled up the intercom controls. He opened the line. “Calling all personnel! We have a catastrophic air leak in Dome Eika with at least five personnel in the interdomal area between Eika and Dva. Evacuate to Genesis immediately. I repeat, evacuate to Genesis immediately. Emergency personnel report to the control room and airlock. We need rescue teams immediately.” He closed the line. “I’m heading for Ag Prep.”

“Hurry! The pressure will be too low in maybe five minutes!”

Rivers nodded. “Get help here in the control room and get someone to assemble a rescue team!”

“Be careful!” Victor pointed to the pressure monitoring screen. “The pressure’s dropped in Dva; there’s a leak all the way across the interdomal area. We didn’t build those bulkheads to withstand a full pressure drop on either side, so there’s no guarantee they’ll hold.”

“They’ll have to hold!” said Forest. Then he turned and ran out the door.

He grabbed his ear piece and headed down the pressure tunnel from the brick building in Genesis to Eika, aware that the tunnel’s nickel steel walls were rather thin and

in some places had been hastily welded. They had expanded their facility with immense speed, completing three domes and their facilities in only eight months. *Father Mars must be fertilized by Mother Nature's verdure,* Forest had repeatedly said. Now the revelation echoed in his mind. Father Nature was not so easily tamed.

He reached the end of the tunnel and entered the airlock. Refused to let him cross because of the pressure drop so he used the mechanical controls to bleed off the air. When he opened the door into Eika, he was panting. He could hear a roar from the northern end where they had had air leaks at a fairly low but steady level for three months. No time to investigate. He turned to the sprinkler controls nearby and flicked them on with a single hand movement; they still had no central control over the irrigation system. *Father Mars must be fertilized by Mother Nature's verdure.* There had been no time to integrate and automate everything.

He dashed across the dome as the sprinklers began to come on, splashing water all over him. He stepped into the airlock on the other side with a gasp, slammed the door shut, and began pressurization. On the other side he began to run the length of the interdomal space, a fairly large area with few internal walls. "Evacuate immediately via the main airlock to Genesis!" He shouted. "Get out immediately!"

"It's too late, the air's too thin!" exclaimed Victorino, bringing two others with him from the northern end of the interdomal area.

"Nonsense, I just crossed it! It's a ten second dash!" Forest gave Linda and Mick a push. "Go! Where are the others?"

"I think Carlos and Fabian are at the northern end!" said Mick. "They would have headed for the airlock up there!"

“I’ll check!” said Victorino. “You all go! Jim and Rachel headed for the northern exterior airlock because we know it’ll stay airtight!”

“Good! You all come with me!” said Forest. Linda and Mick nodded, frightened. The three of them turned and headed for the airlock.

By the time it had depressurized enough to open the door to Eika, they were gasping for breath; the dome’s pressure had dropped very fast, in spite of its enormous size. They began to run across the dome to the airlock on the other side. Forest grabbed the door to open. It wouldn’t open. He pounded on it and heard a bang from the other side.

“Someone’s inside and on their way here!” he said.

“Look!” said Mick. “The water coming out of the sprinklers; I think it’s boiling!”

Forest turned to look and was startled to see that the water, which was at about ten centigrade, was indeed vaporizing. Then he suddenly realized a tickle around his eyes; *water around his eyeballs was boiling as well.*

Panic rose and he turned to the airlock to bang on it again. Linda collapsed next to him, but he barely noticed; he banged harder. He noticed blood on his fist, looked, and saw it was bubbling as well. . . then Forest Rivers lost consciousness as well and crumpled to the ground.

Fifteen seconds later the airlock door opened and two pressure-suited figures had Mick literally fall into the lock on them. They pulled him inside, then grabbed Forest and Linda and pulled them in as well. They closed the door and started an emergency air flood, reporting back to Victor as they waited. Once the lock was full they opened the inner door, where someone else had arrived to help move the unconscious but still

breathing figures to sick bay. As they went they could hear sharp snapping or popping sounds coming from the steel bulwark; it was under severe stress as the pressure differential built up.

Victor looked at the various screens around him and called Will Elliott. At Aurorae it was 4 a.m. Will's attaché began to ring wildly in emergency mode, jolting him awake. He dashed out of bed and over to it.

"No video please, Anisa. Activate call." He paused for the light to come on. "Elliott here!"

"Dr. Elliott, this is Victor MacLeod, assistant to Dr. Forest Rivers. We just had a major depressurization of Polder Eika. It's causing bulwarks between it and the Polder Dva to leak and possibly fail."

"Eika? Dva? Which ones are they?"

"Sorry; those are the names we've given our two cylindrical open-ground domes; 'eika' is one in Sanskrit, 'dva' is two. The leak is in number one and number two's in danger of failure."

Will was irritated that he didn't even know the names of their enclosures. "Victor, can you get telemetry to us?"

There was a pause. "Negative, our central control is still not set up properly."

Will wanted to scream *not set up properly?!* But he resisted temptation. "Is everyone safe and accounted for?"

"Negative. We have people sleeping in temporary structures built under the space between the polders and some are trapped."

"How many?"

"I don't know. At least five."

"*You think?* Aren't people wearing their ear pieces?"

"Negative, most of us don't."

"Can they get into an airlock?"

"We've told them to do exactly that."

"I see." Will paused. Ethel was now up and watching. "Anisa, connect this call to Mars Control, please," he said, suddenly realizing that he had to get the expertise involved immediately. "Victor, has dome 2 depressurized yet?"

"No, but it's beginning to."

"Call everyone and get them to count people or report back. You have to know where everyone is. Can you scramble some people in pressure suits to work on the leak?"

"We've got three people suited up; they're handling the injured. Five more are suiting up. But I've found a camera showing the hole in the ground that blew out. It's quite large. A jet of snowy air is shooting fifty meters into the sky outside the dome."

"You have a serious problem. Kent, are you on the line now?"

"Roger, Will. I heard a little of the conversation with Victor."

"Victor, you work with Kent a while. I'm getting dressed and will run up to Mars Control in about two minutes. Anisa, transfer this call to Mars Control and close the call here." Will pulled off his pajama top and put on the shirt he had been wearing the sol before. "The idiots!" he said to Ethel, once the line was dead. "I can't believe this!"

"And they never sent telemetry."

“And it’s four hours after the deadline. I’m fining them a million redbacks, just like I said, and now we have to go rescue them and we’ll get bad publicity for not stopping this.” He pulled on yestersol’s pants.

“Good luck.”

“Thanks, I’ll need it.” He unplugged his attaché, closed it, and picked it up. “Anisa, forward the entire call from Aram to Mars Control in Houston and alert Louisa Turner about it, no matter what time it is, day or night.” He waved goodbye to Ethel and dashed out of the house.

Mars Control was one level up, so he was there in seconds. The two men on duty were clustered together around an attaché that carried audio, but no video; Will hadn’t realized Victor had made a telephone call to him, not a videophone call, because he had turned off his video. “Status?”

“The bulwark between the two domes just failed; there’s rapid depressurization in the interdomal area.”

“What were the walls made of, cardboard? Any more information about personnel?”

“Two of them made it into the airlock on the other side of the dome, but three are still unaccounted for.”

“Damn. Who can we get there?”

“Most of the exploration vehicles are in Marineris or Hellas and two shuttles are at the South Pole. We could scramble two other shuttles, but it’ll be noon tomorrow before they could fly.”

“The South Pole; the Ceres Expedition’s there and scheduled to leave in about six hours. They could fly to Aram just as easily, couldn’t they?”

“It’s the same distance as Aurorae, yes. But there’s inadequate fuel at Aram to get them back here.”

“We’ll handle that later. Call the shuttle crews there; I’m calling Sebastian.” Will put down his attaché, opened it, and ordered it to call Sebastian in emergency mode.

Sebastian’s phone rang and rang and rang; it was the middle of the night. Finally he answered with a groggy voice. “Hello.”

“Sebastian, this is Will. We’ve got an emergency—”

“Is it with Ceres?”

“No, no, but we need the help of Ceres. The Green World Community has had a major dome failure and it has depressurized a second dome as well. People are trapped. Ceres is scheduled to fly back here in six or seven hours; if they flew to Aram instead, they’d get there sooner than anyone else can. By the time they stabilized things, we could drive a team overland. Sunwings can’t move enough people and cargo to be effective.”

“Of course.” There was a pause. “Their training is supposed to involve handling almost any conceivable emergency. Sure, they can go. I doubt both shuttles can go at once; they can probably accelerate the launch of one at the cost of delaying the launch of the other. Considering the team includes two children who barf every time they fly, a delay of the second shuttle may be wise. It’d be nice if some of the costs are picked up.”

“Let’s worry about that detail later. The Green World Community will owe both of us something; probably in the vicinity of ten million redbacks!”

“I’ll call Charles Vickers right now.”

"And we'll call the pilots, since they're Mars Commission employees. Sunrise at Aram is about two hours away. It'd be good if we can get a shuttle there soon after."

"That should be possible because both are loaded up, fueled, and checked out. And we know the launch site's in daylight; the sun won't set down there for half an annum."

"Thanks, Sebastian. Come on down to Mars Control if you want."

"I'll call Charles, get dressed, and come on down. Bye."

"Bye." Will closed the circuit. He looked around Mars Control; three more personnel had arrived to help, one with curlers in her hair. Kent looked up.

"The situation's deteriorating fast," he said. "They think there's two dead in the housing between the domes. And the bulwark between dome one and the B-160 is beginning to distend and leak. It looks like they'll lose it, too."

"No wonder they didn't want to give us telemetry," said Will, disgusted. "It sounds like nothing was built to specifications."

"Pressure walls made of cardboard," agreed Kent, dismissively.

The next few hours were a whirlwind of activity. Within minutes of Sebastian's call, the emergency alarm sounded throughout South Pole Station, followed by details over the intercom. The shuttle *Pavonis* was to launch in less than three hours with eight personnel. It already had a ranger inside—the only one they had brought along—packed with equipment. The shuttle *Hadriaca* was to follow five hours later with everyone else, and it might fly to Aurorae instead if the situation at Aram was stabilizing. All medical personnel were going on the *Pavonis.* So was Helmut, since he knew Aram.

The *Pavonis* launched at 7:30 a.m. The engines burned powerfully but briefly, boosting the ten-tonne shuttle and its fifteen tonnes of cargo to 10,000 kilometers per hour in a bit over two minutes. It flew ballistically up into space, then back toward Aram, entering the atmosphere and burning off much of its speed half an hour later. Its engines roared alive again and set the vehicle down for a safe landing on pad 3 about six kilometers from Aram Outpost.

No one was there to greet them, but no reception party was expected. The eight of them had flown to Aram wearing their pressure suits. They climbed into the ranger as soon as it was driven down the ramp and within fifteen minutes of landing they were approaching the Outpost.

"Oh my God," said Helmut. They could see that both cylinder domes and the B-160 had collapsed.

"How could they have done this?" said Charles, shaking his head. "Two dead, three hectares of planted interior space now frozen and killed, housing destroyed, water boiling away and freezing into ice. . . this is unbelievable."

"Especially since everything was looking fine when we left here six months ago," said Helmut. "Of course, at the time the B-160 was it. The two cylinder domes were just ideas."

"From the sound of things, the B-160 was depressurized because of their shoddy modifications to the work your team did," said Charles.

"I hope we don't have to hang around very long to help them," added Helmut.

The driver pulled the ranger up to the northern end of Cylinder Dome Eika. They could see a long, icy crack in the ground north of them; it was the cause of the air leak.

Air with wisps of condensing water vapor could still be seen rising from it. The ground all around was white with snow.

"Wow; that crack must be five or six meters long and thirty centimeters wide," said Helmut. "That must be a preexisting geological feature."

"The Central Aram Plateau has some patterned ground," said Charles. "I bet that's the edge of a frost polygon. Note the sixty degree bend in it."

"They should have done the seismic survey everyone urged," said Helmut. "But it was 'too expensive.'"

"Not any more. Let's go. Assuming they still have folks trapped in airlocks without space suits, we've got to get that crack plugged up so the dome can be repressurized, even briefly with CO_2, so the trapped people can be rescued before their air runs out."

They depressurized the ranger and stepped out. There was still no one to greet them, so Charles and two others headed for the crack to study it while Helmut headed for a nearby airlock to get inside and the physicians headed for a conestoga nearby where three injured people awaited their assistance. But the airlock Helmut headed for happened to be one of two that had someone trapped inside, so he and the three engineers with him had to walk all the way around the dome over Genesis crater in order to reach the only useable airlock the outpost had. Victor MacLeod greeted him just inside, safely clad in a pressure suit.

"Boy, are you a sight for sore eyes." He held out his gloved hand; Helmut shook.

"It's good to see you again, Victor. What's happening?"

“The B-160’s just about down; the wall between the domes completely failed an hour ago. Did you see the crack around on the other side? Quite a spectacular jet of gas and water was coming out.”

“I bet. How big’s the hole inside?”

“Three meters long and two wide. We emptied twenty tonnes of water into it and it did no good at all. That was all our spare water. There’s a cavern down there and all that water just thawed the sides and eroded it wider.”

“It’s the edge of an ancient permafrost polygon. Freeze-thaw can create permanent cracks in the ground, and the dessication of the sediments on the plateau over the last three billion years probably caused ground shrinkage and opened it up even more. Eolian deposits and crater ejecta buried and hid it.”

“It’s really bad luck to build on top of one.”

“They can be detected seismically. We found some weak zones near the Zen monastery and filled them with slurry. Their dome isn’t leaking at all. Why did the pressure walls fail, Victor?”

“We didn’t build them to exterior standards so they weren’t designed to hold up against a full pressure difference. We were fools; we cut corners.”

“How many injured?”

“Three, including Rivers, who was in Polder Eika—Dome 1—without a suit rescuing people when it depressurized. He’s recovering, though.”

“Who’s been in charge?”

“He is; he still is.”

“Well, actually, not any more. Elliott declared martial law here three hours ago. Charles Vickers is in charge until Lieutenant Governor Érico Lopes arrives by ranger with emergency supplies. That’ll be about midnight, I suppose.”

“I wish someone informed us!”

“I’m sure Elliott did, Victor.”

Victor MacLeod was silent about that. “I’m not sure he has the authority to declare martial law.”

“He does under the Mars Commission Treaty and the Mars Fundamental Law as Governor of Mars, not as High Commissioner. What’s being done to rescue the people trapped in the airlock?”

“We’re welding a ranger to the airlock so that the trapped people can transfer to the ranger.”

“That’ll work, I guess. We’ve got a ranger with us and it has regolith moving equipment. Our priority is plugging the hole so that your domes can be repressurized. Then we’ll have to figure out how to make sure the air stays in.”

“We probably never used enough water; we soaked our 30,000 square meters with only 1,000 tonnes of water. That’s all we were able to extract from the well in eight months. As a result, we’ve lost an unbelievable amount of air in the last six months; something like 100 tonnes of oxygen. We’ve never been able to find a specific leak, either.”

“Victor, when you have a persistent leak, *put down a plastic liner*! You don’t have to have access to the Martian ground everywhere!”

“We’ve made some decisions based on philosophy instead of engineering.”

Charles quickly marshaled the twenty people at Aram able to work and coordinated the welding of a pressure tunnel to the airlock with people trapped inside. They were rescued in about four hours. Another crew turned to the other airlock with trapped people and welded another pressure tunnel to it, rescuing them before sunset. A third, larger crew worked all night to weld steel reinforcements to the bulwark between cylinder dome 1 and the B-160 so that the latter could be repressurized safely. There was no need for the rest of the Ceres crew to fly down; they would add too many people and not enough emergency housing. The second shuttle flew to Aurorae Outpost.

A bit after midnight, Érico Lopes arrived from Aurorae with six more crew, two mobilhabs to provide additional emergency housing, and three robotic trucks with supplies and regolith-moving equipment. In spite of the darkness, they got to work.

By midmorning the emergency was partially over. The B-160 was beginning to repressurize with carbon dioxide. Inside Cylinder Dome 1, water and fine-grained regolith were being mixed to make several tonnes of slurry to plug the cavern. The three injured persons were stable in a mobilhab set up as an infirmary.

About that time three large sunwings appeared in the sky over Aram Outpost. They landed successively at the landing strip. Will Elliott was on the first sunwing. Within minutes he was inside Cylinder Dome 1 staring at the huge circular hole.

“It’s incredible what air pressure and warm water can do,” he said. He peered down into the hole. “It looks big enough for a skinny man to crawl through.”

“I think so,” agreed Charles. “We released a tonne of carbon dioxide into the dome earlier this morning as a test. The air pressure dropped back to ambient in about ten

seconds. There's an entire cave system down there and it must be at least half a meter wide and a meter or two high."

"It's a permafrost polygon?"

"Probably. We'll do seismic tests in three or four sols to map the subsurface in this area, and then we'll know."

Will nodded. He looked around Cylinder Dome 1 in detail for the first time. The space was thirty meters wide and 150 meters long, occupying nearly half a hectare. Originally a series of garden plots of corn, wheat, tomatoes, potatoes, rice, green beans, cucumbers, and zucchini, it was now devastated and brown. The rice paddy was drained of water and tinged white with ice. The corn still stood, leaves limp and withered, but the wheat had fallen flat. Several garden plots had gaping holes where the workers had excavated soil to make the slurry to plug the leak.

