

# *THE MARS FRONTIER*

*Vol. 7*

*New Horizons*

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1.

## Arrival

18 October 2048

Will Elliott glanced at the screen of his attaché. A new video message had just arrived from his friend Sebastian Langlais, High Commissioner of the Lunar Commission, which coordinated operations on the moon. He wanted to listen to it, but the Mars shuttle *Pavonis* had landed a dozen minutes ago and he had to get to Joseph Hall to greet Sebastian's son, Helmut. He stared out the window at the great northern escarpment of Valles Marineris, which rent the horizon a mere twenty kilometers away, and wondered whether he had time. The risk of being late seemed less than the risk of missing something Sebastian wanted him to say to Helmut; after all, it took a half hour or more to unload the passengers and transport them to Joseph. He pushed the play icon on the screen with his finger.

“Good sol, Will. I'm glad to see you had good weather this sol for the landing; or maybe I should say I'm glad tomorrow's weather was good for the landing, since it's already October 18 at Aurorae Outpost. Pretty soon you're going to need not to drop an extra day at the end of the month to get Martian and terrestrial calendars aligned better!

“But I didn't call to complain about your calendar, just to express relief that Helmut's shuttle has landed safely. Give him a hug for me, please. He's a good boy—well, he's a man now, but I tend to forget—you'll get a lot of work out of him, and I think he'll be a creative addition as well. He's what you need up there. His loyalties are in the right place as well; he's devoted to space flight and already has an attachment to Mars. That formed when I videomailed him daily from Aurorae ten years ago, back in

'38 and '39, and since then he's had summer jobs with both the Lunar and Mars Commissions. Space flight's practically in his blood.

"I know how persuasive you can be in getting people to stay there, settle, and start families. Please don't be so persuasive with Helmut! I want to see my boy again.

Actually, I doubt you'll be able to keep him there anyway because he wants to ride the new wave of exploration that appears to be on the horizon. I have no idea whether his family will be on Mars, the Earth, or maybe even Mercury, some asteroid, Callisto, or God knows where. He's living in a pretty interesting time.

"The news here is pretty good. Have you read the report about the LOX-Augmented Nuclear Thermal Rocket engine? It's on NASA's internal website, but they say it'll be released to the public in a few days, since it's leaking anyway. It's been used four times on the semimonthly lunar run and the results have been very, very good. The specific impulse has been consistently 680. The report recommends switching all passenger traffic and some cargo traffic between the Earth and moon to LANTR propulsion. It uses twice as much propellant for cargo launches as the solar ion engines, but the cargo arrives in three days instead of six months, and propellant costs have dropped a lot anyway. The report recommends shifting the rendezvous node from Gateway to low lunar orbit; the scenery will be more dramatic for the tourists, fuel efficiency is improved markedly, and it saves a day of flight. I'm bracing myself because it probably means that in a year or two the cost of flying to the moon will drop by a third and the tourist flow may very well double. Watch out; Dusty Red will be on the tourist horizon soon enough!

“God, I switch to business awfully fast; sorry about that. Tell Helmut that I love him and I would ask you to kiss him for me, but you Americans don’t do that sort of thing. You keep in touch, and make sure he does as well. Bye.” Sebastian smiled and his picture faded from the screen.

Will stared out the window, contemplating Sebastian’s words. The LANTR engine injected oxygen into the reactor’s hydrogen exhaust stream, thereby utilizing all of the products of the electrolysis of water and producing an exhaust velocity fifty percent faster than the best chemical engines. Lunar water was thus used much more efficiently and cheaply. The cost of a flight to the moon or Mars from earth orbit would drop thirty percent; in the latter case, to about seventy-five million bucks per person.

It also could make faster trips to Mars possible. The 2050 opposition would be the closest one since Will had arrived on Mars in 2035. A LANTR-powered vehicle could dash to Mars in about four months, remain a month, and fly back to Earth via Venus in nine months. Tourism would be possible and wealthy entrepreneurs were already lining up. For that matter, their first tourist had just landed on Helmut’s shuttle. Will wasn’t sure how he felt about that.

He glanced at the time; he was late! He’d have to tape a videomail to Sebastian after greeting Helmut. He jumped up from behind his desk and headed for Joseph Hall.

It was a quick walk. He had been in Habitat 1, their first inflatable structure, now dedicated to command and control. It was connected by a plastic tunnel to the Geology Building, their first construction of Martian iron and duricrete, which was used for sample storage. It connected to Renfrew Hall, their second construction, now used to house new arrivals. It connected to Joseph Hall, their third construction, which had their

garage and plastic fabrication area on the first floor and the steel fabrication area on the second floor. The route took him past a dozen greenhouses, some of which had been cleared and sterilized to serve as starter biomes for the Bio-Archive project, a plan to set up ten replicas of ecosystems from across the full range of climatic zones in the United States.

Much to his disappointment, the two rangers bearing eight arrivals from the *Pavonis* had already arrived. The new passengers were milling around, collecting their personal possessions and piling them on small carts to move them to their new housing, and talking to their “buddies,” the local persons assigned to greet and guide them for the next few sols. Will had seen a picture of Helmut Langlais—a bit tall, blonde, 26 years old—but wasn’t sure where the young man was. Then he spotted someone who met the description standing and talking to a little boy: Will’s eight and a half year old son Marshall, who had promised to meet his father in Joseph.