Will was curious to look at the brick housing built into the wall facing cylinder dome 2. The brick façade was quite impressive; it was thirty meters long, with a series of glass windows opening on the sunlight and verdancy of the dome. He could see that behind the façade, the regolith was piled on top of the dome, so the structure had massive radiation shielding. He and Charles walked to the main airlock door and opened it. There was no pressure differential, so they were able to walk through.

Inside was a large, unfinished space, the plastic dome and its regolith overburden overhead supported by metal plates and large brick columns every seven or eight meters. Sunlight poured into the space through the dome-facing windows. He could see sunlight at the far side as well. "So, this future accommodation connects all the way across to cylinder dome 2?"

"Affirmative," said Charles. "That's why the other dome depressurized as well. They'll have to weld a metal pressure barrier across the space and install at least two airlocks."

"A lot of work. But it has immense potential. Is it structurally sound?"

"It appears to be."

Will and Charles crossed to the other side. They opened the door and entered cylinder dome 2. It was a destroyed ecology just like the first. Then they walked back to Cylinder Dome 1 and took the tunnel to Genesis Crater and the B-160. The vegetation inside was not completely dead, since it had been reduced to Martian conditions for only half a sol, but it was badly wilted. The interior of the crater had been smoothed and terraced using the loose rocks originally covering the walls and floor; the transformation was quite impressive. A large brick building with a flat patio roof covered part of the crater floor and extended against the crater wall.

"Does that continue as underground structures?" asked Will.

Charles nodded. "Yes, and eventually they had planned to connect it all the way to Cylinder Dome 1. I think they have to reconsider that idea now."

"I dare say. I like their architecture and their overall plan. The twenty-five of them already had three hectares of greenery; I'm impressed by their accomplishments. I like the idea of extending the cylinder domes over the entire area, too."

"Though it has suffered a pretty serious blow."

"Yes; two people are dead. But what they plan to do is not impossible, they just have to move more slowly and be more careful. These cylinder domes can be made safe. I'm convinced more than ever that we need to move in this direction. Think how nice it

would be to purchase land beneath the interdomal area and build your own house. You could even have your own private garden; you'd have to make an opening in the regolith to let the sunlight in or install skylights through the overburden. Underground housing would be easier to build because the ground could be left to strengthen walls and keep them airtight."

"True. But this disaster shows what a poor design can do."

"That's for sure. How's Dr. Rivers?"

"He wants to get out of bed! He was unconscious for just a few seconds and never stopped breathing, so he's basically okay. He needs to rest, which is impossible with the situation here."

"Yes, and I can't assure him very much." Will turned and they walked back to cylinder dome 1, then out through the airlock and over to the mobilhab serving as an infirmary. The three patients were on the bottom floor in separate areas divided by curtains.

"Dr. Elliott!" said Forest, surprised by his visitor. "What brings you here?"

"What brings me here? I think one could call it a major disaster for Martian settlement. We've never lost two people in one accident before. These are victims three and four. Four dead out of six hundred people on Mars: that's not very good odds if you're considering emigrating here."

"I suppose not. I can't tell you how horrible I feel about this disaster. I won't be able to sleep for months, thinking about this terrible tragedy. My community has been devastated."

"I'm sure. How are you feeling?"

“Slowly better. I managed to get two people to an airlock, but we didn’t quite get there fast enough! I’m on the mend, now.”

“Good. I want to express my personal condolences to you and your entire community for this tragedy. In a few minutes I plan to speak to everyone about this event and its implications, but I wanted at least to see you first and tell you what the implications are.”

Rivers had a grave look on his face. “Yes; what are the implications?”

“First, martial law will have to continue here, with Lieutenant Governor Érico Lopes in charge, for at least a month. That will give him time to stabilize the environmental management situation; we can’t leave until the oxygen leakage has been greatly reduced and the pressure regime is stable. Second, there has to be an investigation. Everyone here will be interviewed. In the end charges of criminal negligence may be filed against you or someone else. I can’t predict the result of the investigation since I won’t be involved in it.”

“You won’t?”

“No. In the last twenty-four hours there has been a persistent and growing call for an independent investigation, so that’s what it will be. They won’t just be investigating you, Forest; they’ll be investigating me and everyone else as well. They’ll be investigating all of Mars.”

9

Investigation

mid March 2056

Helmut was quite self-conscious as he walked across the Patio to the table where Clara and Charlie were already seated, eating lunch. He hadn't been in Aurorae for two months. Everyone who knew about his appendix operation—which was everyone on Mars—wanted to visit briefly and congratulate him for dealing with a challenging situation.

He nodded to six people and waved to four others on his way to the table. Father Greg and Anna immediately joined them with their two children, John and Esther, now six and three. Charlie was delighted to see Esther again, who was six months older than he. They were now old enough to play together.

"I've been tempted to extend my condolences to the Green World Community, but I don't know whether they would be offended by that gesture from a Catholic priest," said Greg.

"I don't think it'll offend them," replied Helmut. "They like to think of themselves as nonreligious, but they are utopians and have a definite ideology. I think you should write them or call Dr. Rivers."

"Is he recovered?" asked Greg.

"Yes. He wasn't seriously injured. He rescued two people from possible death."

"What's the place like now?" asked Anna.

"The interiors are dead. Some trees survived in the B-160, but all the crops had to be plowed under. The airlocks have been reinforced and the big hole has been completely filled up with slurry; they sprayed it with dry ice first to cool off the hole, then added

more to be sure the mud froze solid. Teams are busy injecting steam and water into the ground to strengthen some weak spots because three large dessication cracks pass under the dome. We also hauled down more drilling equipment to double their water supply, because the domes need 15,000 tonnes of water to freeze the subsurface properly. The domes are slowly repressurizing; it'll take several months to make enough oxygen and extract enough argon and nitrogen from the atmosphere to raise the pressures to normal levels."

"How's morale?"

"The GWC people are devastated. Rivers would have lost all credibility if he hadn't heroically risked his own life to save others. There are some who are whispering that he took the chance because he knew he'd be completely discredited otherwise. I don't buy that; I think he really does believe he has some sort of inspiration. Victorino Alves was one of the three who died—he was in charge of the cylinder domes when they leaked—so there's now something of a struggle to see who emerges as the new number three man, and I do mean 'man' because Rivers would never appoint a woman. So far, he's sitting back and waiting. Everyone wonders whether he'll be indicted for murder."

"I wonder, too," said Anna. "People have been slow in saying whether they will serve on the Commission of Investigation or not."

"That's the accident investigation," replied Greg. "Kent Bytown has started the criminal investigation. Silvio has issued a court order that no records related to the incident be destroyed. Helmut, you probably didn't hear this; Brendon Maxwell, who is the GWC person here at the Outpost, has approached the Commission for a job."

"You mean he's leaving GWC?" asked Helmut, surprised.

Greg nodded. “And he told me there’s at least one person at Aram who wants to leave. That will cause shock waves through the GWC.”

“Yes. It’s a small, tight-knit community, and they are very sure their philosophy is right. But I doubt GWC will disintegrate. The feeling I got is that they were determined to rebuild and get the domes right this time.”

“I’m not surprised,” added Clara.

“So, how are you doing?” asked Greg. “You seem to have weathered the appendicitis and the operation just fine.”

Helmut shrugged. “There was no danger; Juliette is an experienced physician, she had a good operating room, and the problem was caught early. I was fully recovered in a week.”

“Well, more,” said Clara.

“Okay, ten sols. It’s an interesting thought that I have left a frozen piece of myself at the Martian south pole forever.”

“And it’s good to know the medical team was able to handle the emergency.”

“And it was good to see the Ceres team was able to handle the Aram emergency. We feel more ready to make this trip than ever.”

Just then Dr. Nigel Stanfield approached the table. “Hey, Dr. Helmut, welcome back! You’ve had a busy month!”

“I sure have, between the appendix and the trip to Aram. I thought I’d see you at the South Pole Station.”

“I changed my plans about three weeks ago. I’ll go down in June or July, depending on the dust storm activity. I want to spend more time here so that I can finish

my survey of the northern layered deposits. What a terrible tragedy, Aram. I suppose they started an outpost cemetery."

"Yes, and it has two graves marked by fresh headstones."

"Are they going to arrest Rivers?"

"I don't know. It won't be easy. It'll be difficult securing the cooperation of the GWC personnel."

"Really? Just what we need, a sort of rebellion against authority. This incident really exposes the fatal weakness of the immigration plan. We've already had to deal with all sorts of slightly fanatical people running around the Outpost. But this shows the dangers of loading Mars with ideologically driven people; well, no offense, Father Greg. I don't know how the plan can survive. I don't know how Elliott can survive, for that matter."

"How do you link him to the accident?" asked Helmut, puzzled.

"He approved the immigration of these people, he had them trained inadequately, and he was the one who was looking the other way when they ignored safety protocols."

"I don't know about that, Nigel. I was involved in training them, and we even gave them a full extra month of training at Aram. After we left they cut corners, but they knew what the corners were."

"As I said, Elliott was the one interfacing with them about safety protocols. He bears partial responsibility. That's one reason the investigation has to be independent."

"To the extent anything here can be independent," replied Greg. "We all know each other and we're all dependent on each other."

"The panel will have to have terrestrial members as well. They may want to postpone some of the investigation a year until new people can arrive."

"They can't postpone it that long," replied Helmut. "People need answers sooner than that."

"Perhaps." Stanfield sighed. "This is a big mess."

Will's attaché buzzed with a videophone call. He glanced at the caller identification: it was Brian Stark. He opened the circuit.

"Good sol, Brian."

"Good morning, Will. I would ask you how you are doing and all that, but I suppose I had better not. I have a practical question about the Aram Accident Commission. How much of a staff are we talking about?"

"Terrestrial support, as much as needed. Mars support, we'll probably have to limit it to a few people, but if you can make a case that the Commission needs more, we'll probably have to grant it, because we don't want to do anything that looks like we are trying to obstruct the work."

Stark looked at Will's face very carefully. "We really will need full independence."

"I know, and I want you to have it. Brian, if anyone can make the Commission credible and serious, it is you. Your agency is the largest non-Commission operation up here. It has its own people, budget, and facilities. You've been here a long time yourself; people up here know you and trust you."

"I'm not sure they will trust me after this, though."

“Brian, they have to trust the process. We’re all up here together, but we owe it to each other and to the future of this place to be honest and thorough. We don’t want immigrants to think their lives are in danger because of shoddy construction or shoddy safety management. Investors have to have confidence their teams are safe. Everyone has to have trust in Mars. You have integrity and people know it.”

“Even if they dislike my politics.” Stark sighed, then nodded. “Okay, I’ll chair the Commission. Silvio declined, right?”

“Correct. He said it was a conflict of interest because he was chief judge and was on the Mars Council. Kent Bytown has accepted. We’re approaching Father Greg to see whether he’ll accept in place of Silvio. Gerhard Bach has accepted. Tang Enlai is the fifth Mars member. On Earth we have David Alaoui, Laura Stillwell, Yuri Severin, Harold Lassen, and Douglas Morgan.”

“It’s a powerful team. This will delay our work, I’m sure; we’re rushing to get one hundred kilograms of enriched uranium ready for export this fall. It probably means we’ll delay refueling two of your reactors until early next year. But you are right, Mars needs this, so I’ll do it. I’ll return the letter to you this afternoon.”

“Thanks, Brian. The Commission can be sure of my full cooperation.”

“Thank you, Will. I’m sure we’ll talk about the matter more. Bye for now.”

“Bye.” Will closed the circuit, feeling relieved and a sense of foreboding at the same time. Mars needed a good investigation, but it was going to be difficult for him.

He instructed Anisa to prepare a letter to send to Father Greg Harris that would include the update about the membership. He sent a confidential email to the heads of staff telling them Stark had accepted. He read an emailed report from Emily Scoville,

Commander of Cassini Outpost, about the expansion of their supercritical carbon dioxide separation facility. Then he heard a knock on the door. It was Alexandra Lescov.

"Good news about Stark," she said. "That'll solidify the Commission's credibility."

"I think so."

"It's a shame there aren't more women on it, though."

Will sighed. "I know, but you and Lisa can't serve because you are heads of staff that report to me, and Madhu can't serve because she's on the Mars Council, and Heather Kimball turned us down. What can I do for you?"

"I just wanted to let you know that we just got a very thorough study from the Mars Construction Institute, Moscow, about 'Open-Floor Cylindrical Domes.' It has detailed design recommendations."

"Oh?" Will was pleased. "What are they?"

"They recommend cylindrical domes forty meters wide and up to two hundred long, forty meters apart, with a curtain of plastic buried at least five meters deep between them and a palisade of two pilings per meter extending diagonally twenty meters into the ground along the dome edge and frozen into place to hold it down. They recommend the domes be for agriculture only unless completely surrounded by agricultural domes. Housing and work space under the plastic membrane between domes would be allowed as long as it is enclosed in its own airtight bubble. Up to twenty percent of the interdomal area can consist of skylights up to three meters in diameter. The soil under the dome needs to have a minimum of 300 kilograms of water per square meter to guarantee an

airtight seal. It's a complete vindication of the construction principles and a complete rejection of the way Aram proceeded."

"So, we'd need at least nine cylinder domes in order for one to be habitable?"

"Yes, but they wouldn't all have to be two hundred meters long; you could have fifty-meter long domes at each end and a two-hundred meter dome in the middle. We could build three lines of these domes, and the middle dome of line number two could be filled with housing and other structures. As soon as we built a fourth line of domes, though, we could convert the middle dome of the third line from agriculture into housing as well. It's a very practical system for expanding the outpost across the Martian surface. The report comes with specifications for making the endcaps for the cylinders and detailed manufacturing guidelines."

"And how do you feel about the report?"

She considered. "I would take a different approach; I plan to ask them about wider, higher domes. I like the length, but I want spaces that have more atmospheric volume; they're a hedge against leaks and produce more attractive spaces."

"Ask them to study wider domes, then. What do you think of the idea of releasing the interdomal spaces to private construction?"

"The report recommends installing the airtight in the interdomal areas before installing the domes. It's the first step toward privatizing construction and that worries me gravely."

"I know. But it's out of my hands; the Borough Council will have to decide."

"True, but be prepared for a deluge of questions and requests, Will. The design goes on the website this sol. The minimum size of this design involves three rows of forty

by forty meter domes with a forty-meter space between the rows, so it's one hundred twenty by one hundred and sixty. Including the interdomal areas, that's 19,200 square meters; enough to house and feed about 120 people. Cassini and Dawes will want one even though they don't need that much space. Meridiani may want one. Aram will want one. Aurorae will want a larger version to replace the 160-meter domes we planned to build after Andalus; we'll build them on the northern and western side of Andalus where the other three 160s would have gone. In the next two years demand for construction plastic will probably triple. I need to order more equipment while I still can get it during Columbiad 11 and I need to restructure my workforce to accommodate the demand. You'll get a lot of requests for restructuring budgets and redesigning growth plans. Bioarchive will want lots of space, and note the cylinders can be made any length desired, so every environment can have its own tailored space. There will be calls for public parks."

"How much cheaper is this construction system?"

"Maybe a third or a quarter."

Will nodded. "This will be a revolution, then. Yet another revolution."

"Exactly, and at the same time we're beginning to get substantial immigration. Even associating this design with Forest Rivers won't discredit it. Even I can't discredit it, and I don't particularly like it. It's the wave of the future; phase six of construction."

"Thanks for the notice, then. I'll plan to skim the report later this sol. It's come just in time, I think, with demand for caravels apparently picking up. It's also good news on the heals of the accident. It'll help everyone feel a bit better."

“Definitely.” Alexandra turned toward the door. “Have a good sol. Read it carefully, and then we can sit and debate various minor points.”

“Okay. Ciao.”

“Ciao.” She headed back to her office and he stared out the window at the escarpment, feeling rather pleased with the development. When they had first arrived on Mars—they had passed the twentieth anniversary just a month earlier—each human being had to be accompanied by over a tonne of life support machinery and two tonnes of structure. But huge enclosures made of indigenous materials did much of the recycling of air and water naturally, which meant they had to import sensors and motors to run fans and pumps. Each arrival now came with slightly less than a tonne of equipment, mostly related to the person’s work. It was an incredible change.

He turned to his emails. After reading three, the videophone rang. It was Father Greg.

“Good sol, Greg.”

“Good sol. So, I would be quite a lightweight on this Commission, don’t you think?”

“Lightweight? When are you ever a lightweight, Father Greg? No, we want people with a lot of experience, with good reputations, but we also need a range of experience in life support systems, administrative structures, and ethics. You have the experience in ethics to give balance to the Commission.”

“I see.” Greg considered. “Alright, I’ll do it. I suppose you need the formal letter signed and sent back, right?”

“Correct. Sign it, send it back, and it’ll be official. Then we issue the press release and Brian will call everyone to set up a time for the first meeting.”

“Okay. I hate interplanetary meetings; I hope we do as much of our work as possible by email. I’m sure this will interfere with the parish, too; it now takes more time than I can give it. But I’ll muster some volunteers to help with the church work, and possibly I’ll cancel my trip to Cassini next month to celebrate mass there.”

“I heard a parish was forming there; congratulations. You can make that trip; ask Brian. Thank you for accepting.”

“I will be honored to serve. Have a good sol, Will.”

“You, too. Bye.”

“Bye.”

Will closed the circuit. He saw that an urgent videomail had arrived from Louisa Turner. He hit play.

“Will, I’m attaching a videotape of a web press conference that Forest Rivers has held; actually, it’s still going on, and it’s likely to have more reporters join in. Rivers has made a statement saying that he was in frequent contact with you about their construction effort and that you never objected. I have transcripts of two conversations you had with him, including the conversation where you informed him of the one million redback per month fine. I’m drafting a summary of the conversations right now; I’ll get them to you and to your lawyer in about an hour. We need to respond to this right away so that our refutation is in the same news cycle, so if I don’t hear from Greene, you’ll need to call him and remind him to respond. I need anything else you have; emails with Rivers, other videophone conversations, etc. We’ll need to consider what we’ll release and when; we’ll

be pressured by everyone to release everything. But we need to get it together first, release a summary to refute Rivers, then consider our strategy. Bye."

Will stared at the screen, his heart sinking. It looked like it was going to get nasty. He hit reply. "Thanks, Louisa. I've assembled all the emails I exchanged with Rivers for the lawyers. Only three relate to the issue. I'll send them to you. There was one other videophone conversation and Anisa kept a transcript; I'll ask her to send it. Rivers does not remember our conversations correctly, to put it politely. Every conversation about their construction included an effort to press him about safety. Collins in Safety Management sent him a series of emails as well; you should work them into your chronology. He can send that stuff to you right away because it all went to the lawyers as well. I'll be glad to look over everything. Bye."

Will rose and walked to the window to look at the escarpment. Lawyers, charges, responses. The next few months, he could see, were going to be very difficult.

10

Findings

mid May 2056

Will was walking down the hallway of Mariner Hospital when he saw Martha Vickers in her office. He stuck his head in. “It’s so nice to see you here. I don’t know how we’ll manage when you’re cruising through the asteroid belt.”

“Oh, I don’t know. We’ve got two other psychiatrists and three psychologists and they’re all good. Premarital and marital counseling are organized well; it appears we’ve saved three marriages in six months. The grief counseling is managing loss more effectively than in the past if you consider the percentage of people who’ve lost parents and other significant persons on Earth who have come into our offices. Illness counseling is collecting a larger fraction of people facing serious health issues, too. I could use a break and deal with just twenty-five other people!”

“I bet, but you’ll still be consulting for us, right?”

“Yes, about twenty-five hours a week, just like I am now. So what brings you to the hospital? The semiannual physical?”

“No, a quarterly scan. They’re watching my prostate, like just about every other male up here, and some funny lipid profiles.” Will sighed. “I’m 55, after all, I’m not getting any younger!”

“No, none of us are. You still haven’t had any cancer, though.”

“No, except for a bit in the prostate that is growing too slowly to worry about right now.”

"You may be lucky, considering your radiation exposure. I watched your testimony before the Aram Accident Commission the other sol. You really did a good job; clear, honest, calm."

"Thank you. As I'm sure you can appreciate, this has been a very tough two months. Everything I say can be dissected, taken out of context, and distorted; that's the way these legal processes can be. And no matter how carefully and clearly one defends one's actions, one can never fully clear one's name. That's frustrating and frightening."

"I think you explained yourself quite well. I don't know what the Commission will do with Rivers. His testimony was riveting; such a passionate man! It's now clear to me that the problem at Aram was not just a single man telling everyone what to do, but an entire community developing common attitudes and values about the inevitability of their 'endeavor' as they call it, attitudes that led to lax safety standards."

"Yes, there was a communal component, but there was also a component of individual responsibility. Personally, I think they need to indict Rivers. From a pragmatic point of view, I'd rather they didn't, in that it will cause a lot of trouble and may not solve anything, but morally I think they have no choice."

"I'm not sure I agree. I'm amazed at the community's resilience and unity in the face of this challenge to their existence. If they had fallen apart and pointed the finger at Rivers, that would have been one thing; but the fact that they didn't tells me there's a culture involved here. Accidents are often caused by our values and not by negligence. The very idea of negligence is culturally defined. I'd favor changing the culture, not punishing the individuals."

"Perhaps." Will shrugged, rather than argue with her.

"Say, if you want to talk more about the stress the situation has caused, I'm free several times tomorrow afternoon. It can help."

Will considered, then nodded. "Sure; I think that would be helpful. What about 3:30?"

Martha checked her calendar and nodded. "Yes, that's good. See you then."

"Okay. Ciao." Will headed out of the hospital with a quicker step than he went in. Martha was always a good person to talk to; he generally visited with her every three or four months. Counseling was inexpensive and was so common that they needed one psychiatrist or psychologist per hundred residents. It had been helpful; people managed their anger better, related to their spouses and children more effectively, and dealt with vocational issues before they became serious. Even existential matters seemed to be resolved better. It was one aspect of their commitment to "living well" that had been successful, and it made all of them safer against the damage that anger could cause.

Will headed straight to the Patio for a quick breakfast; he had been fasting before his blood tests. Then he walked to Vandevelde on the northeast side of the Outpost to visit with Ethel quickly. She was monitoring one of the three large carbonyl metal separation towers at that moment.

"How was the appointment?" she asked.

He shrugged. "Nothing new. I forgot to be sure to arrive with a full bladder, so I may have to go back this afternoon. They have so many urine and blood tests for cancer now, it's hard to provide enough fluids!"

"I know. I think they did fifty-three blood and urine tests on me last week, and I was lucky there was only one false positive." She rolled her eyes.

“Yes, I’m wondering what I’ll have to return for in a week or two.” He looked at the screen in front of her. “Is the tower acting up?”

“Oh, nothing we can’t fix. One of the carbon monoxide heat recirculation fans is having trouble. I think we’ll have to take the unit down for the sol. But at the moment we’re short on meteoritic nickel-iron ore. We’ve got enough to run the other two towers at 125% capacity this sol, until another twenty tonnes of ore arrives tomorrow.”

“Do you still think you’ll have six tonnes of platinum group metals to export in the fall?”

She nodded. “Yes. You can count on the 24 million redbacks of income. Of course, we have about 100,000 tonnes of processed metal piling up outside. I still think we should bury it under the cylinder domes.”

“They’re looking into that, but I think they’ll ‘bury’ the spare water produced by the deuterium extractors and use the metal to pave the roads. I’d better run. Bye.”

“Bye.” They kissed quickly and he headed out the door. He went to the Caravel Building next to Vandevelde to see the *Courageous* taking shape. After a quick tour he walked down the South Main Street tunnel to Andalus Dome, just west of Bangalore.

They had just pressurized it a month earlier. The air pressure was the same as the rest of the Outpost, but the air was carbon dioxide because of the high leakage rates into the ground underneath. Will donned a breathing helmet and stepped into the space to see the construction work. He loved the size of the dome; 160 meters in diameter and 80 meters high—525 feet by 264 feet—it felt open and spacious in ways that made even the most capacious domes and biomes feel cramped. It was really amazing that they had the ability to enclose such large volumes, fill them with oxygen, and maintain them safely.

The interior, soon to be the site of Mars's largest housing and commercial complex, was still heaps of sifted dirt. Excavating equipment was preparing holes for concrete foundations. Heated water was being poured on the ground in other areas to create a water table and an ice table beneath, thereby reducing the air loss. He wandered around and watched the work to get a feel for it; when he read reports about it later they would fit in a context. He asked several workers questions about their progress and problems with the subsurface, then headed to his office.

"I wish you had checked your messages; you have an urgent one from the Budget Office," said Anisa to him, as soon as he stepped in. Her face automatically appeared on the screen of "her" attaché; it was always on and always on one side of his desk.

"I turned off the communicator. It's very hard to tour the Outpost without getting interrupted, and I want to be able to pay attention to what I see. Please play the videomessage."

Sally Chines's face appeared on the screen of his attaché. "Good sol, Will. We have a new projection based on the continued drop in the price of gold; it appears we'll have 600 million redbacks less in fiscal 2057 than we had hoped. And we're including a 500 million redback adjustment to fiscal 2057 because we've lost some support from national governments; it's a ripple from the Aram accident. In short, we're hemorrhaging badly. The cuts are now pushing toward twenty percent of the budget. We're preparing some priorities, but we'll have to cut terrestrial operations to the bone. We have some difficult decisions to make, especially about terrestrial support for environmental management. The Aram accident makes cuts in that area politically risky, but the fact

remains that larger domes and smarter software mean that we need fewer people. Call me so we can start the process. Bye."

Will's heart sank as he listened to the message. It meant a month of tough two-planet negotiations with heads of staff and national representatives. He wished that they could move the bulk of the Commission to Mars; they needed to cut the terrestrial support system until Martian gold and other exports paid for an expanded Mars operation. But they were still a decade or more from that milestone. Meanwhile, they were dependent on terrestrial personnel and national government resources that came with strings attached.

With a sigh, Will turned to his attaché to initiate a process of budget revision that he went through several times per year.

The return of the Project Ceres personnel to Aurorae Outpost initiated a two-month long series of seminars about the geology of the asteroids they were visiting. Three of the four had been studied by ion-powered probes that had orbited them to photograph their surfaces, map their altitudes by laser, and study their exterior compositions through spectral and neutron reflection techniques. Ceres had received two visitors to its surface, the latest being the automated ABC precursor mission, which had deployed a drill and several Prospector-250C remotely controlled rovers. A lot was known about that small and complex world, and the crew had to assimilate as much of the knowledge as possible.

"It's a really fascinating place," Helmut said to Anna Racan over lunch. He, Clara, and Charlie had joined Anna, son John, daughter Esther, Clara's cousin Tomas, and the Hunter clan—John, Vanessa, and sons Maaka and Wicahpi-luta—in the Patio

after attending Catholic mass earlier that Sunsol. “Ceres is carbonaceous chondrite, density twice that of water. It has no metallic core. As it formed, the center—we call it the ‘lower mantle’ because it’s not a core—got hot enough to drive off most of the water and metamorphize the chondrite into rock, though we aren’t sure what sort of rock it is. The rising hot water altered the interior, probably creating all sorts of minerals. When it reached the surface it created cryovolcanoes of dirty, salty ice that over billions of years have partially evaporated and are partially buried by salt and silicate debris. The water spread over the surface as water vapor frost that got buried through impact gardening, forming a permafrost regolith rich in hydrated clays and salts. In places impacts have exposed the ice, causing the formation of chaotic terrain similar to Martian chaotic terrain. The poles have ice caps and temperatures as low as the Galilean satellites, maybe lower; there’s evidence of frozen methane and other gases at the north polar basin. We may be able to witness geological phenomena that occur as far out as the Kuiper belt. It’s a perfect test bed for technologies for use on Callisto.”

“Amazing,” said Anna. “I can see why Project Jove originally had a Ceres precursor mission.”

“It’s also why half the Ceres crew aspires to go to the Galileans eventually,” added Clara.

“Well, I hope you all don’t find the alteration between Ceres gravity and artificial caravel gravity to be difficult,” said Anna. “I’ve had to prescribe physical therapy and exercises for a lot of astronauts who switch between two gravity fields regularly. It’s pretty hard on the musculature. Each gravity field uses a different set of muscles.”

“Juliette’s on top of that,” replied Helmut.

"Yes, she should be; she's good," agreed Anna.

"If I have any criticism of the Ceres plans, it's the lack of an eobiologist," said Vanessa. "I said this last week at the seminar at Martech about the geochemistry of Ceres, and I'll repeat it again. Half a billion cubic kilometers of warm, wet rock: the lower mantle of Ceres is probably only a few hundred degrees Centigrade, and we know of life that survives in those temperatures and pressures. I doubt there's life inside Ceres, but terrestrial methanogenic bacteria certainly would survive. There might be all sorts of prebiotic compounds. The asteroid may have methane and hydrocarbons inside! Ceres may give us chemical clues for understanding early Martian conditions, which in turn have helped a lot to reconstruct the origin of life on Earth. It'll help us understand the Europa ocean and the compounds in Titan's oceans and lakes. And because of its size, it can contribute clues that no other asteroid can offer."

"I suppose we don't have an eobiologist on board because it's unlikely we can obtain material from the inside," said Helmut. "We'll drill down five hundred meters, but that won't be enough. I think we need to plan for a permanent human presence on Ceres. An outpost there could do deep drilling. The lunar mantle drilling project has developed the technology that with modification could go 100 kilometers or more into Ceres. It might eventually be possible to drill 500 kilometers all the way to the center. That would tell us about the chemical and prebiological processes going on inside."

"If the funding can be obtained," she agreed.

"The ABC's working on the funding for another Ceres mission, after the Vesta mission is launched," said Clara. "Since Vesta's fairly dry, Ceres is the best source of return fuel, so we're leaving a functioning fuel manufacturing plant there."

“I wish we could go,” said John Hunter. “It would be quite an adventure. But I think these boys have to get older first.”

“I want to go to Titan,” replied Maaka, who was five. “I want to see waterfalls of methane!”

“You’ll probably be the right age to go, if you do well at Martech,” replied Vanessa. “Mars looks set to be the source of most of the explorers for the outer solar system.”

“Oh, look, they’re gathering,” said Anna, pointing. The five Mars members of the Aram Accident Commission had just entered the Patio and were walking to the stage.

“They wrote their report pretty fast,” said Helmut.

“Not fast enough,” replied Anna. “Greg’s been consumed by the effort for eight weeks, and he has worked harder than I’ve seen him work before. All ten of them have been that way. He says they really overcame the interplanetary communications barrier, too. That’s not easy.”

“Indeed,” agreed Helmut, impressed.

“Ah, there’s Will Elliott,” added John Hunter, pointing to Will, Alexandra, Yevgeny, Ruhullah, and Érico, who had just entered through the same airlock as the Commission members and headed for a table up front.

“They had a private meeting with the Commission members, where they heard the report summary,” exclaimed Anna. “I can’t tell from their faces what their reaction was.”

“Speculation that Will Elliott will have to resign is extreme,” replied John. “He made a serious, good faith effort to stop the air leaks at Aram and find out how the domes were doing.”

"I agree," said Anna.

"So, Greg's wearing his collar?" said Helmut, surprised.

"It gives him *gravitas* in an occasion like this," replied Anna.

The five members of the Commission resident on Mars huddled briefly to talk while more residents poured into Yalta Biome for the public news conference. The press conference had been scheduled purposely on Sunsol afternoon to maximize Martian attendance.

Finally the five of them carried their chairs up onto the stage in front of the Patio and Brian Stark walked to the microphone. "Good afternoon," he began. "Welcome to the official, final news conference of the Aram Accident Commission. This commission is simultaneously meeting in three places today, at Aurorae Outpost, Mars; Houston, Texas; and Paris, France. We cannot present our entire 357-page report in a brief meeting such as this. At the end of this news conference it will be available at our website. At this meeting we will summarize the major findings and recommendations.

"Almost three months ago, a failure of the central dome at Aram Outpost led to the catastrophic failure of the other two domes, the deaths of two personnel, and the injury of four others. It was our responsibility to determine how that happened. The first conclusion of the report, based on interviewing all the survivors of Aram Outpost and all outsiders who visited the outpost from the time it was started to the present, is that the community culture at Aram led to carelessness and inattention to safety. The result was violation of twenty different safety standards and procedures over the first nine months of Aram's existence. Not all of these violations have been corrected to this day; indeed, our study found, as a second conclusion, three problems—with fire safety, occupational

safety, and evacuation standards of biomes—that had not even been identified in the standards as potential problems and had not been pursued systematically. Many outposts on Mars potentially face these problems as well. One cause of Aram's lax safety standards, we conclude—in our third conclusion—was the outpost's leadership, which was not yet sufficiently sensitive to the dangers of the Martian environment. Indeed, their negligence of safety appears to be a potential criminal offense.

"Training of Aram Outpost's personnel was extensive, on Earth, during the flight out, at Aurorae, and at Aram itself. But in retrospect—and this is our fourth conclusion—it was not rigorous enough and did not include enough certification. Indeed, it proved one thing to certify Commission employees with extensive space-related training and experience and another thing certifying new arrivals lacking such background. The personnel who run Aurorae Outpost are extensively certified in all matters that relate to safety. When Cassini, Dawes, Meridiani, and Thymiamata Outposts were founded, their environmental management personnel were also certified and had extensive experience running the environments of earlier outposts. The procedures were changed when Aram was established, partly because of intense pressure from the Aram Outpost's leadership to give them a wide range of independence. In retrospect, this was in error.

"Because there was inadequate environmental management auditing at the planetary level—which is our fifth conclusion—the problems at Aram went largely undetected, in spite of increasingly vigorous and aggressive efforts to obtain environmental management data and ultimately a fine of one million redbacks per month, which ironically went into place just hours before the dome failure. This error was

compounded by—our sixth conclusion—inadequate data and understanding of the type of dome being used at Aram.