He was about to speak when someone to his right spoke. “Commander Elliott! I’m over here!” Will turned and saw a man who was in his late thirties, also blond but balding, and slightly built. “Thank you for coming to greet me, I’m very grateful!”

“Oh; Mr. Carson! Skip Carson. It’s very good to meet you. Welcome to Mars.”

“Thank you.” Skip approached and held out his hand. Will shook. “Greg was very apologetic when he called just before we approached the atmosphere and said he couldn’t greet me; some sort of emergency, he said. I’m glad you were able to substitute.”

“Father Greg is one of our psychologists; he can have emergencies at odd times.”

“Father Greg?”

“He’s a former Catholic priest, though he functions as one here, so we call him Father Greg. I’m honored to greet you. How was—”

“Dad, where have you been?” Marshall said, interrupting. The little boy walked over. “Helmut has been waiting twenty minutes!”

“No, more like five,” Helmut replied quietly to Marshall. He sounded like an American kid; quite unlike his father, who retained a strong German accent.

“Skip, this is my son, Marshall. And I suppose you’ve already met Helmut.”

“Oh, yes; an excellent zero-gee volleyball player.”

“You’re pretty good yourself, Mr. Carson,” Helmut replied with a smile.

“I’d be remiss if I didn’t shake the hand of the son of an old friend,” Will said. He shook Helmut hand. “Actually, your father said I should give you a hug for him.” So he hugged Helmut. “He then added he wanted me to kiss you on his behalf, but said he knew Americans don’t do that.”

“No, they don’t! That’s one difference with us Europeans. Thank you, Commander.”

“Dad, he wants to see the biomes,” said Marshall impatiently. “He told me.”

“Would you like a tour, Mr. Carson?”

“Yes, that would be quite nice. Thank you.”

“We can come back for the luggage; no one will disturb it,” said Will.

“Dad, I want to tell Helmut about the biomes,” persisted Marshall.

“Alright; you lead the tour.” Will looked at the two arrivals. “I gather it was a pretty good flight?”

Helmut nodded. “The landing was exhilarating; or maybe I should say bumpy and frightening. In other words, everything went as expected.”

“I like your way of phrasing things, Helmut,” added Skip. “It was quite a ride. Same with the aerobraking. Deimos was very interesting and I’m grateful I got to go.”

“They selected part of the team at random because so many wanted to go,” noted Will. “Helmut, did you get to a moon?”

“Phobos. I was amazed how, every hundred meters or so, there were footprints. It was pretty hard to find an unexplored spot.”

They pushed their luggage carts into a corner and began to follow Marshall, who had already walked to an exit.

“And the interplanetary cruise went pretty well, too?” added Will.

Helmut shrugged. “It was crowded, but we kept ourselves busy.”

“His team won the volleyball championship,” added Skip. “I stayed in my stateroom much of the first half of the flight writing a novel, but when I came out I found the rivalry between the two teams was hot. I joined the wrong one, too.”

“Y’all were pretty good, though,” replied Helmut.

“How were the two Interplanetary Transit Annexes?” asked Will.

Helmut nodded. “Fabulous. They really increased our living space.”

“It was a pain having to change rooms, though,” said Skip.

“You changed rooms?” asked Will. “Oh, of course. The staterooms in the ITV are surrounded by cargo and thus are a much lower radiation environment.”



“Exactly. I came out of my room in midvoyage because I had to move into the annex,” replied Skip. “And we had to move all the furniture in the annexes to the ITVs for aerobraking, since the annexes burned up.”

Marshall listened to the adult conversation, a bit irritated that he was being ignored. He pushed a button and the door opened for them. “This is the plastics fabrication area,” he said. “We make our plastics here, for a little while longer, anyway.”

“A little while?” asked Skip.

“We’re getting lots of new plastics making and chemical synthesis equipment on this flight,” replied Will. “So this area will be added to the garage and we’ll build a new structure for plastics fabrication.”

Marshall led them to the building’s northern airlock. They passed through and entered a tunnel with a junction a few meters in front of them. Marshall pointed westward, to the left, instead of straight ahead. “Let’s start with Riviera biome first.”

“Okay,” replied Helmut. They turned westward. “This is a really wide tunnel,” he noted.

“Five meters,” said Will. “We just finished it. It’s is the Outpost’s main axis. It’s just wide enough for two rangers to pass, though right now we use it for storage. Under the metal floor is a crawl space for cables and pipes. The tunnel runs along the southern sides of Yalta and Riviera and will be extended westward when we build the next pair of biomes. The biomes will always be in pairs north of the tunnel. Eventually we’ll build a parallel tunnel north of the biomes as well.”

“For public transportation?” asked Skip.

Will nodded. They walked along the tunnel. He looked at Helmut. “What did you think of the *Olympus*’s expedition?”

Helmut had to smile. “Fascinating. I would have loved to explore 2009XV for a month. But there was no way I would have qualified for the trip with just a Master’s in geology, no asteroid experience, and an employee of Muller Mining to boot.”

“It sounds like they had a great time. I’m looking forward to hearing the entire story when the *Olympus* arrives in two weeks. They must have walked on every square meter of the thing, since it was only 500 meters across.”

“And being able to detach a chunk of nickel-iron eleven meters across and anchor it firmly to an ion engine; that’s a real coup for the Commission,” added Skip. “Who would have thought the Mars Commission would get into the asteroid mining business first.”

“It’s controversial, as you know. We may have to divert the chunk to Venus or Mars because of fears that there’s one chance in ten million we might drop it accidentally on a terrestrial city and incinerate it. I think legislation will limit the diversion of asteroids to earth orbit to under ten meters in diameter, and this piece is just a bit too large.”

“It’d be a shame,” said Skip.

“Was the voyage a good inspiration for your writing?” Will asked.

“Yes, I think so. I’ve outlined all sorts of possible plots and recorded incidents I could use as is or with some rewriting,” replied Skip. “But I plan to avoid writing a novel or screenplay now; I need the total experience first.”

“I understand,” said Will. “We’re excited to have you as our first tourist. You’re very welcome. We’ve planned quite a six-week tour for you.”

“Thank you, Commander. I brought a camera and plan to record it.”

“Maybe we’ll be stars in your next movie!” said Marshall.

Skip laughed. “Who knows?”

They walked almost one hundred meters until they reached the far end of the tunnel. They turned into a side tunnel that was also five meters wide and high that ran seventy-five meters southward. A third of the way down the tunnel was an airlock in the right wall; they stopped and Will said “Open Sesame!” and it opened.

They passed through an airlock and suddenly they were in Riviera. After the dim artificial light of the tunnel, the daylight was momentarily blinding. “Riviera Biome is forty meters in diameter,” explained Marshall, taking on the tone of a tour guide. “It’s the southern member of our second pair of biomes. Shikoku’s that way—” Marshall pointed northward. “And it’s pretty much identical to Riviera, except it has a Japanese garden instead of a lot of flowers. Riviera has two buildings, one on the northern side and one on the southern side. Each has three main levels and a smaller fourth level. The roofs are covered by two meters of soil for radiation protection and farming. The gardens are tended by robots or sometimes by kids like Sammie and me; picking vegetables is our main chore. This straight middle area between the buildings is called ‘the yard.’ The sun shines straight down all day as it crosses the sky. The yard has fruit trees, flowers, vegetables, grass, and clover for the honey bees; when we play on it we have to be careful not to get a bee mad at us! I got stung a few months ago in Yalta, where we live.

Riviera's the prettiest of our biomes because instead of a patio or swimming pool or basketball court or zen garden it has flower gardens. People like to get married in here."

"I can see why," said Skip.

"My dad's new office is up there." Marshall pointed to the top of the northern building.

"The Commission offices aren't moved in yet, though," added Will. "Riviera's ready for people to live and work in it except one thing; we've run out of wireless communications nodes. Six months ago a power surge burned out a bunch of them and that used up all our spares. The first flight this morning brought replacements, so we should have this placed wired up in a few sols."

Helmut grabbed his attaché hanging from his belt and glanced at the screen. "Ah, hah. We're on self-networking mode; audio communications, no video."

"Exactly. We have two attachés set up near the eastern airlock with their antennas extending through to Yalta. They serve as network relays for the entire biome, so that really limits communications in here."

They all started to walk across the biome toward the airlock on the other side, which led them into Yalta Biome. "Skip is quartered in here; I think your suite is in the southern building, Skip." Will pointed; Carson nodded. "Helmut, because you're going to Dawes Outpost next week, you're staying in temporary housing in Renfrew."

"You're not remaining here?" asked Marshall, disappointed.

"No, I'm working for Muller Mining, so I have to go to Dawes to recover gold."

"Oh, darn!"

"Why Muller?" asked Will.

“I really wanted to come here, and I had no chance being accepted for Columbus 7, but there was less competition for Muller’s slots. I soon found that the money had a lot of advantages, too; I was able to buy a bigger personal property allotment.”

“Muller’s generous about personal property, and they gave two million dollar signing bonuses to their workers who agreed to stay another columbiad.”

“I know. My plan is to work for them two columbiads. Then maybe I’ll stay here and settle down.”

“Your father hinted to me that you’d like to go elsewhere.”

Helmut nodded. “It looks like we’re about to open a lot of the solar system to manned exploration. The long-term space power and life support systems are pretty well developed, and radiation reduction systems are taking shape fairly well. Propulsion is still the weak link, but LANTR helps. We’ve got human operations on the moon, Mars, and in Venus orbit. Europe will land a crew on Mercury in the next decade in partnership with the Russians and maybe with NASA. NASA has started an ambitious asteroid exploration program. India and Brazil may do the same. The Chinese are hinting they may consider establishing a station on Callisto by 2065, so NASA will probably feel compelled to do the same. There could be humans in the Saturn system in the 2080s, only thirty years from now.” He tousled Marshall’s hair. “This guy could be exploring Titan.”

“Especially if he works harder on his math,” added Will.

“A mining company is a pretty unusual route into the astronaut corps,” said Skip.

“Maybe not. Competition’s heating up; it’ll be easier to be admitted if I have spaceflight experience, and even easier if I’m already here!”