"What is to be done differently in the future? This leads us to our recommendations. The Governor quite rightly declared a state of emergency and assumed control over Aram Outpost within hours of the dome failure. The state of emergency continues at a low level to this sol. It cannot be lifted until Aram's personnel demonstrate full certification in environmental management and the safety culture of the outpost has reached an adequate level, which we define in detail in our report.

"To ensure the safety of the environments of all outposts, we recommend the establishment of an Environmental Management Safety Office for all of Mars. This department would not actually manage the environments of the outposts; that responsibility would be earned by the outposts and exercised by them. Rather, this department would oversee the outposts' efforts, inspect them, continuously consider ways to upgrade safety standards, and would take away an outpost's environmental management responsibility if it failed to meet standards. We recommend that the very process of certification be examined, to make sure certification standards are uniform, because in the last decade as the Mars population has expanded, the number of certifiable skills has gone from dozens to nearly a thousand. Since not all outposts on Mars are run by the Mars Commission—a trend that can only increase in the future—we recommend that safety and certification be a responsibility of the elected authority of the Mars Commonwealth and its employees. To ensure an adequate focus on safety, we recommend that the positions of Commissioner and Governor be separated."

Stark paused after that statement, which caused an audible reaction in the audience. “We do not feel that the fusion of Commissioner and Governor to date has led to a weakening of safety, but both tasks can only grow more intensive in the future, and they are naturally different tasks, consequently they logically should be separated.

“We recommend that one task of the Environmental Management Safety Office should be to determine when an outpost is ready to assume control over its own environment. This means that any future outposts will have to fulfill a list of requirements before they can become truly self governing. The legal principle has already been established that an outpost has a territorial jurisdiction and certain responsibilities granted to it by the Commonwealth, such as child education. The vote to establish universal health insurance on Mars was by implication a devolution to the Commonwealth by the Mars electorate of the responsibility for health care. We would recommend that with the continued expansion of the population of Mars, other responsibilities be devolved to the Commonwealth, which in some cases it can in turn devolve to outposts as they are ready to assume them.

“The rapid response of the Governor to the emergency was possible because there was a trained team capable of getting to Aram quickly and managing the crisis effectively. Mars cannot count on the Asteroid Belt Commission to have such a team assembled and ready to go, however. Therefore we recommend the establishment of a Mars Emergency Corps, a team of people with the skills and the training to handle emergencies and the ability to be deployed quickly anywhere on the planet or in near-Mars space. This team will cost a lot of money to develop and maintain, but the growing complexity of human settlement of Mars necessitates its creation. Like a national guard,

the corps need not be on constant active duty; rather, it should consist of concentric circles of people, the smaller groups being more ready to be deployed immediately, the larger circles of people being able to provide support and longer term deployment as the emergency continues. The development of the Corps should accompany an overhaul of the emergency plans of all outposts, including Aurorae, where a major disaster could imperil the continued presence of human beings on the entire planet. This reassessment of emergencies should fall under the purview of a new, permanent Emergency Management Office. One specific recommendation: Aurorae must replace Yalta Biome, which it has outgrown, or dramatically expand the escape routes, which are inadequate to handle hundreds of people.

"Finally, we note that disasters are the occasion when safety is reconsidered, emergency preparedness reviewed, and structures of authority overhauled. If Mars is to represent a new sort of society, one more mature than the societies that have gone before, restructuring must be built into its structure. Therefore we recommend that every five years, if events have not demanded it sooner, the Commonwealth appoint a Commission to reexamine and question safety arrangements and propose a new set of recommendations, in order to continue the refinement of our safety systems."

Brian lowered the pages from which he had been reading. There was silence in the Patio for a moment, then someone began to applaud. Everyone began to applaud and a few even stood, prompting others to do the same. In a few seconds the Commission had received a standing ovation, much to their surprise.

“We can take a few questions,” said Brian, obviously startled by the positive response. Will Elliott’s hand immediately shot up. With a bit of hesitation Brian acknowledged the Commissioner himself, who rose and walked to the microphone.

“It is not necessary for me to thank you on behalf of Mars because Mars just thanked you itself,” he said. “So allow me to offer you my deepest gratitude and appreciation for your tireless and thorough efforts. You have presented all of us with more than a new set of safety standards and procedures; you have offered a new vision of Mars. This indeed is exactly what we need if we are to learn from our mistakes and move this world forward. We will be eternally grateful to you and history will remember you.” Then Will returned to his seat.

Helmut was surprised. “It sounds like he just accepted the Commission’s rather critical conclusions, where he is concerned.”

“I think so,” agreed John. “But that’s how Will is. Wait and see; he’ll make something very interesting from this report.”

11

Devolution

late May 2056

"God, no one will talk about anything else!" exclaimed Clara, a bit exasperated. "Three sols, and Marsian politics still dominates every conversation!"

"And we're even relatively isolated," added Helmut. "The Ceres crew eats breakfasts and suppers apart from everyone else. But the lunches between seminar meetings at Martech inevitably will be about politics; how couldn't they be, dear!"

"We're still residents here; or maybe I should even say citizens," echoed Zach Hersey, sitting across the dinner table from Helmut. "And the Commission report put issues on the table that no one had dared even to whisper speculations about before."

"*Devolution*," added Thierry Colmar, whispering the word loudly. "Maybe it is time the Marsians made more decisions themselves; there are now over 600 of us, after all. I think it's a persuasive argument that elected institutions have more of a stake in safety than the Commission, which has to worry about growth and expenditures as well."

"I don't know," replied Jack Alberghini. "Obviously, one does not want one agency in charge of safety *and* other matters, like expansion, but the safety agency can be an independent agency located anywhere; within the Commission, under the Commonwealth, or whatever."

"I get the impression a lot of the newly arrived people are wary about devolution," said Helmut to Jack.

"Yes, it's true. We all arrived here very enthusiastic about Mars, but the economic reality of the place has hit some people pretty hard. My finances are now in pretty good

shape; I'm single and the Ceres Project comes with a pretty hefty salary. But I have married friends who are postponing or having fewer children because of the costs of this place. A condo is outrageously expensive; 30,000 redbacks per square meter, before interest, property taxes, insurance, utilities, and condo fee! Most single people have 'flats' about the size of their bedroom when they were teenagers. Food costs almost 100,000 redbacks per year. I was spending 80,000 redbacks per year on purchases from the stores, and I wasn't buying practically anything! And all the costs and fees keep going up! People who have been here a decade have over twice the income we have."

"Part of the problem is the increase in consumer goods," replied Thierry, trying to sound sympathetic. "Zach and I have been here since 2044; we arrived on Columbus 5. In those sols there was nothing to buy, so you saved most of your salary in banks on Earth or invested it. We had fifty square meters per person for housing and work space rather than one hundred before Yalta Biome was finished, and it was much less pleasant. Furniture was imported from Earth or was rather crude. But now we can buy a condo, and that puts our money into the Marsian economy rather than the terrestrial economy. And we now make a thousand crucial consumer items here, several thousand if you include construction-related items like toilets and door knobs. If Zach and I had had so many things to buy back in 2044, we would have saved a lot less."

"And by now, we've furnished our condo, so we have more surplus," added Zach.

"Yeah, but I bet your salary after taxes and fees was more," replied Jack.

"Not much more."

"I bet it was fifty percent more! And how big was the condo you guys first bought? I bet it was bigger, too."

“Yes, but we didn’t have the clever furniture you have, where a loft double bed comes with a closet and desk underneath it.” Zach tried not to sound defensive.

“Clever is one word; cramped is another. My bathroom has a cabinet over the toilet and I have to make sure I don’t bang my head when I stand up.” Jack sounded disgusted. “But regardless of the cause, the new arrivals feel a lot more economic distress,” he added, more conciliatory. “We fear that devolution will just squeeze salaries more and we can’t afford that.”

“That’s understandable,” agreed Helmut. “Clara and I have been amazed how fast our money has disappeared.”

“The rumor I’ve heard is that the Commission will continue paying for things even if responsibility were devolved to the Commonwealth Authority,” exclaimed Thierry. “And I don’t see why that couldn’t happen. The Commission’s role in settling Mars needs to be reconceived. Rather than having it run everything, it has to become an enabler and financer of the settlement effort. But let the settlements run themselves as much as possible.”

“I agree,” said Helmut. “Who says a few hundred people can’t run their own affairs via an elected government, when they already are running their own affairs via the Commission?”

“Well, we really aren’t running our own affairs because there are several thousand people on Earth helping,” pointed out Jack.

“So? They can continue to help,” replied Zach. “It’s called outsourcing.”

"If they can be paid, and it isn't clear terrestrial governments will subsidize Marsian government the same way they'll subsidize the Commission," said Jack. "That's the rub."

"And I don't know how we'll finesse that problem," added Helmut. "Because what I hear on *Mars This Sol* indicates that the U.S. and Europe, at least, are opposed to greater freedom up here."

"Ironic, isn't it?" said Zach, shaking his head.

Will made his way across Catalina and Yalta Biomes, heading from the Mars Commission offices to Silvio's store. The shelves were looking sparse—no supplies had arrived for a year and the Venus swingby cargo flight was still a month away—consequently much of what was left was Mars-made. Will walked to the food area, one of the better stocked sections, the shelves loaded with jars of preserves, bags of tea, containers of coffee and sugar, and a snack section with locally made chocolate bars. The quality of the chocolate was better than many had expected, but it was achieved by including small quantities of high-quality chocolate from Earth. He grabbed a 25-gram "Shalbatana" bar—a mere 10 redbacks—and walked to the unattended checkout area, where he scanned it and swiped his credit card.

He was about to look for Silvio when the Rev. Tuesday Nah entered. Will turned to him. "Good sol, Tuesday."

"Good afternoon, Will. How are you this sol?"

"Pretty good. I had to get out of the office and walk around a bit; it helps me solve problems. And I just bought one of the chocolate bars your wife makes."

He smiled. “They’re good, aren’t they? She cooks up a big kettleful almost every month, now. And only ten redbacks; that’s what, one quarter of the old price?”

“About that. I like the wrapper; very pretty. Is the design by Madhu?”

“No; by my daughter! But everyone thinks it’s Madhu’s.”

Will chuckled. “I didn’t know. That’s two major contributions by your family to Mars. I love my chocolate. The consumer goods your church members are making, and the ones the Mormons are making, have increased our consumer economy by fifty million redbacks per year. It’s really amazing.”

“I just wish we were getting more of that fifty million! Actually, though, we aren’t doing badly.”

“I’m glad. And the building you all are planning for Andalus Dome is pretty ambitious; housing, manufacturing space, and a church space to boot.”

“All made to look like a big church; it’ll give us a presence, you might say.” Nah smiled, obviously proud.

“I congratulate you for that. And congratulations on the grandson! You’re the first Martian grandfather.”

“Oh, thank you very much. I’m here to find him another present; something from Earth, that is! Silvio needs to buy more baby presents because we have several children on the way. It’s very good to see you, Mr. Commissioner. You must come to church again, or to our Wednesol evening Bible study with the evangelicals.”

“Thank you, I’d enjoy that. Ciao.”

“Ciao.” Will turned to the rear of the store where Silvio had his office. He walked back and found his friend reviewing a huge electronic paper spreadsheet on a table.

“Oh, Will, good afternoon. What’s new with you?”

“Not too much. Last minute changes to the cargo manifests are driving everyone crazy. The first automated cargo vehicles head here in three months.”

“I know; it’s amazing to think we’ll have cargo so early this columbiad. The price of fuel at Gateway has dropped so much, all sorts of transportation possibilities are now available.”

“Which is fortunate; the shuttles will have more time to haul everything down. Where’s Simeon? I was surprised no one was in the store.”

“He’s off for a few sols because of the baby.”

“Oh, that’s right! And I was just congratulating Tuesday.”

“I can’t afford a greeter all the time. Without one, I can offer lower prices than Deseret; people like that, too.”

“How’s the store been doing?”

“Pretty well. Sales are up sixty percent compared to two years ago. Of course, if Deseret hadn’t arrived and we had the consumer goods we now have, business probably would have tripled! They’re doing about the same volume of business as I, judging from their bank deposits at least. And my web sales are stronger, especially at Dawes. So it’s alright.” He pointed to the spreadsheet. “The bank is the problem right now. Our savings rate has been dropping because people are buying consumer goods and demand for loans has been going up because individuals and groups want to start businesses. That means the bank has to ask the mining companies to ‘deposit’ more in the bank, which means giving them a favorable interest rate and charging more interest on new loans. I’ve been

checking the figures and there's no alternative. I contacted the Commission's budget office, too, to see if they can make some deposits."

"They're legally bound to maximize return on deposits. We should change that regulation to deposit more money here. Have you asked Muller about the problem?"

"Yes, and Muller Mining has deposited more money, but demand for loans keeps going up. The default rate may be a problem, too."

"Some of the small businesses, I'm sure; business is not developing very fast up here."

"And the Green World Community: I may have to start legal proceedings against them to make them pay. They seem to have tens of millions in U.S and Canadian banks. And I'm the local judge, so I can't be involved; it makes everything complicated."

"Speaking of complicated, I came here to get your advice," said Will. "I need to figure out a way to implement the recommendation of the Accident Commission about devolving the authority of Governor on someone else and increasing the responsibility of the Commonwealth Authority. As you know, in the last few sols devolution has taken on a life of its own and everyone's speculating about what to devolve and how. I don't hear the speculations and ideas personally; almost no one will speak frankly in front of me. But *Mars This Sol* has carried quite a digest of them, and the blogs are public, so I've been pouring over them."

"If people knew the boss was reading them, they probably wouldn't be so frank."

"Probably not, but how else am I to get ideas? I'm isolated by my position. Very few people have been uncomplimentary; most people are struggling to come up with ideas, and some have been pretty good. The problem of financing the Mars Authority is

less serious than people think. It's pretty easy to figure out how much money is needed; right now the median salary on Mars is 500,000 redbacks per year, and the average person requires 300 kilograms of imported equipment and other necessities per columbiad, which costs 500,000 redbacks total or about 250,000 per year. That includes medicines, fuel cells, mobilhabs, and anything else we need on the surface. Once the responsibility of the Commonwealth Authority is defined, we can calculate the staffing needed, from that the cost, and the Commonwealth can levy an individual and corporate income tax or an export tax to cover the costs. Since the corporate tax would be on gold exports, there's a lot of money to capture."

"But the companies will object on the grounds that they have a contract that fixes their costs on Mars, including taxes."

"The contracts specify the Commission would lower its fees commensurately."

"Can the Commission afford that?"

"We're rearranging income and expenses, not adding to them. Look, we're going to have to devolve responsibilities, expenses, and income to the Commonwealth Authority eventually. Right now the Commission's income and expenses are pretty easy to divide up. Mars surface operations, and the cargo to support them cost about a billion redbacks per columbiad. Transportation of new people to Mars, complete with about two tonnes of stuff each new person needs here, costs about 4 billion redbacks. Terrestrial support operations and their 2,000 personnel cost about a billion redbacks. Research and development—grants to universities to support Mars surface research, research on better domes and life support systems, research on manufacturing techniques and use of silane, research on new aerobraking systems and improvements in the engines—have been

sharply cut back but still cost another 2.5 billion redbacks. Medical research and consulting costs one billion. Then there's insurance, lawyer's fees, depreciation, and assorted other fees that add another 1.5 billion. So the total's eleven billion redbacks per columbiad. Exports of gold and other commodities earn us 3 billion; they used to earn 4.5 billion, but the value of gold has declined significantly. We receive about 2 billion from governments to cover transportation costs of their citizens to Mars. The rest is covered by government dues to the Commission, mostly from the U.S., Europe, Canada, Russia, China, and India. The export income far exceeds Mars surface expenses. The logical thing to do is devote a certain amount of Mars surface income to cover expenses here through Commission grants and various taxes."

"That's true," said Silvio. "But there's still the question of what responsibility to give the Authority."

"Yes. I'd be in favor of turning over Martech, Mariner Hospital, the outpost clinics, surface transportation, maintenance of trails and sunwing strips, environmental management safety, sale and taxation of land, and emergency management; that's half of the personnel on Mars and probably a third of terrestrial support personnel. The Commission would keep responsibility for the spaceports, near-Mars transportation, planetary quarantine and customs, the Exploration Corps, interplanetary transportation, and most terrestrial research and development operations."

"Of course, a lot of the items you mentioned could be privatized."

"One step at a time. Martech could become a semi-private self-governing educational institution supported by a large land grant, an endowment, and taxes. Mariner Hospital could become something similar. Construction could be completely privatized.

Interplanetary transportation has already been partially privatized. Near-Mars transportation could be, also. The Exploration Corps personnel could have all sorts of part time assignments as Martech faculty or as construction specialists to get their engineering certifications. Collectively, it's a huge restructuring, and with the population about to grow to a thousand, the time has come. But the bigger issue is what sort of political restructuring should accompany all of this. I think the Commonwealth Authority needs to pass a home rule statue whereby large outposts would acquire an elected mayor and the right to tax. Ironically, Aram has this authority right now by special arrangement as a non-Commission facility but Aurorae doesn't. The Commanders of the other outposts could be appointed by the Commission or even appointed by the Authority, or heck, they could be elected as well. And if Aram can have an elected mayor, and Aurorae as well, why can't all of Mars have an elected executive?"