Will laughed. “Yes, that pretty much guarantees the Mars Commission will hire you. You could probably transfer to other operations later.” They stopped to pass through an airlock, then another airlock that opened into Yalta.

“This is Yalta, and you can see it’s much older than Riviera,” exclaimed Marshall. “The trees are a lot bigger.”

“Yes, you’re right.” Skip looked at the swimming pool in front of them. At the moment two people were rolling a deck rolled over it and locking it into place so that a basketball game could take place on top of it. They nodded to Will, who nodded back. The three of them started across the biome.

“Of course, you may not have to leave Dusty Red in order to have some pretty interesting exploration opportunities,” noted Will to Helmut. “We have six Mars shuttles here for the next eighteen months. Until Columbus 6 we only had four, so we couldn’t spare any, and their technology was still being tested. But thanks to Columbus 7’s visits to Phobos and Deimos, each moon can now produce 150 tonnes of methane and oxygen propellant per year, and last year we outfitted them with the tanks to store that much fuel as well. That means Mars has the ability to send shuttles on asteroid exploration missions of six to twelve months duration.”

“Commander, do you really plan to send out missions?” asked Skip. “It strikes me as pretty ambitious, for a small population.”

“An asteroid fifty meters in diameter flies within five million kilometers of Mars every few weeks; half kilometer objects are available about once a year. We have a possible target in December of this year and two more in 2049. There’s no reason why

we shouldn't fly an unmanned probe to one of them, using leftover equipment, and fly two shuttles and a crew to another. We've got plenty of mission support, now."

"I'd love to do that, Commander, in a few years," said Helmut.

"And a few years it'll have to be, since you owe your soul to Muller Mining for the upcoming columbiad! Mars presents a lot of opportunities."

"So I see." Helmut smiled. "I'm going to like this place."

"I hope you still feel that way after Muller works you to death," replied Will. He laughed. "Your father asked me not to try to persuade you to stay, and I'm afraid I've slipped into my old habits!"

"Oh, don't worry about it."

They exited Yalta through an airlock that led them back to Joseph. Soon they were back in the garage.

"Marshall can show you to Renfrew 208," Will said to Helmut. "I'll help Skip. Do you remember your room number?"

"Riviera 306S."

"We'll have the video communications working by tomorrow morning. Let me help you get your stuff there." Will reached for the handle to the luggage cart, but Skip put his hands on it instead.

"Thank you Commander, but I can at least push my own luggage. I didn't spend some enormous undisclosed amount to be waited on hand and foot. If that had been my desire, I could have gotten much better service on Earth."

"Alright. But let me help you get it over the edges of the airlock doors and other rough spots."

“That’s fine.” They began to head back to Riviera. “Commander, I understand there was some opposition to my coming here. I assure you I don’t want to be a problem. I’ve paid for a service, but I’m not one to push for every detail. I want to learn while I’m here; I want to experience.”

“I wouldn’t call it ‘opposition’ Mr. Carson—”

“Please call me Skip.”

“Alright, then please call me Will. No one refers to me as ‘Commander’ in informal conversation. I wouldn’t call it ‘opposition.’ We have a core of scientists here who regard Mars primarily as an object of science. They are concerned about commercialization—the gold recovery efforts—and about tourism. They are not opposed to either, they just want those efforts set in the larger scientific context.”

“I understand; I encountered that when I was on the moon.”

“It’s similar here. The moon has a lot more tourists to deal with, but we have a lot more myth and fantasy to deal with.”

“A good point. Dusty Red has excited the human imagination in a way no other world has. I attended a Mars Exploration Society annual meeting a few years ago; my, it can attract the weirdos! But there is also a lot of solid science to do here.”

“Exactly. Some of those weirdos are landowners here and we interact with them. I’m curious, Skip; what motivated you to spend an undisclosed large sum of money to fly here and become our first tourist?”

“Well, I completed the two *Empire Wars* science fiction movies four years ago, and they were huge hits; they made me a lot of money. But they didn’t make me happy. I



love science fiction, but I'm actually a frustrated scientist; I have a Master's degree in planetary geology."

"Really?"

Carson nodded. "Yes indeed, from Cornell. I'm not going to go back into the field because I love film making too much. I'm a writer at heart. So I went to the moon for a month and that was fascinating, but no movie plot immediately jumped out at me. So I contacted the Mars Commission about flying to Mars and got nowhere. But shortly thereafter there was the decision to fly two annexes as an experiment on Columbus 7, and suddenly there were vacancies, so I was accepted to go out and head right back on the Venus return flight; it made the trip more practical, since I'll be away 19 months. I have no personal ties that prevent the trip, I have the money, communications allow me to get almost as much done from here as from my house in Malibu; so why not?"

"It puts a big hiatus into your movie making career."

Carson shrugged. "You don't have to make a movie every year or two. Besides, this trip is for me. And maybe it'll result in a movie plot or two; who knows? Maybe the plots will have nothing to do with Mars. I'm learning a lot about human nature. On Earth I have to live in a fishbowl, with a public intruding into my privacy and papparazzi constantly snapping pictures. Here, I'm free."

"I never thought of that."