Silvio was startled. "That is radical."

"Is it? As many people are saying, 1,000 people can be run military-style with appointed commanders or democratically with elected leaders, but either way, it's the same thousand people handling their own affairs with the same money. Either way, we're not talking about national independence; more like state or provincial authority at the higher level and local, civic authority at the lower level. The ultimate 'national' authority rests with the member states of the Commission and the decisions of their Board."

"Do you think you can get them to go along?"

"I don't know. It has a lot to do with the shape or appearance of the restructuring. We have to convince the large corporations, the land owners, and the residents as well. There are a lot of constituencies."

"True." Silvio thought about the situation. "What sort of restructuring are you thinking about?"

"That's why I wanted to talk to you; I'm not an expert on political structures. I'd favor a modification of the Fundamental Law to specify that the Lieutenant Governor was elected every columbiad and that he would serve as sol-to-sol executive of the Authority."

Silvio shook his head. "That sounds funny. If the position has executive authority, the person is a Governor, a Secretary-General, a Prime Minister, a President, or even a Manager."

"True. But we tried to include a 'First Minister' ten years ago when the Fundamental Law was first proposed, and the idea was rejected by the U.S. and Russia."

"The position does not have to be elected; the person could also be selected by the Commissioner and ratified by the legislative bodies. Many small towns on Earth elect a council of some sort and it hires a town manager. On a much larger scale many nations do virtually the same thing; the people elect members of Parliament, and the Parliament selects a Prime Minister."

"Hum. Already the Mars Council chooses a secretary and the borough voters elect clerks. If the clerk is given all the authority of an outpost commander, we have the equivalent of a mayor without doing anything complicated. And if the Residents Council and Landowners Assembly were jointly given authority to do a bunch of things, they'd have to choose a clerk or an executive to do it all on their behalf."

"And one wouldn't even need to change the Fundamental Law," added Silvio. "The change would be in custom and policy, but once established it'd be hard to reverse."

"And it'd be hard for the national representatives to object," added Will. "If we rolled out the plan in the right sequence we could probably drag them along."

"It sounds like you're going to have a lot of persuading to do," said Silvio.

"Yes, I think so."

"I'll call together an informal meeting of the Mars Council and discuss these ideas with them. We probably should hold some additional meetings together."

"Agreed; confidential meetings."

For the next few sols, Will worked very quietly, starting with the Aram Accident Commission members to find out how hard they would push individually for some of the changes they had advocated. Brian Stark was the hardest to talk to, since he usually lived outside Aurorae at the New Hanford Station, twenty kilometers to the east. But three sols later he was at Aurorae for business. "We never thought devolution would be a recommendation," he explained as he sat in Will's office. "But as we deliberated about the situation that led to the accident, it became clear that someone had to speak up about the Mars Commission's current structure, which was fine when Mars had a few dozen people but which has become unwieldy as the population grows. We never meant to question your capabilities, Will, or undermine your leadership, or criticize you; at least not beyond the legitimate criticism any leader must face when a major failure occurs on his watch."

"I understand, and I took no offense. Indeed, I accept a measure of responsibility for the emergency. I tried, but I could have done more. But what I want to know is whether you'll talk to some of your friends in Washington about devolution. The

Commission's report is ambiguous; you call for a lot of changes and you specify that some involve the Mars Authority. If one takes the recommendations and the implications for devolution seriously, one needs to transfer money and executive authority to the Commonwealth's bodies. How do you think your conservative friends in Washington will feel about this?"

"I think it can be sold to them. The trick is to keep this from getting politicized. If the Republicans come out in favor, the Democrats will feel they have to oppose. Right now with divided government and severe partisanship in Washington, it's hard to prevent politicization of the matter."

"I know. But our friend Skip Carson has liberal friends, and so does Louisa Turner. Douglas Morgan, Harold Lassen, and Laura Stillwell have conservative friends. And I know a lot of people on both sides of the aisle. So we have a formidable team. Doug won't do much for us because of his health, but everyone else will."

"Yes, we probably can develop bipartisan support for this issue. I think Europe's a bigger problem, though."

"Pierre Messier, David Alaoui, and Krister Soderblom will work on the Europeans. Pavel Rudenkov and the folks at the Institute for Mars Construction are working on Russian government officials. We'll get support of long-time residents here to work on the Chinese, Japanese, Brazilian, and Indian governments."

"So, what's the message?"

"We want to take the Accident Commission's recommendations seriously. That means giving the Commonwealth Authority responsibility for environmental management safety, certifications, surface and air transportation, emergency

management, and land sales. They already have authority over health and higher education, can tax, and have set up thousands of laws regulating all sorts of things here. The Commissioner will nominate a Chief Minister who will be the Authority's executive, to be ratified by the Mars Council and Mars Assembly. The Commission will transfer terrestrial personnel to the Authority as needed to carry out its broader responsibilities and will provide a subsidy until such time that taxation can cover the additional expenditures."

Brian turned to his attaché and looked at the list that his machine had transcribed onto the screen. "That looks pretty complete to me. It even includes a few things we didn't recommend, not that we'd be opposed."

"Land sales have to be done in consultation with the Assembly of Landowners anyway, since it effects property value, and we've already consulted with the Mars Council over issues like natural parks and preserving, versus developing, geothermal areas. We might as well include it. Planetary quarantine is linked to environmental management safety, and customs is linked to quarantine. What we allow or restrict really should be decided by elected representatives anyway, not by the Commission. It makes sense that just about everything related to life here should be handled by an elected body. The Commission owns the spaceports and shuttles, at least until those things are privatized. It represents the nations of Earth in the Mars enterprise and coordinates research on or for the benefit of Mars."

"What about veto power?"

“The Commissioner should have veto over the taxation rate because that affects the Commission’s income. I suppose the Chief Minister should have veto power over the budget, because he has to spend it.”

“With legislative override?”

“I suppose. That’s a feature of most governmental systems.”

“That’s rather close to the role we had in mind, I think; it’s more fleshed out,” said Brian, nodding. “Okay, you can count on me. I’ll pull out the address book and start making videocalls tonight.”

“Thanks.” Brian rose from his chair; Will extended a hand. “I appreciate your help, Brian. Devolution should increase popular interest in Mars, and we will benefit. It could even spur land sales, with utopians buying a vote to participate in the enterprise.”

“Yes, it’ll do that, though not enough to help,” said Brian. “I suppose with declining gold prices, every little bit helps. Our uranium enrichment is working very well, by the way. We’re importing equipment and people to more than double output next columbiad. The space nuclear reactor design is coming along really well, too. The hope is to test a nuclear-electric engine in lunar orbit in about a year, fueled by Martian uranium of course. We should meet the 2065 goal of launching a Jupiter mission.”

“And the Chinese may beat you, using clunky old technology,” added Will.

“Maybe. We’ll see.” Brian nodded. “Ciao.”

“Ciao.” Will watched Brian go. Then he turned to his attaché. He reviewed the transcript as well; he had phrased the plan quite nicely. He edited part of the text into a memo giving the main talking points and forwarded it to the two dozen people who had agreed to start making calls. The effort had begun.

Over the next few sols, Will devoted almost all his time to the campaign; it wouldn't remain secret for long, so they had to maximize their success before opposition built and the whole thing hit the press. Satursol arrived and he went to the office to make more calls. He found the usual assortment of arguments and comments. An elderly South Carolina Senator called to express his grave concern that many foreigners would get elected to leadership positions if they were filled via the franchise. Will suppressed the desire to make a sarcastic comment that Mars was not the future fifty-first state of the United States and painted a word portrait of all the American values enshrined in Marsian culture and that the population had assimilated the values, just as millions of immigrants to the United States had for generations. The chief of staff of a Minnesota Senator on a powerful Senate committee called to express support; Will thanked him and reused a bit of the same rhetoric. The argument of a key member of the House of Representatives was more complicated; that restructuring and devolution was premature and should await Mars's growth to at least several tens of thousands of people. Will replied that they were following the accident commission's recommendations, which had generated a rather powerful sentiment on Mars for greater participation in civic life, a participation that one should never suppress if one wanted to see a society mature and develop. He also forwarded a copy of his comments to Doug Morgan, who was a friend of the man.

And then there was the comment of Tom Brady, a senior NASA administrator and the U.S.'s chief liaison with the Mars Commission. "Will, I've heard all these arguments before, but really, why should we care that the Marsians want more control? None of us have as much freedom as we'd like. That's life. The current structure is working fine. The

accident commission was packed with a bunch of meddlers. You seem to be using their conclusions as an opportunity to make yourself popular with the residents, or to push your own free Mars agenda, or both. So convince me; why should we care? Bye."

Will stared at the screen a moment uncertain how to respond. He certainly would not respond to attacks on his own motivations. He asked Anisa to print out a transcript of the short call. He skimmed it but realized that the transcript lacked the emotional tone of the videomail, so he watched again. He asked Anisa for the outlines and summaries of the three previous calls he had had with Brady and they brought back many details of the exchanges. Tom Brady was an American patriot who was sure that NASA should still be running Mars and had no sense that anyone would have a reason to object to that arrangement. It was an old problem; six years earlier NASA had even tried to shut down the Commission and reassert control over Mars.

"Good sol, Tom," Will began in his reply. "I think the answer to your question comes from the long-term picture. This place has been increasing its population ten-fold per decade for two decades. I don't think that will continue; if it did, by 2100 Mars would have ten or twenty million people. But this place could have 100,000 by the end of the century and a few million by the end of the next century. We're talking about highly educated, highly creative, economically productive people, and we're talking about a population with a median age twenty years less than in the United States. It's an impatient population, too. We need to be riding the wave, not letting the wave ride over us. The United States needs to be in a position to influence and steer this world. The first starship may set out from Mars, Tom; the first ship to the asteroid belt leaves here in six months and the first ships to Jupiter will almost certainly include Marsians. Mars may be

the greatest promoter of American democracy, freedom, creativity, and compassion in history. Mars lives the so-called melting pot and makes it work. This place is beginning to get restless with the current structure. Let's make the structure fit the potential for growth, and that means a measure of devolution. It's the lesson all founding countries learn, sooner or later, is it not? Let me know what you think. Bye."

He sent the message. He hoped Brady would reply; he was prepared to exchange fifty videomails with him. That was Will's technique; keep the line of communication open, be clear and reasonable, and wear them down.

He was startled when, almost immediately after hitting send, the attaché beeped with an incoming call. It couldn't be Brady, of course. The caller i.d. said it was from the Commander of Cassini Outpost, so he opened the line. "Good sol, Will; I figured you'd be in the office," exclaimed Emily Scoville-Rahmani. "Say, what's this rumor I hear that a devolution of authority is coming and all outpost Commanders might be replaced?"

"What? That's a new one, Emily. Don't worry, you're safe. I'm not planning any changes to command structure."

"I didn't think so. But is it true that devolution may inspire reform of the command structure?"

"The plan right now focuses on the recommendations of the accident commission and a few logical corollaries. But they necessitate strengthening the Authority by giving it an executive and more money. We're not talking about restructuring the local command structure. That's not to say it won't be talked about some day. What are your thoughts?"

"As many people have said, if Aram can elect its Commander with 25 voters, why can't Aurorae with over 500? I think that makes sense. Cassini has 45 adults and 5 kids

and with the new supercritical CO_2 facility and expanded gold recovery equipment, it'll grow to about 100 next year. If I were an elected executive, I might be more effective. People respect me, but I think the military-style command structure is getting old-fashioned." She seemed a bit nervous saying what she said; perhaps she was uncertain what Will's reaction would be. She fiddled with a strand a hair and finally pushed it under her headscarf.

"I think that's a fair observation," Will replied. "Here at Aurorae it feels out of date. But the reactions on Earth have been that we're proposing too much change, not too little. I've had to back-pedal from some reforms. We want to focus on a package that is internally consistent; that represents one theme only. We'll turn to other themes later."

"You're right, and the devolution you're talking about makes the other changes more logical." Emily sighed. "I love Cassini, Will. You've got to come down and see us now that we have a B-160. So much space! Housing's fifty percent less costly here than at Aurorae, thanks to spare labor from the mining companies in the dome construction. We've got more and more kids here all the time. It's a great little village, and we want it to grow. Most people here want more elected governance. So I guess I have two messages. One, don't worry about me, where my position is concerned; and two, don't keep us out of the loop. We want to know what's going on and to be consulted."

"Thanks. If you want my advice, start a petition drive for home rule. That means two things: an elected executive and authority to set a local budget and taxation rate. If Cassini voters demand home rule from the Mars Authority, the folks in Washington and Paris will feel they can't get in the way of voters, and my hands will be free to support the petition."

Emily's face lit up. "Ah, that's a good idea. We have a borough meeting scheduled next month. I'll make sure the idea comes up."

"Good. I had better run. If there are specific places where you can help or should give input, I will contact you."

"Thanks, Will. How are your kids?"

"Oh, great. Lizzie will be in the art summer camp here in July and she's looking forward to it."

"Good. Muhammad and I are bringing Amina; we're spending all of July at the Dacha on vacation. Amina really had fun with Lizzie last time; it was like having a big sister."

"Lizzie will enjoy having her around, too. Marshall's now sixteen and has full pressure suit certification. He and Sammie are taking an AP course on organic chemistry via the web and it'll keep them pretty busy."

"AP? Isn't he finishing ninth grade?"

Will nodded. "They accepted him; his science is good enough. Sammie was borderline, but then Sammie's really a year younger than Marshall, even if they are in the same grade. Next year he may be able to audit a summer course at Martech, believe it or not! Anyway, let's talk in another week or so. Ciao."

"Ciao."

He closed the circuit and turned to emails, a dozen of which were from Congressional aides or lower-level NASA administrators, expressing support or opposition to the devolution plan for a variety of reasons, good and bad. He spent almost an hour answering them, dictating responses that became written text before his eyes. He

was working on the seventh email when the videophone rang again. Calls were beginning to become irritating, but this one was from Yoshi Suzuki. “Good sol, Yoshi, how are you?”

“I am well, my friend; how are you?”

“Very well.”

“I’m surprised you’re in this sol. I had planned to leave you a message.”

“Oh, I work a lot of Satursols; the new shortened work week hasn’t decreased my duties. How can I help you?”

“I’m calling to invite you to a special ceremony we’re having next month; June 12 at noon. We’re now putting the finishing touches on a twelve-meter statue of the Buddha in the “earth-witnessing” position; he is pointing one hand downward toward the ground, swearing an oath to the ground that he will never succumb to the temptations of Mara, the great tempter of humanity. We’ve put him against an artificial cliff we’ve excavated into the side of our crater and assembled him from blocks of carved dune sandstone. The color is a pleasant light yellow. We’re pleased with the quality and with the symbolism that here he is pointing to, and swearing by, Father Mars rather than by Mother Earth. The ceremony will be broadcast live back to Japan; the timing was chosen because Japan and Aurorae will be on roughly the same time zone on June 12. Besides, we have been assured that it is astrologically auspicious. Your presence would lend weight and prestige to the occasion.”

“Let me check.” Will turned to the calendar on his attaché. “Yes, I’m free. I’ll be glad to attend. As you know, I have great respect for the Buddha.”

“Yes, I recall our conversation.” Yoshi did not mention that Will’s Bahá'í views of the Buddha as the recipient of a revelation from God made him very uncomfortable, though he had hinted as much to Will when they had talked, and Will had understood and respected the hint.

“How are all your plans going?” Will asked.

“Fairly well. Several Japanese conglomerates have joined together to fund an expansion of our operation by adding a Shinto monastery. A few of us have had training as Shinto priests, though we cannot say we are experts. We are delighted that we will have a dozen Shinto brothers here, as well as six more Zen monks.”

“Yes, I saw the passenger manifest the other sol, and I saw that there were six other Japanese coming to provide some support services for the two monasteries. They’ve contracted for nine cylinder domes over four years.”

“We recommended that they do so. How is all your work going? I gather there is a lot of discussion going on right now about devolution. I received a call from a Japanese journalist yestersol asking me what we knew.”

“Really? I guess the media is getting wind of the discussions. There’s nothing I can say right now, Yoshi, other than I’m talking to a lot of people.”

“I am sure you are. I won’t repeat that information to anyone, Will. We’re behind you; we are very honored to be early participants in the colonization of this world. I think the result will be much greater interest by all of Japan as well.”

“I hope so. Thank you for calling, Yoshi. See you at the ceremony next month.”

“Thank you, Will. Goodbye.”

“Goodbye.” Will smiled as he closed the circuit; he always enjoyed talking to the monk. He turned back to his email and was startled by an almost immediate ring from the videophone.

“God, when will I ever get the work finished?” he said, exasperated. Then he saw that it was Silvio. “Good sol, Will. I’m in my office with the Aurorae members of the Mars Council; it’s an informal caucus, you might say. Can you stop by the store in twenty minutes or so? We have some ideas.”

“Sure. It’ll look like I’m going to lunch.”