They entered Riviera Biome, then the south building. Another arrival was there; Skip struck up a conversation with her. Will excused himself and headed for his office. On arrival, he saw a rather stocky, short, dark-haired, prematurely balding man waiting for him. "Brian Stark, I presume," said Will.

“Correct, Commander. I presume you received my message?”

Will reached down, lifted up the attaché hanging from his belt, and scrutinized the screen. “So it would seem. I have a message in my in-box. But I’ve been showing someone around the outpost.”

“I was asking for an 11 a.m. appointment; is that possible?”

“Well, it’s 11:12 a.m. right now, so I suppose an 11:12 a.m. appointment is possible.”

“Thank you.” Stark’s voice betrayed irritation; but then, so had Will’s. He followed Will into his office, then closed the door. They sat in two comfortable chairs in front of Will’s desk, around a small circular table.

“Welcome to Mars, Colonel. How can I help you? We’re delighted to have you here. We could use your nuclear expertise. As you know, our reactors are getting a bit old and cranky.”

“Indeed. My experience is with new systems, not used ones, but I’ll do what I can.” Stark leaned closer. “But I wanted to talk to you about another matter; the main reason I’m here, you might say.”

“And what’s that?” asked Will suspiciously.

“As you know, environmentalists are making the launch of uranium and other radioactive materials from Earth extremely difficult and expensive. The last launch was tied up in court five months; it greatly delayed the last round of LANTR engine tests. The delays cost two hundred fifty million bucks, ten times as much as the actual launch of the materials into low earth orbit. We haven’t had a serious radiation problem in sixty years of launching radioactives to low earth orbit, but the protests and court challenges

continue. Perhaps the time has come to obtain the uranium for space uses from Mars instead.”

Will raised his eyebrows, surprised. “And who is it that wants to obtain the Martian uranium?”

“The United States Department of Energy and the U.S. Navy. They’ve been engaged in private talks with Douglas Morgan for the last two years.”

“Why wasn’t I told about this idea?”

“You’re being told about it right now, face to face. Even with encryption of interplanetary communications, there was no guarantee they’d be secure.”

“So, are you a spy? Are you an employee of the Commission?”

“I am certainly not a spy. There’s nothing here to spy on. I’m an employee of the Commission’s nuclear reactor maintenance division, here to work on the nukes. But I’m also here to ascertain whether Mars can support a project of this sort. If so, I’ll stay and manage it. If not, I’ll head home on Columbus 8.”

“I see. Why can’t the United States government ask me or the other Americans here? Aren’t we regarded as loyal citizens? I don’t see why you’re needed on Mars.”

Brian spread his hands. “Commander, after over a decade here, you really don’t have a sense of the priorities of the United States government or the navy. I do.”

“I see. How can you possibly think this will work? The Chinese will oppose it strongly. My staff will be very suspicious, even angry if they learn of your mission.”

“Well, this is the way it has to be. Because the United States will never support uranium enrichment by the Commission. We’re going to be the only game in town.”

“I see. What sort of support are you seeking?”

“The technical side is relatively straightforward. The new uranium isotope centrifuge technology is fairly compact and its energy consumption is manageable. We can import equipment to fashion uranium carbide spheres from the enriched U-235 coming out of the centrifuges. We’d want to build a facility a few kilometers from here so that people could go back and forth easily, security is absolutely guaranteed, and of course we’d assure the environmental protection of the outpost. The preliminary estimate is that we’d have to fly fifty tonnes of equipment here and about 150 tonnes of equipment would have to be made locally. The new level of automation means the plant would require eight to ten personnel. They’d build everything over a two or three year period.”

“To produce how much U-235?”

Stark hesitated. “It would meet the entire demand for LANTR and solid-core engines and lunar reactors, which is about one hundred kilograms per year.”

“What about Martian demand?”

“We didn’t take that into account.”

“You should! We need nuclear supplementation of solar and wind energy.”

He nodded. “As you alluded, the big issue is social and political, not technical. There will be anti-nuclear fanatics among the Mars land owners who will oppose this effort. I’m sure there are anti-nuke people here, too. There will be a lot of fear on Earth that we are creating a nuclear power on Mars. The automation we’ll need to develop, if it leaks, would make it easier for a rogue state to manufacture a bomb. We will have to consider a lot of security issues here, and I don’t just mean lots of cameras pointing at enrichment equipment and broadcasting their pictures back to Earth twice a second. We have to be able to assure everyone that the Martian population is trustworthy.”

Will nodded. "I understand your point."

"So, are you willing to cooperate?"

"I'm not sure I have a choice, Colonel. I need to talk to Commissioner Morgan. I also know that this could blow up and cause a huge controversy."

"That's a chance we'll take."

2.

## Dinner

20 October 2048

The five shuttles descended to Mars like clockwork every six hours; the *Pavonis* at 8 a.m., the *Tharsis* at 2 p.m. the *Alba* at 8 a.m. the next sol, the *Arsia* at 2 p.m., and the *Hadriaca* at 8 a.m. the third sol. Each brought six to eight persons to the surface, for a total of 36. Each descended with twenty tonnes of cargo as well. The entire outpost was engaged in giving tours and unloading badly needed cargo, for Mars had received no supplies for twenty-six months. Many eagerly visited Diponte's general store on the afternoon of the second sol, when the shelves were restocked with nylons, Barbie dolls, cigars, champagne, gourmet foods, and a hundred other eagerly sought items. Adding to the chaos of new arrivals was the presence of about half of the residents of Cassini, who came to help unload supplies—especially those destined for their borough—and to shop.