“That’s the idea. The store is perfect for such meetings, isn’t it? See you then.”

They exchanged ciaos and closed the call. Will turned back to his emails, then heard a knock on the door. It was Marshall. “Dad, can I ask you a question?”

“Sure; this is a good time.” Will rose and walked over to a table where he talked to visitors. He looked at his son and was struck by the fact that Marshall was now within a centimeter of his own height, though much thinner. His sideburns were growing in as well and his arm muscles were getting larger. He was growing up fast.

They sat. “Sammie and I were just talking to Alexandra. She said that she could hire us part time over the summer—fifteen hours a week—to do construction on Andalus. We’d get a first grade welding certificate or an electrical wiring certificate. She’ll pay one hundred redbacks per hour.”

Will whistled. “Deseret can’t compete with that!”

“No. I think most of the part timers there are getting other summer jobs. Dad, I really want to do this. I’ll earn 1,500 redbacks per week; 15,000 in two and a half

months. I've got a list of things I want to buy; a holoprojection television, holos, some golf clubs, a new rock hammer . . ."

"Hey, hold on. Remember, you're taking AP organic chemistry."

"I can do that at the same time; the job's only fifteen hours a week."

"And we've already planned out your thirty-kilogram mass allocation, remember? You've got clothes and birthday presents coming."

"But dad, if you and mom want to give me birthday presents, they should come out of *your* mass allocation, not mine! It's not fair to count my presents against my allocation! Besides, adults have a fifty-kilogram allocation. And I know the clothes totaled seventeen kilos; that leaves thirteen kilos I can use. The holoprojector, stripped of packing and stuff we can make here, masses twelve kilos; I checked the Import Office's website."

"You've done some research. Come on, let's walk and talk; I have to be in Yalta in fifteen minutes." They rose from the chairs and headed out of the office. "You're sure you want to spend all the rest of your quota on a holoprojector?"

"Yes."

"How much is it?"

"Ten thousand. They're still really expensive."

"Do you realize that very few Earth teenagers can afford holoprojectors? None of them can earn ten thousand redbacks in one summer. They're still really rare and expensive. There aren't even tv signals broadcast in holo yet."

"Not true! Korean tv stations started to broadcast in holo in January, Japan starts next month, the European Union in a year and a half and the U.S. in three years. And

they've been holorizing movies like crazy; you should see the chariot race in *Ben Hur* in holo! My friend Jeremy has a holoprojector at home and he says all his friends do, too."

"That's Stamford, Connecticut, where everyone's rich."

"Well, I'm not the only one."

"The deadline for ordering items is July 15. You'll have less than half the money by then."

"I was hoping you and mom could loan me the difference, and I'd pay you back by the end of August."

Will considered that. "Do you realize you probably should save some of the money for college? It's impossible for kids on Earth; universities are too expensive. But wages are so much more here, and tuition is the same because of all the e-learning courses you'll be taking."

"Dad, I can't even begin to think about saving for college now!"

"Maybe you should."

"Can I take this job or not?"

"Yes, sure. It'll be good experience and it'll earn you a vocational certificate. The question we need to resolve is how you'll spend the small fortune you'll earn. Tell you what. Let's see whether you can plan your time well enough to work *and* do well in AP organic chemistry."

"What do you mean by well?"

"An A."

"Oh, dad!"

"You can do it. What did Sam's dad say?"

“I don’t know; they’re talking right now.”

“Well, I bet Roger will say the same thing. Show me you’re responsible with your time and money, and I’ll talk to mom about advancing you the rest of the money you need. How’s that?”

“The best I’m going to get, I think.” He was sullen, but objected no further.

“Yes, I think so.” They passed through the last airlock and entered Yalta. “I’ve got to go to the store and chat with Silvio for a while, so I’ll see you here for lunch.”

“Okay, thanks dad.”

They parted company. Will walked across the central yard to the entrance to Silvio’s, nodded a hello to Simeon—who was back on duty—and headed to Silvio’s office. There he found the six Aurorae members of the Mars Council: Silvio, Madhu, Ruhullah, Tang, Lal, and Alexandra. Except for John Hunter, who was out of town, they constituted the members of the Aurorae Borough Council as well. On Silvio’s attaché was the face of Gerhard Bach, Commander of Dawes and that Outpost’s representative on the Council. He was surprised to see Gerhard.

“Good sol, Will, and thanks for coming,” said Silvio.

“Glad to. Hope you are all well this sol.” Will turned to the attaché. “How are you, Gerhard?”

“Pretty good, Will. They just called me, so I’m in the dark as well.”

“We thought we’d add Gerhard,” explained Silvio. “But this is a caucus, not a formal meeting of the Mars Council. We won’t transact any real business. We’ve been talking about devolution and related issues all morning; in fact, the entire Council has

been emailing back and forth for the last four sols. Pretty soon the Council will need to meet formally. Enlai's got one question we've discussed."

"We think Martech should be included in the first round of devolution, not the second, because it'll speed up the reform of health care," said Enlai. "It should be reorganized. Rather than a Chancellor appointed by the Commission and approved by the Mars Council, we suggest a Board of Trustees with one or more members elected by the faculty, alumni, the Commission, and the Council, plus the Chancellor. Martech would be incorporated as a semi-private corporation. It'd have an annual subsidy coming from the Commonwealth, an endowment, and a substantial land grant; perhaps 100,000 square kilometers west of here in Gangis or Candor. Martech has grown in the last five years and is becoming a significant center of learning, so it needs independent standing."

"I have no objection to those ideas, as I have already said to Silvio; only to the timing. We need a coherent set of reforms, a clear package to sell."

"Perhaps the best compromise is to pursue the reform of Martech in parallel," suggested Madhu. "It doesn't strike me as a matter requiring input from other governments."

"It depends on whether devolution gets politicized, or maybe I should say how politicized it gets," replied Will. "Everything nowadays get linked with bigger issues and rises or falls with them, even if the link is tenuous or ridiculous. Governments might object to the loss of their property because Martech's the Mars Commission's right now." He pondered the matter. "I am in favor of this change in Martech, but I can't push it right now. The Council can push the matter as much or as little as it wants; that's your

constitutional prerogative. But right now I've got to stay focused on the commission's recommendations."

"That gets to another question we want to raise," said Silvio. "The role of the Landowner's Assembly. Some landowners were extremely difficult when New Hanford was proposed. The Assembly even debated a resolution banning major nuclear facilities on Mars. Absentee landowners don't have enough of a stake in Mars to play a major role in governance. Besides, it's a medieval arrangement to give landowners a stake. Mars does not need a House of Lords."

"We don't have a House of Lords," replied Will. "If anything, the Mars Council is the House of Lords and the Landowners' Assembly is the House of Commons. The latter represents far more interests, far more diversity, and is much less mature as an institution. As you said, the Assembly debated a resolution banning large nuclear facilities, but it never actually voted on the resolution. We debated similar ideas in the Borough Meetings. So did the Council."

"Will, it is a strange arrangement," persisted Enlai. "No one on Earth would set up a government this way."

"But we aren't Earth. Ten years ago when the Mars Commonwealth Authority was first established, 30,000 people and 130 corporations sank a billion redbacks into land here. This sol we have 65,000 people, 200 corporations, and six billion redbacks in investment, mostly gold leases to three companies. That's more value than Commission property here. Some of the investment, especially by small landowners, was motivated to support us and be a part of the enterprise; to be part of the Commonwealth. It's their endeavor too; why shouldn't they have a role to play? They're shareholders. Fifty years

from now, if this place has a hundred thousand people, almost all of whom will own property, Mars residents and Mars corporations will dominate the Landowners Assembly as well. But right now, the Mars effort involves three groups; residents, the Commission, and terrestrial landowners. Including the latter in the system makes it more inclusive and empowers investment."

"It strikes me as a clever way of reusing old principles of governance to produce something new and progressive," noted Madhu. "When the Puritans arrived in New England they used corporate law as the basis of their Commonwealth and English property law to determine who could vote; which in their case was all the men, since they all had property!"

"Well, then they established a voting requirement based on church membership," growled Silvio.

"Let's not plan to do that," replied Will. "We can't and won't abolish the Landowners Assembly. I doubt that's what you had in mind anyway. But the Assembly already doesn't have as much authority as the Council and it needn't have as much. For example—"

"We have exactly that issue in mind," interrupted Silvio. "Specifically, we'd limit the Landowners Assembly to approval of any taxes the landowners have to pay."

"I. . . could see that." Will nodded.

"The budget for the proposed Ministry of Transportation is larger than the annual property tax levy," added "Lal. "It's perfectly legitimate for the landowners to pay for the maintenance and improvement of roads. Their land would be nearly worthless if it weren't on a road."

"We've already sent land use bills to the Assembly and the Commission has already consulted with them about the release of new tracts of land to the market," said Will. "They should continue to have the privilege of consent about policies and laws that affect the value of their property."

"I suppose that's unavoidable," agreed Lal. "The Assembly had a good balance of positions when the question of setting up natural parks was resolved. We'd be willing to allow that; but in return, we believe the landowners should not have a say over who is Chief Minister."

Will was startled by that statement. His first impulse was to reject it forcefully. "We have a bicameral legislature," he replied. "I think that means that denying the landowners such a privilege would make a mockery of the legislative status of their Assembly."

"While I'm representing Dawes here, I can't deny that I'm Muller Mining's chief officer on Mars," added Gerhard. "Dr. Muller is a great supporter of Mars, but he would feel personally affronted if his right to vote as an Assemblyman for the Chief Minister were taken from him."

"Of course," said Will. "Silvio, I know you opposed the Landowners Assembly ten years ago, but it was established and it has existed for a decade now. We can't strip it of its privileges now."

"I'm not talking about taking away anything," replied Silvio. "For the last decade the Council and Assembly haven't done much. We've controlled the budget for the arts on Mars and we've had the authority to charter boroughs. We've passed a land use bill defining natural parks and historic sites. Now the range of responsibilities is increasing.

Why do both legislative bodies have to increase in responsibility the same amount at the same time?"

"They don't, but we can't create the impression that we are ignoring the Landowners Assembly," replied Will. "There's no reason for the landowners to be involved in education, health, the interior environment, safety, or emergency services. But they have legitimate interests in transportation, resource recovery, the exterior environment, land sales, and property taxation. We've stretched their interest to include Martian art and culture and they have accepted that; it's good corporate citizenship and of great interest to small landowners, who love to watch our cultural events. They inevitably have interest in who runs everything and should have some sort of say."

"What if the Chief Minister were elected by the residents?" asked Lal. "Then neither chamber would have a role."

"And what if the Chief Minister had veto power over taxation, rather than the Commissioner?" added Silvio.

"We're having enough trouble selling this change to the Earth governments," replied Will. "They'll accept election of local mayors, but not of the Chief Minister. Not for another decade or so. And they'll want the High Commissioner to retain a say over taxation because it affects Commission income. Giving the Chief Minister the veto over the budget will be a hard sell."

"Will, why should the Commission have a say over how much money we spend on schools and hospitals?" asked Enlai. "You've got to try to sell that, at least."

Will considered. "That will be difficult, but I can give it a try. I'll need all the help I can get. We're encountering strong resistance."

"How is the campaign going?" asked Silvio.

Will shrugged. "It's hard to say; we're getting noncommittals, but no outright rejections. That will change in the next few sols because the media has gotten wind of the issue. Once they report about it, there will be official statements."

"We won't discuss the matter officially as a Council for several weeks," said Silvio. "We don't want Mars to get less as a result of any controversy up here."

Later that night, a Japanese television network released the first story about the negotiations about devolution. When Will awoke the next morning, a videomail from Louisa Turner awaited him. "I almost awakened you in the middle of the night," she said. "Tom Brady released a statement promptly at 6 a.m. Eastern time that the United States 'would strongly oppose any effort to change the current structure of the Mars operation beyond minimal reforms necessary to assure safety.' The Europeans, Russians, and Japanese appear to be disposed in favor of the devolution plan; Brazil and India have not commented; China is assumed to be opposed. You should ask Stark to call Brady and try to get a sense of what 'strongly opposed' means. But it doesn't sound good. I'm attaching a statement for your approval; we have to say something. Bye."

He opened the statement and began to read it. Ethel came over. "I heard what Louisa said. What are you going to do?"

"Well, no country pays fifty percent or more of the government dues, so no one can veto. The U.S. could stop this if one or two larger funders agreed with it, like China, or India and Europe together. Even so, going against its will could have some pretty serious consequences."

“Funding?”

He nodded. “Or they could oppose renewing my authority as High Commissioner.”

“There’s also a Presidential campaign going on.”

“There’s always an election coming up, but who knows what that means.” Will shrugged. “We’ve lost one battle, but the war’s not over yet.”

12

Kasei

early and mid June 2056

Charlie Langlais seemed as intimidated by the crowd of people around him, vacuuming up his vomit, as he was by the weightlessness and the strange conditions. He began to cry again and Clara held onto him tightly but tenderly, trying to comfort him.

"We're almost there, Charlie," assured Helmut, who was strapped into the seat next to them. "Come on, lean over and look out the porthole. Do you see the 'Spirit of Mars' statue?"

The two-and-a-half year old glanced at his dad, but didn't look out the porthole. He didn't even stop his crying. It echoed through the cabin; the other twelve people pretended not to be bothered by it. The little boy had cried most of the shuttle flight up from Aurorae. It had been a long, fifteen-hour trip.

Helmut looked out. He loved to see the statue, which was even visible to the naked eye from the planet's surface, though only as a moving star. Near it was Embarcadero Station, a collection of retired Interplanetary Transit Vehicles sprouting spoke-like from a central axis of annexes and docking cubes, the whole thing rotating four times a minute to generate Martian gravity. Several hundred meters past the end of Embarcadero's axis was the caravel *Giovanni Piazzi*, their destination. The backdrop for the entire view was their home, Mars, Dusty Red, the one the peoples of Earth had called by many names: Ares, Tiu, Shalbatana, Nirgal, al-Qahira, Kasei.

Charlie's crying intensified, distracting Helmut from the view. He looked over; Clara made more effort to comfort him. "He's hungry," she said.

"We already tried feeding him. Try the pacifier again."

"He's too old for a pacifier. The only thing left is sleep, but he's too upset to sleep."

"This wasn't such a good idea."

"He won't die," replied Clara, defensively. "We're almost there."

"He's going to have to get used to weightlessness; he's going to experience a lot of it."

"I know."

Helmut turned back to the window; the crying was getting on his nerves. But they were closing on the *Piazzi*, and it was exciting to watch it get larger and larger. In another hour they were lined up and heading toward the single docking collar in the center of vehicle. Shortly thereafter there was a series of clanks.

"Welcome to the *Giovanni Piazzi*," said Charles Vickers over the intercom. "We are clear to open the hatch."

Everyone in the cabin relaxed; most people unstrapped themselves while Adam Haddad and Thierry Colmar floated to the hatch to clear the docking apparatus away. Charlie stopped crying, especially when his mom assured him they'd soon be inside and in gravity.

Charles Vickers floated into the cabin from the cockpit and headed to the hatch. He was there when the connection was opened and floated through to the central axis of the ship. He entered a cylinder about three meters in diameter and ten meters long. The wall of the cylinder was set up as a "floor." The three meters of cylinder he floated into

was not rotating, but beyond a railing the rest was. The railing had three gaps in it leading to three elevators, their doors protruding up into the cylinder.

"Welcome, Commander Vickers, to your vessel!" exclaimed Ernesto Gomes, head of the construction crew. He was pleased to see Vickers and anxious to be hospitable.

"Thank you." They shook hands. Charles obviously was excited. "We have our first team with us and they're anxious to come on board."

"Permission to come on board is granted. They should take the red elevator to their quarters in sectors 1 and 2."

"Thank you. Is there anything new to report?"

"No. All of sector 1 is set up and half of sector 2. Life support is set up for all six sectors, though it is rudimentary for sectors 3 through 6; air and power only, no water."

"There's a lot for us to do," agreed Charles. "But we've got plenty of time, here, at Deimos, and on our way to Astrea."

"Everyone should settle into their rooms, then come to the cafeteria. We've got lunch ready for you. We'll do the official transfer of the vehicle to you there."

"Excellent," agreed Charles, with a smile. He stepped out of the way to let everyone else through the tunnel. His crew began to board the *Piazzi,* maneuvering luggage as they went. Helmut and Clara came through last with Charlie; it was all Clara could do to hold him while Helmut pulled the luggage along.

Clara maneuvered herself down to the nonrotating floor with some difficulty. The velcro on the bottoms of her shoes gripped the carpeting; she walked carefully. "Come on Charlie, let's step onto the moving floor." Clara said.

“But it’s moving!” protested Charlie.

“I know. Here.” Clara reached out and grabbed the railing with her right hand while carrying Charlie in her left arm. She hopped onto the rotating floor, which immediately gave her and Charlie a bit of weight. She walked along the railing to one of the three openings where she could step through, toward the red elevator shaft labeled “Sectors 1-2” above the door. She pulled herself along another railing to the door and pushed the down button. Helmut followed a moment later, wrestling with the luggage in the microgravity.

They had to wait a minute for the elevator to return; then the door opened. They carefully stepped in. “Second floor?” announced Helmut to the elevator’s computer. The door closed and they started down.

“Wow!” said Charlie, thrilled to feel weight return.

“Do you feel better?” asked Clara.

“Yes, much better!” replied the little boy.

It was a slow elevator; the computer controlling it had to open and close pressure doors between every other floor. They descended four floors of the five, then stopped and the elevator door opened. They stepped into a hallway with “sector 1” to the right and “sector 2” to the left.

“This way,” said Helmut, turning left. They walked down the hall—Charlie walked on his own, now that the gravity felt normal—almost to the end of sector 2. Then they stopped and Helmut opened a door. “Here we are!” They stepped into a room seven meters long and five wide and, except for a big bed, completely empty.

“Pretty bare,” noted Clara. “Bare bones. But then, we’re supposed to finish it.”

“It’ll be our quarters for over four years, so we might as well set it up the way we want it.”

“And what’s this, our closet? Oh, no, it’s Charlie’s room.” Clara stepped into a two by five-meter space. The boy’s bed was already inside the door on the right; the rest of the space was empty.

“My bed?” said Charlie. He looked at it, touched it, then said to Clara “But I want to sleep with you and daddy tonight.”

“No, dear, this is your room.” She looked around. “We have some cute wallpaper for it, remember? It has pictures of your favorite superheroes.”

“We’ll put it up next week,” added Helmut. “We have to put together and install all the storage cabinets under our bed, then put together shelves and closets.”

Actually, I think we put the wallpaper in place first, then the shelves and closet in his room to cover the ragged edges.”

“You’re right.” Helmut stuck his head into the other part of their quarters, a bathroom two meters square. “Well, at least the bathroom is more or less finished.”

“More or less?” Clara stuck her head inside. “No wallpaper.”

“The sink, toilet, and shower are usable.” Helmut turned one of the sink’s faucets as a test and out came water.

“Where will we put Charlie’s potty? How about over here.” She pointed to a spot just inside the door and the little boy nodded.

“Won’t this be a nice house?” Helmut asked Charlie, and the little boy nodded.

"For a long time," added Clara. "Two weeks here, two and a half months on Deimos, then after two months, back on Mars, then a month here to prepare for launch. Time is flying fast."

"Yes, we've got to get some essential things set up for ourselves while we're at Embarcadero and can rely on its backups; and prepare the launch of supplies to Astraea, of course. It's a pain, but the more we do ourselves, the more we know about everything."

"I think I'll envy future missions in the *Piazzi*, though; they'll have quarters set up, horticulture fully functional, completed scientific labs. . . a lot less work!"

The Yellow Buddha stood serene yet defiant, gentle yet powerful, his finger pointing downward at Father Mars. As the ceremony came to an end Will approached it one last time. He closed his eyes, bowed slightly, and said a prayer to the Lord Buddha, a divine Manifestation according to his own belief. Then he turned to follow the crowd—about 150 people—across the crater to the refreshment tables.

His friend Shinji Nagatani, his wife Michiko, and their two children, an eleven year old girl and an eight year old boy, strolled behind the crowd, talking in Japanese about the ceremony. Will caught up to them. Shinji turned to him. "What did you think?"

"Such dignity and solemnity; I was very moved."

"It was beautiful. And I was impressed that so many people came and seemed to enjoy, even appreciate, the ceremony."

"Yes, I think the Lord Buddha is welcome on Mars. Did you ever think you'd live to see this, Shinji?"

Shinji laughed. “No. But then, I never expected to spend twenty years on Mars; I was planning to stay one columbiad, remember?” The two men laughed together.

“Life can take some very unexpected turns, can’t it?” observed Will.

“Yes, indeed.” Shinji looked at his children. “And do you realize, Will, I’ll be *sixty* next year? It’s hard to believe.”

“It is. I just turned 55 last month. We both have to consider retirement pretty soon.”

“How long do you want to stay as Commissioner?”

Will shrugged. “My second term has four years left to it, at which point I’ll have done the job eleven years. Maybe that’ll be enough. The Trustees want a two-term limit.”

“But how would you retire?”

“There’s always geology. Once upon a time I was called ‘the Moon man.’ Roger and I have a textbook and related website that needs updating. And I suppose I’d meddle in things.”

“How are you handling the stress right now?”

“I’m mostly disgusted. We tried diplomatic efforts, then a media blitz. The latter has persuaded public opinion; the terrestrial public mostly loves Mars and wishes us well. But the U.S. administration hasn’t budged. So there will be a vote next week, they will lose—right now it’s beginning to look like China will support devolution, and some countries want to spite the Americans—and the Americans will cut a billion dollars a year from their support of Mars.”

“Ouch.” Shinji contemplated. “Well, that’s the way it has to be.”

"I think so. If they cut their support, we'll greatly reduce our U.S. operation. We would move the Mars Commission headquarters to Paris or even to here, with the Paris office coordinating terrestrial operations. We're probably at the point when we can cut back on terrestrial support anyway. And I think a century from now, history will judge that a turning point was reached and the torch was passed."

"That could be."

They approached the crowd again, milling around the tables of hors d'oeuvres, so they ended their sensitive conversation. Someone approached Will with a question, so Shinji and family drifted away. Later Will saw Shinji and Michiko talking to Yoshi Suzuki, who was Michiko's third cousin.

After forty-five minutes, the crowd began to thin. Some headed for the conestogas pulled up outside to take them to Aurorae; others started down the 800-meter tunnel recently completed to the Dacha, where they could swim, have a drink, and relax before catching a conestoga from there to Aurorae. Will went inside the visitors' center to get his pressure suit and walk to the Dacha when Yoshi sent a monk to get him.

"My friend, I had no intention of leaving without saying goodbye," Will said. "I was very impressed by the ceremony. It was extremely moving."

"I saw you pay homage to the Mars-witnessing Buddha afterward," said Yoshi. "I think it went well, also. For us Zen monks, a statue of the Buddha is not of high priority; what we seek is inside us. But the statue helps others because it spreads the word. The ceremony was very well received in Japan; even in Thailand, China, and other countries with large numbers of Buddhists it was watched by many people."

“I’m sure it’ll be covered by CNN, the BBC, and all the other news channels. We anticipated the likelihood and made it was the focus of our publicity efforts as well.”

“I heard that, and we are grateful. How have the efforts to foster devolution been going?”

“We’ve had some success, and encountered some difficulties.”

“So I’ve heard.”

“How have your efforts to expand your facility been going? I haven’t heard in a long time. I walked here from the Dacha; the tunnel is quite a feat of engineering.”

“Thank you. It took a team of monks and hired help just about one year to complete. It will be a great assistance to everyone and may even stimulate more development up here. And the side tunnel to the escarpment is finished; would you like to see?” And before Will could answer Yoshi rose. Silently, Will followed him into the tunnel.

“How are your personal quarters developing?” he asked, as they walked down the tunnel.

Yoshi pointed down a side tunnel. “Oh, fairly well, but we have concentrated on the outside right now; the dome, the crater, the landscaping, the Buddha, the tunnel to the Dacha. Our personal spaces are just caves hewn from the rock and sprayed with a concrete sealant, then a plastic coating. Very primitive and basic. Our goal has been to do something that will take the message of the Buddha to the world; to two worlds, actually. And we seem to have made good progress.”

“Yes, I think so.”

They stopped to open a pressure door, closed it behind them, then ten meters later passed through another. They started down a fairly simple tunnel three hundred meters long and two meters wide and high, hewn from rock and then sprayed with a concrete sealant and a plastic coat. A wire ran overhead, nailed to the rock periodically, feeding electricity to lights every eight meters; sensors brightened each light and then dimmed it after one passed.

"How's the air loss in here?" asked Will.

"I think it's down to two or three kilos per sol. That's still a tonne per year, but we can afford it. The leakage rate's slowing down, too."

"It should be; I suppose it'll halve in the next year or two, as humidity freezes up the pores in the rock."

"Unless the freeze-up creates a pressure increase, which in turn causes a blowout. We may spray another plastic coat on the tunnel."

They reached a point in the tunnel where it turned sharply to the right; the Dacha was five hundred meters in that direction and there was another pair of pressure doors. But just before the right turn there was another pressure door to the left marked in English and Japanese "Construction Area: Do Not Enter." Yoshi punched in a code, then turned the handle and they passed through another pair of pressure doors, then started down a short, fifty-meter tunnel that was still unfinished.

Light streamed in from the end. As they approached, Will could see a view of the Aurorae Valley spreading out before him. They reached the end of the tunnel and stepped onto a ledge that was enclosed by a bubble about twenty meters wide and ten meters high, its top soaring up and almost touching the rock overhang above them.

“Wow!” said Will. “The view’s spectacular, and the rock overhang makes it even better!”

“Yes, this natural overhang is an incredible spot. We’ll cover the floor with a rock garden that will complement the view. We’ll use this for meditation. Maybe we’ll open it to visitors when it isn’t used by us.”

“Very special. Thank you for showing me.”

“I am happy to do so.” They turned and walked back down the tunnel. After they entered the main tunnel, Yoshi pointed northwestery. “There’s a ninety-meter crater about two hundred meters in that direction. It’d make the nice focal center of a housing development.”

“Really? Interesting idea.”

“I mention it because our patron is very pleased with the results of this effort; this ‘investment,’ as it were. It has been good for Buddhism around the world; but it has also been good for Japanese culture, and more broadly for East Asian culture. For him—and for me, I must admit—that is just about as important as promoting Buddhism. So our patron has been organizing a group of Japanese industrialists to endow a Japanese community here; ultimately they want at least one hundred Japanese people here.”

“Really? We would welcome the effort. Mars is an idea that can embrace everyone. It must embrace all cultures and peoples.”

“We want to make sure Mars, if it really does grow to the size and importance it can, embraces Japanese culture. We don’t want it dominated by the United States and Europe. We’d prefer a balance, if not an East Asian focus.”

“Of course, I understand; and I will support the inclusion of everyone and the dominant role of anyone, so long as the latter doesn’t preclude the former. Every culture on the Earth is capable of serving as a template for Marsian culture, though I suspect Marsian culture will be different from any of them.”

“I am sure you are right about that; Mars already has its own distinctive culture. But we want to make sure Japan makes an important, if not central, contribution, and the Kasei Project, as they are calling it, will do that. They already have commitments for a 1.6 billion redbacks over seven years, and they’re still raising the money privately and quietly. Their goal is to triple that in private monies and arrange a Japanese governmental contribution of 2.1 billion redbacks over seven years. Everyone thinks that’s possible, in spite of the demographic crisis Japan is going through right now.”

Will stopped walking. “Yoshi, I’ve never heard about this before.”

“I know, I’m telling you right now! So the total should be about six billion redbacks over seven years; not equal to the U.S. contribution, but close.”

“It may very well equal the amount they cut from their contribution to Mars, though.”

“Good. They can have less influence over the culture here, if they choose; and Japan can have more.”

“Marvelous! You are welcome!”

“So we are interested in building a ‘Japanese village’ up here on the escarpment. Or perhaps I should just say a ‘village’; Japanese can live down in Aurorae if they want, and non-Japanese people can live up here if they want. It’ll be a village within the borough of Aurorae. The Kasei Project has already started identifying the skills we want

to import. Japan has some incredible industrial artisans, very capable engineers, and remarkable cultural resources. We'll import an interior designer to give the village a Japanese-Mars design. I have the permission of our patron to talk to you about this."

"He should call me when he is ready."

"I'll tell him. I think he'll call in a week or two. Perhaps he'll wait until after the vote, so as not to look like his effort is political."

They came through the last set of pressure doors and down the last thirty meters of tunnel. The bright sunlight of the monastery's crater was a bit blinding at first, after the dim light of the tunnel. Will looked around the crater, with its perfectly manicured lawns, beds of flowers, shaped trees, and artfully arranged rocks, all dominated by the yellow 'Mars-witnessing Buddha' at the far end. The beauty was striking. "We need more of this, Yoshi."

"Mars is not just efficiency, technology, scientific discovery, and material production. Nor is just a happy family, supported by good schools and generous psychological counseling. It is also beauty, serenity, inner peace, self discovery; suffering and the cessation of suffering."

"It is nirvana," agreed Will.

13

Departures

Oct. 2056

Will looked at the wall of flames and the column of inky black smoke on the television with a sense of dread. Khaliestan's revolution had swept into its largest petroleum distribution facility; several percent of the Earth's petroleum production capacity no longer existed. Oil prices already had risen. The green and black flag of the revolutionaries fluttered over a ruined facility of no use to them or anyone else.

Érico, walking by, stuck his head in. "The price of gold is on its way up," he said. "It's gained thirty redbacks an ounce since trading opened in New York."

"We'll make more money from exports than expected; but governments will have less to give next year," said Will. "This is shaping up to be a major crisis. If the revolutionaries get any farther, the United States may intervene militarily."

"A lot of good that'll do; the revolution against the royal family has strong popular support. They'll just get a guerilla war against them. And you can't export a fifth of the world's oil productivity reliably under those circumstances."

"I agree. You'd think the U.S. would have learned its lesson from its previous interventions in the Middle East. If Khaliestan's output is shut down, they say oil prices will quadruple and the world economy will contract ten percent."

"That's what I heard, too." Érico shook his head. "By the way, Yuri Severin has accepted to be in charge of the Emergency Management Office. He'll start to work as soon as he leaves Earth orbit. He's scheduled to depart October 27, I believe."

“So he’ll be on the job in two weeks; that’s amazing. What about the Environmental Management Safety Office?”

“No response from either candidate yet. It’s a hard one to fill. I’ll turn up the charm.”

“Good. Ask Tom Brady for advice about contacting Rachel Evans. If I remember her c.v. right, she listed him as a boss.”

“Do you really think Brady will respond, after loosing the huge fight over Chief Minister?”

“You never know. The U.S. has been cold toward us and they said they’d never vote to renew my term as Commissioner in 2061, but they have continued their Martian polar research and have proposed relatively small cuts to their part of our budget. They don’t want Houston to lose our headquarters and they don’t want American business to lose our contracts. We have to show persistent friendliness; it should help.”

“Okay, I’ll send him an email. Have we heard anything more from Alexandra about production quotas? We’ve got a crew scheduled to set up oases along the Circumnavigational through western Marineris and across Tharsis early next year and no shelters have been produced.”

“I was talking to her yestersol about production bottlenecks. They simply can’t keep up with demand. Everyone wants a set of cylinder domes in the next two years, construction of housing for the arrivals is behind schedule because of the increased numbers, and contracts for three more caravels appear in the offing. I’m sure she’ll want the trip postponed and the crew added to construction duty.”

“No doubt, but the trail construction crew consists of burned out workers from her units who can’t stand making plastic or houses or caravels much longer! They need a change of pace. Trail upgrading is vastly behind schedule because of her situation.”

“I know, and it’s perpetual; we can never have enough construction specialists up here. I doubt the eleventh columbiad will be any different.”

“But we have to resolve this somehow, Will. Early next year we’re establishing a Ministry of Transportation with a permanent minister in charge and a full-time crew whose main purpose will be to grade and widen trails and install oases. It has to have steady work.”

“I know, and the chief minister has no control over construction and fabrication, either, which means I’ll have to mediate these problems. Let’s plan to meet with Alexandra briefly next week to talk about the matter.”

“Okay. I’ll ask Huma to set it up.” Érico nodded and headed out of Will’s office. Will sighed at the thought of more problems to resolve. He turned to his messages, which were constantly arriving.

One puzzled him; the subject was “Your mother gave me your number.” Will activated the videomail. “Hello, Will Elliott,” began a man in his mid thirties, with black hair and a thin mustache. “My name’s Rostam Tehrani and I was visiting your mother in her nursing home the other day. She’s such a sweet lady and was very kind to me about fifteen years ago when I moved to the area; it’s a real joy to see her. Anyway, she told me about the plan of the Spiritual Assembly of Aurorae to build a Bahá'í House of Worship on Mars, so I wanted to find out how I could help. I’m the C.E.O. of Rostam Robotics; it’s a company I founded twelve years ago in the Boston area that produces robotic

software for the construction industry. Our code runs more bulldozers and related earth movers than anyone else's; it's used on Mars as well. Our product wouldn't exist if the Mars and Lunar Commissions hadn't sunk a couple hundred million dollars into automating earth movers, back in the mid 30s. So I'm interested in making a contribution to your temple, partly out of gratitude. I have some friends who might help as well. But we don't know how to make the contribution. Your mother suggested that I call you; she says the big push began a few months ago. Looking forward to hearing from you some time. Bye."

Will hit reply. "Thank you for calling, Rostam. My mother has become the big promoter of a Mars temple; she wants to see it finished before she dies, and I suspect she'll make it, even if she is 87, and even if it takes us a decade to build it! I heard from a New York banker last week who also visited mom and heard all about the effort. We've been talking about the idea for about a year, but after the Zen monastery dedicated its statue of the 'Mars Witnessing Buddha' we were so moved by the beauty and peace of the spot that the Spiritual Assembly resolved to build a temple, and in September the plan was approved by the Universal House of Justice, though it hasn't been announced to the public yet. All the religious communities here are working on places of worship; we could fill an entire dome with them. A Catholic church, a Protestant church, a church for the Universal Church of Jesus and the Creator, a Mormon Temple, a Bahá'í temple, and a mosque are all being contemplated. We're trying to avoid a competitive atmosphere. The Bahá'í community includes eighteen persons and we'll be gaining four more in a few months; we're small, but large enough to do it, and we have some resources. We've also

had some new believers; we've done reasonably well in that respect. So I think we can be confident the plans will move forward.