The evening of the third sol saw the patio of Yalta Biome decorated for the Arrival Dinner, the fancy social event of the season. It was the chance for Lisa Kok and her culinary team to show off what could be prepared on Mars, so it was always the greatest feast possible. Three kinds of fish, chicken, turkey, rabbit, goat, pig, sheep, and beef—in short, every edible vertebrate in the Outpost—were available on the buffet tables in various combinations with the products of about one hundred fifty plant species, from wheat and rice to cinnamon, cacao, and kiwi. Everyone pigged out on every imaginable type of food, and all for free; no one had to pay for the meal. The patio was packed with fifteen tables able to seat eight each.

The Commander's table was up front, next to the podium. Its eight chairs were occupied by the Commander himself and family—Will, Ethel, Marshall, and Lizzie—Helmut Langlais, Skip Carson, Greg Harris, and Anna Racan, a Croatian physical therapist whom Carson had recommended to Will Elliott as a fascinating addition to the table.

“Dad, can I fly to Phobos or Deimos some time, when I'm older?” asked Marshall, after listening to Helmut describe what it was like to fly over Phobos, land, and explore its geology.

Will had to smile. “Well, you need to be a lot older. But I suspect when you're taking college geology, we may very well include a field trip to one of the moons.”

“You mean I have to wait that long?”

“Don't worry, it'll come sooner than you think,” replied Helmut. “I was getting video messages from my dad from the moon and Mars starting when I was about your age.”

“Really?” asked Marshall. It made him even more interested in the young man who had arrived just two sols ago. They had a lot in common, and Helmut was older and wiser; a natural role model.

Some of the adults chuckled; Marshall was still young enough to be cute. Smiling, Greg turned to Anna, who was sitting next to him. “So, you're a physical therapist?”

“Yes,” she said. “A study of the medical services here showed that physical therapy was a big gap. People get aches from overusing muscles, which seems to happen because of partial atrophy, as well as the strange demands of space suits on our muscular system. The muscular system undergoes some unusual adaptations to low gravity; there

are cases where people develop severe backaches after being on the moon four months, for example, when intuition tells you they should have fewer back problems there. But if selective atrophy of muscle groups occurs, you can get a back ache in almost any gravitational field.”

“I never thought of that. It makes sense, too. I deal with emotional and existential problems, mostly, and in a few cases they seem to be triggered by physical problems.”

“Well, some of them are muscular. Special exercises can help quite a lot. Generally, we need not more exercise up here, but selective exercise. So that’s what I hope to offer.”

“Fascinating.” Greg took her in with his eyes; she was a beautiful woman, well proportioned and nicely dressed. “How long have you been in the field?”

“I entered it right out of university, twelve years ago. Croatia had a scholarship for space medicine at an astronautical institute in Moscow and I got it. It was so interesting, I soon found myself studying returning astronauts and writing a doctoral dissertation about physical therapy for their problems with selective muscle atrophy. Then I ended up in Houston doing a two year postdoc with the Lunar Commission, which resulted in a six-month stay at Shackleton three years ago. Then the Mars Commission recruited me because of the problems here.”

“We have strange health problems here,” agreed Greg. “Last columbiad we had one person unable to sleep well; his circadian rhythm insisted on maintaining a 24-hour cycle and refused to switch to 24.6 hours. Someone else found his coordination unable to adjust to the gravity; he literally collided with walls while walking around. Allergies to Martian dust are the biggest problem. Yet other people adapt with no difficulty at all.”



“It’s the same on the moon. The gravity problems are worse. We still don’t have good tests to detect who will encounter these problems, and we have few medications that will help. Coming out here it was interesting to watch the adjustments to Martian gravity. It wasn’t easy. I’ve got an entire paper outlined.”

“Good.”

“What about you? How did you end up in psychology?”

“Psychology and nursing, actually. Two fields,” Greg said. He smiled and thought about his reply for a moment. He decided not to mention his priestly training. “To make a long story short, I’ve always wanted to help people; minister to them. I tried various careers, but finally found nursing to be satisfying, and I combined it with psychology in order to be more effective. Then a friend of mine pointed out that NASA’s Mars exploration division was looking for experts in both nursing and psychology, and because I had both I was uniquely qualified to serve in ground control. From there it was a short step to applying for a chance to fly here. Except when we deliver babies, we don’t need much nursing care; our training has so far kept the accident rate quite low.”

“I am impressed by the health of the population. I hope I can help keep it that way! I’m very interested in service to others as well. You referred to ministry; that’s very much how I feel about it also. Physical therapy is my form of ministry.”

“Indeed, it should be! One doesn’t hear that sentiment expressed here very often.”

“I apologize if I have offended you; that was not my intention. But as a . . .theist, I feel that we are called to serve our fellow human beings, and we must put that in the center of our lives.”

“As a theist, I couldn’t agree more! The gospels make this clear. Jesus makes it clear.”

“Exactly,” replied Anna. “It is refreshing to meet someone with the same perspective.”

“I’m delighted. Healing people most certainly has become my vocation; physical, mental, and of course spiritual.”

“They’re all linked.” Anna agreed matter-of-factly.

Greg smiled. He felt attraction to the woman. It surprised him. He had never explicitly renounced his vow of celibacy, but he had also adhered to it for the last eight years since he had resigned his priestly position, because he had seen his priestly ordination as complementing his psychological and nursing work. And indeed it had complemented them; people trusted him more, knowing he had been a priest. As the only ordained clergy on Mars, he had played a public role as priest as well, one he had never expected to perform when he arrived on Columbus 5.

Anna had the same reaction. She didn’t know what else to say to him. Noting that he had not gotten anything to drink, Anna if she needed anything; she said no. Greg excused himself and went to get a cup of punch.

As he was filling his cup and as he felt his head clearing a bit, his friend John Hunter came over. “You look a bit dazed, Greg.”

“I was just talking to a remarkable woman and I don’t even remember her name!”

“It sounds serious.” John looked at the table where Greg was seated. “Anna Racan. She’s a very gentle spirit.”

“She is indeed.”

“Do you see whom I’m seated next to?” John said, smiling. He pointed to a woman with light brown skin and long, brown hair. “She’s from New Zealand.”

“She looks Maori.”

“I think so.”

“She’s a buddy of Martha Vickers.”

“I saw them talking. She’s very. . . interesting. Intelligent, and she has a nice laugh. It isn’t too loud.”

Greg nudged him. “Well, go introduce yourself.”

“Alright, I will.” John smiled. “Can I wish a priest good luck?”

“I’m not a priest, remember?” whispered Greg. He smiled to John and headed back to his table feeling as tongue-tied as he had left.

John, however, felt emboldened. He returned with the refill of his drink and sat. “By the way, my name is John Hunter,” he said to her. “From the United States.”

“It’s good to meet you, John, I’m Vanessa Smith from New Zealand.” She had a sweet smile, an understated manner, and an unfamiliar accent. “What do you do here?”

“Geology, chemistry, and geochemistry. My focus lately has been the chemistry of early Noachian lakes. What about you?”

“Eobiology; specifically, biotic precursors. I’ve been interested in determining the range of dissolved iron levels in the water.”

“So have I! The PH data is poorly constrained; the CO<sub>2</sub> data is too spotty and the mineral formation evidence is contradictory. And I gather the iron content is important in understanding some of the precursors.”

“Absolutely, and in understanding the differences between the early evolution of life here and on Earth. Mars had salty lakes, rather than oceans, lots of ice, freeze drying rather than evaporative drying, no tides. . . lots of differences. The few fragments of eobiotic Earth that have been found on the moon yield precious few clues about the chemical evolution going on there.”

“It’s a jigsaw puzzle with too many pieces missing.”

Vanessa frowned. “Maybe not. We’re finding new pieces every year. But there are a lot more pieces of the puzzle here!”

“Oh, definitely. We’re making a lot of progress.”

“Do you think there’s life here?” she asked.

“We haven’t checked everywhere yet, but the chances are fading and the false positives are multiplying.”

“So many species of terrestrial microorganisms are being found, sometimes hundreds of kilometers from any source of contamination. It’s really surprising and worrisome.”

“We may even find a terrestrial species that is highly adapted to conditions here, and then we’ll wonder whether it got here with us or whether it rode a meteorite from Earth.” John paused to consider his next words carefully. “How we define ‘life’ is an important question, too. This world may not have any indigenous life currently, but it has terrestrial life. And my people—the Lakota—very much believe that all things are alive in some sense, including so-called inanimate rocks. I believe that, and I believe Mars has spirits; of rocks, of its ancient life, of the worldlets that gave it its craters.”

“Yes, I understand.” She said it matter-of-factly. “My people have a similar view. My interest in the essence of life goes back to my Maori culture, and it led me into eobiology. I wouldn’t say that to very many people here; it sounds superstitious.”

John shrugged. “If you ask the people here how they got interested in their career, half the time the reason will be arbitrary or even silly; like reading science fiction novels about a mythic Mars when they were children. Those stories are as divorced from our reality here as native experiences of spirits are from eobiology.”

Vanessa laughed. “No; they’re more divorced!”

And they both laughed together. She asked him what his family thought of his career and his living on Mars, and he asked her the same. About the time they finished exchanging stories, Will Elliott walked to the podium on the low stage at the eastern end of the biome. The screen behind him, which had displayed the emergency evacuation plan for the biome, switched to a map of the planet with the words “Mars 2048-49” below. “Oh, the program’s beginning,” said John, surprised. “Where has the time gone?”

Will Elliott looked around at the crowded patio. “Dear Friends, I want to thank you for coming tonight and to welcome our new friends and residents to Mars. With your arrival, we have a new problem; everyone can’t eat on the patio at once! We’ve had to set up tables on the clover. One of the discussions some of us will have soon will be a redesign of this biome, to focus on its commercial development.