"As for contributions, send them to the National Spiritual Assembly of the Bahá'ís of the United States. They already have an account set up for it and they've already received contributions, thanks to mom. You'll get a tax deduction that way, also. We'll be announcing more details later. Bye."

He sent the message, pleased he was able to do something positive while Khaliestan burned.

Helmut and Clara's living room in Aurorae was filled with late afternoon sunlight by the time Sebastian arrived with the pizza. Clara immediately put plates on the table while Helmut grabbed drinks from the fridge—lemonade, coke, and mineral water. Charlie managed to get himself into his chair and began to bang his hands on the table with anticipation. Then they all sat.

"What a relief, to get away from the office," said Sebastian. "Khaliestan will cost Mars some money, but the price of gold will go up and compensate. The ABC doesn't have gold. I've been sending videomails all sol to shore up support. The Europeans and Japanese are wavering."

"Could that put mission three in jeopardy?" asked Helmut.

Sebastian nodded. "I think so. Mission 2 should be okay; Vesta has solid scientific objectives. Maybe we'll have to delay the launch. But Mission 3 is headed for the outer belt to sample the chondritic bodies there. I hope we can increase our support from the U.S.; it's a useful precursor for Jove 1."

“It’d be nice to get a pair of their nuclear-electric engines, too,” said Clara.

“Yes, but I wouldn’t hold my breath! They’ll cost two billion redbacks each.”

“Wow! I guess they won’t be used on the Earth to Mars run any time soon!”

“No, it looks like old fashioned chemical propulsion will dominate that route for some time. So, did you find a renter?”

“Yes!” replied Clara. “A couple arriving in February, Rachel Evans and Thad Vail. They emailed me earlier. They’re renting for one columbiad.”

“Good; one less hassle for me,” observed Sebastian. He turned to his grandson. “So, do you know what you want for your birthday, yet?”

Charlie nodded. “A train set.”

Sebastian laughed. “We don’t have them here, and you can’t take something like that on board anyway!”

“Why not? I can run the tracks from my room to mom and dad’s room!”

“Charlie, we don’t have train sets here,” Helmut repeated. “But I think Silvio’s has a little used wooden train.”

“Oh, that’s good!” the little boy replied.

“Maybe I’ll get that for your birthday, then,” said Sebastian. “So, we’re celebrating your birthday early; are you excited?”

“Yes!”

“That way his friends can go, as well as grandpa,” noted Clara.

“I’ll miss all of you,” said Sebastian.

“Kristoff will be here in a few months,” noted Helmut.

“I know, and I’m looking forward to it. It’s a shame both of you boys won’t be here at once.”

“It is, but the launch can’t be postponed, and we’ll see him when we return in four years. Maybe by then he’ll be married.”

“That’d be good, but don’t hold your breath.” Sebastian sighed. “I have a grandson who was the first child to see Deimos, and by the time he returns, at age seven, he’ll have seen four more worlds!”

“He didn’t see much of Deimos,” said Helmut. “After realizing the *Piazzi* didn’t have any windows, because it has to spin to produce gravity, he was very disappointed and kept asking me to take him out even though he has no space suit. The ride in the hopper-van was fun for him and he was glued to the window most of the time.”

“I like Deimos,” said Charlie, smiling. “Daddy gave me a piece, too!”

“We’re starting his rock collection,” said Clara.

“You all did very well up there,” said Sebastian. “The Ceres mission’s already a success. The coring all the way to the center of Deimos will be analyzed for years. Yestersol we received a request from yet another university for samples. I think we’ll be sending almost a tonne of samples back to Earth. They have a very sensitive spectrometer for measuring isotopes to the parts per quadrillion range. They plan to reconstruct the accretional history and subsequent fragmentation history of Deimos’s parent body in detail. They hope to do similar analyses on asteroid samples you bring back.”

“Good,” said Helmut.

“The *Piazzi* is in good shape for the trip,” exclaimed Clara. “We still have to set up some of the chemistry and geology labs, but we’ll have seven months for that. The

hydroponics are set up; we'll have our first oranges and strawberries when we launch! The quarters are the least ready, but we'll finish them up on the cruise as well."

"I like my room," said Charlie.

"Well, we've finished it," replied Helmut. "But mom and dad's room still needs some furniture and wallpaper."

"We've even ordered an extra wallpaper design so we can change the room," added Clara. "We figure when we leave Ceres we'll need a new look."

"The mission will be on its way home by then," agreed Sebastian. "That's assuming you can make the plastic paper on Ceres, of course."

"We'll be able to make paper," said Helmut. "We've got great equipment, good plans, and fantastic people. The mission will go great."

"I hope so. There are never guarantees. The risk assessors say there's one chance in a thousand of a fuel tank leak or explosion, engine irregularities, aerobraking failures, life support explosions. . . there are plenty of things that can go wrong. No ship is unsinkable."

"We won't forget that," said Helmut.

Forty thousand kilometers above the moon, at the Gateway staging area, the caravel *Intrepid* fired its engines briefly and began to fall toward Earth's companion. Two days later the flying saucer-shaped vehicle, its roof covered by hydrogen and oxygen tanks, flew past the moon, firing its engines briefly as it was just twenty kilometers above the craters and hills of the far side. The *Intrepid* whipped toward the Earth, falling rapidly toward a point three hundred kilometers above northern Australia. Three days later, on

October 6th—September 5th at Aurorae—as it skimmed the far reaches of Earth's upper atmosphere, the *Intrepid* fired its engines for one last time, accelerating itself by 3 kilometers per second. It was on its way to Mars.

"The burn was nominal," reported Captain Yuri Severin. "According to GPS positioning, we are within four centimeters per second of our intended velocity."

"That's very good," commented Will, sitting in Mars Control and listening to the data from the *Intrepid*, a cup of hot tea in his hand. It was 11:50 p.m. in Aurorae.

"The engines are good," replied Rostam, looking at a screen full of data in front of him. "The telemetry we're receiving shows that everything went perfectly."

Will reached down to the console in front of him and tapped an icon. "Congratulations, Yuri, and have a good flight. We're looking forward to seeing you in one hundred forty days." He closed the connection to send the message.

Rostam looked over everything again, especially the red numbers that were drifting from nominal; there were always a few of them. "They've started full engine shutdown on schedule. It was a nearly perfect burn."

"Good." Will sighed. "And the *Courageous* leaves Earth with 120 on board in mid October, Lufthansa's *Bering* complex with 64 in early November, and United Space Express's *Orion* departs with 64 in late November. The *Intrepid* is carrying 150. That's 398 people, including 35 tourists. We have 45 folks heading back to Earth, so Mars grows by 309. I'm not sure where we'll put them all!"

"And so much diversity!" added Rostam. "We'll have interesting times ahead, I think."

"Yes, I'm sure," agreed Will.

Suddenly his attaché beeped with an incoming videomessage from Earth. Will looked at the screen. “Tom Brady.”

“The American representative?”

“Exactly. I’d better take this in private.” Will walked back to his office a dozen meters away, closed the door, and pressed play.

“Good sol, Dr. Elliott. I was watching the telemetry streaming back from the *Intrepid.* It was an excellent burn; incredibly precise. It’s another demonstration of the marvelous technology that went into the caravels.

“So congratulations on another job well done. I should add that I was talking to the President yesterday about the issue of devolution. We were impressed by the mature and professional manner it has proceeded so far. It appears some tasks will remain under the Commission for some years simply because a precipitous transfer isn’t wise. Our people at Johnson Spaceflight Center have felt the collegiality of your personnel across the street and are relieved you have no plans to move Commission headquarters to Paris. The President is fairly sure that most of the cuts the Congress made to the fiscal 2057 budget can be restored in fiscal 2058 if restraint continues to dominate.

“We look forward to working with you. Good bye.”

Will played the message a second time to observe the nuances, then he taped a response. “Good day, Mr. Brady. Thank you for your warm words about the caravel; it has again proved to be very capable. As you know, we indeed plan to devolve authority gradually for various practical reasons, but mostly it boils down to safety; we want the Commission’s Mars Control to retain full audit and backup capability. We are also very pleased with our Houston headquarters—it is even more beautiful and functional now

than before the attack—so we have no plans to move to Paris. Mars wants to work closely with the United States, indeed I want to see the U.S. continue to be the major influence up here, because it has more capability and diversity than any other country. But obviously we are delighted to have contributions and involvement from as many nations as possible. We look forward to working with you as well."

Three weeks later, it was time for another departure. The Ceres crew had a grand sending off in the Patio. All of Yalta Biome's floor space—the grassy yard included—had to be covered by tables and chairs to accommodate the entire population of Aurorae. After the meal, Will Elliott walked to the stage.

"Good evening, everyone," he began. "We are gathered here to convey our best wishes and warmest thoughts to the crew of the caravel *Giovanni Piazzi* as they embark on what may be the greatest adventure humanity has yet launched. We are privileged that the voyage of discovery is departing from Mars. It will visit four worlds and extend the human presence to the asteroid belt, which may someday be the home of millions of people. Many regard the asteroid belt as Mars's territory, where we can send out colonies and make our voyages of exploration. But I am not so sure of that. No one stays dependent on a home world forever. Mars is weakening the ties that bind it to Earth. Will not the same process repeat with the asteroid belt in the upcoming decades and centuries? This is the reason the Asteroid Belt Commission is a separate agency from the Mars Commission. This sol is the inauguration not just of a new territory for human exploration, but the opening of a new frontier for human settlement, one that will see its own declaration of independence in the future.

“The twenty-six brave men, women, and children departing from our midst tomorrow morning are among Mars’s brightest and most capable. We send them forth with the greatest confidence that they will produce results that will go down in history. We will follow their progress closely, will miss them dearly, and will welcome them back joyfully. Upon their return, they will be senior members of our exploration corps and will be embraced by every national astronaut corps. No doubt, many of them will be bound for other worlds; the moons of Jupiter beckon next decade, Saturn the decade after.

“In short, our hopes and aspirations, in large measure, rest on your shoulders. Humanity accompanies you in its dreams. Bon voyage.”

Will sat to warm applause and Sebastian Langlais walked to the stage next. “When I arrived here almost two years ago, I thought I was going into retirement to do a few small tasks while enjoying time with my son, daughter-in-law, and grandson. Little did I know that I would be assuming one of the biggest tasks of my life, and would be sending them off to the asteroid belt! Will’s comments about humanity accompanying this crew in their hopes and aspirations rings true for me; my dreams are indeed with them!

“Some have described the solar system as consisting of the sun plus debris. Others view it as eight planets plus debris. The Asteroid Belt Commission, however, views the solar system as composed of thousands of worlds, large and small. We have the privilege of exploring many of those worlds.

“We are not the first. Currently there are probes exploring the asteroid belt from six nations plus Mars. Astrea is being orbited by a craft launched by India; Flora has a Chinese orbiter; Ceres has a rover sent by the Netherlands, two sent by us, and a

geochemical mapper from Malaysia. But as all of us know very well, automated exploration must—and inevitably will—be followed by human beings.

"Among these worlds, Ceres is unique. A third the size of Earth's moon, it is a huge world by a human scale, and because it formed cold it is full of water. Now the time has come for crews to leave footprints in its dust. We know, in broad outline, what they will find there scientifically. It has already been extensively mapped and studied. No doubt its cryovolcanoes and rifts hold many mysteries to discover. It is a world full of resources to assess. What we cannot predict is the impact of Ceres on the crew and on humanity. It is central in the belt and a logical base of operations. It appears to be a beautiful world. It is a world with which some will fall in love.

"Hence we send this crew out with much anticipation. Our parting words to them are simple: come home safely and enrich all of us with wisdom."

Sebastian walked back to his table amidst applause. As he sat, he put one arm on Charles Vickers, seated to his right, and the other on Helmut, seated to his left. "I meant those words," he added. "Be careful out there." He felt his throat tighten.

"We will, don't worry," replied Charles.

"We'll come home safe, dad," added Helmut. "And we'll bring you wisdom."

17 Dec. 2054: opposition
Sept. 17 2054: Earth to Mars Feb 17 2055 (153d, 5.2 km/s departure, 3.8 km/s arr.); Apr. 1 2055 depart Mars 7.1 km/s arr. Earth Dec. 1, 2055 244 d 10.7 km/s [or: arrive Earth Nov. 1, 2055, depart 9.2 km/s, arrive 9.6 km/s]

16 Dec. 2054: Vernal Equinox

January 29, 2055: Ceres/Mars opposition (cargo arrives Jan. 2056)

Oct. 12, 2055: Earth to Mercury Feb. 2 2056; 6.7 km/sec depart, 9.6 km/s arr.

Earth 2055-9-10 158d Venus 2056-2-15 106d Mars 2056-5-31 10.3 (5.04 Mars) 264d (leave Earth 2055-9-15, swingby Venus 2056-2-20, arr. Mars 2056-7-5, arr. Delta-v 3.4, total delta-v 8.84)

Jan. 3, 2056: Autumnal Equinox

Feb. 21, 2056: Dust storm season begins

July 7, 2056: Dust storm season ends

Nov. 2, 2056: Vernal Equinox

Dec. 31, 2056: Earth to Venus, 4.4 km/s 86d; 27 Mar. 2057 Venus swingby to Mercury; May 13, 2057 arrival, 5.4 km/sec delta-v, 133d total

Jan. 24, 2057: Earth/Mars opposition

Oct. 18, 2057: Mars/Ceres opposition

Nov. 20, 2057: Autumnal Equinox

Jan. 8, 2058: Dust storm season begins

Jan. 23, 2058: Earth/Mars conjunction

May 24, 2058: Dust storm season ends

July 17, 2058: Earth to Venus; Oct. 2, 2058: arrive Venus; 14 Dec. 2058: arrive Mercury

Sept. 20, 2058: Vernal Equinox

Feb. 27, 2059: Earth/Mars opposition (Earth 8/10/58 Mars 3/15/59 dep. Delta-v 10.5 km/s, arr. Delta-v 4.9 km/s travel time 217 d) (11-4-58 5.02km/s 183d 5-7-59 4.82 km/s)

Mars 4-28-2059 218d Venus 12-2-59 175 Earth 5-25-60 6.54 393d

Oct. 8, 2059: Autumnal Equinox

Nov. 26, 2059: Dust storm season begins

Apr. 11, 2060: Dust storm season ends

Apr. 2, 2061: Earth/Mars opposition

Earth 2062-1-28 163d Venus 2062-7-10 155d Mars 2062-12-12 9.12 (Mars 3.87) 318d

Ceres crew meets and plans training together. Helmut defends his dissertation. Will meets with Alexandra and Lisa about domes and housing. The price of gold has dropped seriously, so other exports are important. Smith talks to Will about a place for a Mormon temple. Universal health insurance and five-day work week start Jan. 1. [Ceres 0 arrives Ceres]
Date: late Dec. 2055 and early January 2056

8. Emergency 137
Helmut gets appendicitis at the South Pole. Aram's central cylinder dome depressurizes and it depressurizes the other cylinder dome and the B-160; the emergency requires the caravel crew to go help.
DATE: March 2056

9. Investigation 167
Helmut returns to Aurorae and hears a debate about the Aram accident. Will finalizes membership on the independent Commission and learns Forest Rivers is slandering him.
DATE: mid March 2056

10. Findings 179
Will talks to Martha about health and stress. He visits Vandevelde and Andalus. The budget has to be cut again because of lack of money. Weeks later, Helmut tells Anna Racan about Ceres and their plans to go there. They listen to the Aram Emergency Commission's report, which argues that Commissioner and Governor positions should be separate.
DATE: mid May 2056

11. Devolution 194
Mars public opinion pushes for devolution as well. Will agrees that the Lieutenant Governor position will become replaced by a Chief Minister. The Mars Council doesn't want the Landowners Assembly involved; the U.S. comes out against the plan. [Earth Venus Mars arrives 31 May 2056]
Date: late May 2056

12. Kasei 227
Ceres team goes to Embarcadero. Will goes to Zen monastery and hears from Yoshi about a Japanese business group who wants to support a major Japanese presence—the Kasei Project—on Mars.
DATE: early and mid June 2056

13. Departures 240-52
Will talks to a rich Bahá'í financier about funding a Bahá'í temple on Mars; revolution in Khaliestan interrupts the world petroleum supply and threatens collapse of the world economic system; Columbiad-11 ships depart Earth with a record number of settlers mid September; Will talks to Érico about the matters and others; the Ceres crew leaves Mars for the last time, October 30.
DATE: Oct. 2056

Ceres team departs Mars, Dec. 2056; 11th Columbiad starts 2 weeks before opposition [4 Feb. 2042]; Andalus and cylindrical equivalents planned

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