“Perhaps I should start with a few statistics. Human beings have now been on Mars twelve and a half years. Our adult population has risen to 110, with 8 more still in space and on the way. We have twenty-four children, with several more on the way. Mars has 134 human beings, soon to rise to 142, and barring unforeseen circumstances it will

exceed 150 by the end of 2049, which is pretty impressive. If you had asked an expert fifteen years ago, he or she might have speculated that Mars would attain this size by the end of the twenty-first century, not at its midpoint.

“Mars has three boroughs, Aurorae, Cassini, and Dawes. Aurorae will soon have more than 100 inhabitants which is a critical size in terms of political development, because the new Martian Fundamental Law says at that size it will elect, in addition to three borough officers, two representatives, who with the officers will constitute a Borough Council. Aurorae’s population will be about  $\frac{1}{4}$  children, so the Mars Commission will have to consider the devolution of child education to the Borough. Because Aurorae Hospital is a research facility as well as a primary care facility, it will remain under the jurisdiction of the Commission, but the time will come when we will have to decide whether to turn responsibility for it to the Mars Council, a body we will elect this annum. Mars art and culture rightly will go to one or the other body as well. Farther down the timeline, the borough will gain responsibility for environmental management. I mention all of this because we will see some historic landmarks during this columbiad that we should collectively acknowledge and prepare ourselves for.

“There will be scientific, exploratory, and engineering landmarks this columbiad as well. We will complete the Pisces and Virgo Trails circling Mars roughly along the 25 degree north and south parallels respectively. We will probably extend the Tharsis Trail and the Cassini-Dawes Trail to both polar regions and will start a north-south Elysium Trail as well. We will have a dozen telerobotically operated rovers—mostly in the Prospector-200 series—and two dozen automated meteorological stations. Who knows what our geologists and biologists will find as they explore this world.

“We will look outward as well, to near-Mars asteroids and possibly even to objects in the asteroid belt, launching automated probes and probably at least one crewed mission to them. Both Phobos and Deimos have expanded fuel-making facilities and temporarily staffed stations. Our interests are not purely scientific because Mars may have an important role to play in the development of the asteroid belt. We must keep an eye on commercial possibilities.

“With the arrival of Sibireco and the expansion of the facilities of Muller Mining and Consolidated Mining, Mars may be in the position to influence the price of gold adversely. Exports over this columbiaid may reach two hundred tonnes, requiring the development of heat shields from native materials. With exports approaching one hundred tonnes per terrestrial year, Mars’s production will be near South Africa’s, the largest national exporter of gold on Earth. Exports not only earn us badly needed income, but the volume helps to push down the costs of transporting people and cargo between the worlds. We do not anticipate the near advent of the time when Mars can cover its costs, but we are getting closer.

“We are building here a community that can grow and evolve into a partner in human progress. We are trying to build a more humane society. A humane society will never be perfect as long as it is built out of humans. But we challenge all of you, while you are working hard, to also live well, that is, lovingly, honestly, in service to others, compassionately, in a spirit of giving rather than receiving. If we can accomplish this breakthrough—the breakthrough to humane living and to a humane civilization—we will have made a greater contribution to humanity than all our gold or science. It is to this breakthrough that I call you, when we resume our work tomorrow. Thank you.”

Will returned to his seat to enthusiastic applause. Vanessa was surprised. “Does he always talk this way?”

“How?” replied John.

“Well, he talked about life and love, not just science.”

John nodded. “Yes, that’s Commander Elliott’s passion. Of course, he knows that the image of a loving, harmonious, Mars—some derisively call it a ‘middle class Mars’—plays well on Earth and builds support for us, not only among the utopians but among the rank and file. But his concern is not just public relations; he means it. He has two children and has made a long-term commitment to this place; he may retire and lay his bones here.”

Vanessa nodded. “I guess I knew that. And I had heard of his reputation. But seeing him speaking; it’s very different.”

“Yes; well, you’re on Mars now!”



## Developments

3 November 2048

“Are you looking forward to the flight to Dawes?” Will said to Helmut. They were both bussing their trays after eating a pleasant Sunsol supper. Will was pleased to have a chance to see the young man again.

“Yes; finally getting to my post! And it’ll be exciting to see Mars from the air.”

“You’ll get bored with that after a few hours, and you’ll have daylight only half the time. Twenty-four hour flights are not fun.” Will shrugged. “Still, the Sunwing-C is much bigger and faster than anything we used to have. The Sunwing-A could hold only two people and took twice as long. With silane engines, the Sunwing-D will take half as long as C, and it should have some additional safety options.”

“That’s always a concern,” agreed Helmut. “I have no idea what the chances of surviving a crash are!”

“No one knows; we’ve never had a crash. But the tests on earth with dummies in spacesuits were encouraging; the airbag system is pretty good. They say there’s nothing in the cabin except airbags and people when they deploy! The trick then is getting additional oxygen to keep everyone alive until a rescue shuttle can arrive.”

“And at least there’s no danger of fire. That’s the big danger on Earth.”

“How’s the training been so far?”

Helmut shrugged. “A week of safety drills is not very exciting, commander, especially when you’ve been through it all before.”

“Yes, but on Earth or the moon, not here. The situation is different here.”

“I know. I regret leaving in one way; I’ve had a lot of fun with Marshall!”

Will smiled. “And he has had a great time with you. I hope you’re around when he’s a teenager; I may need your help with him.”

“It gives me a glimpse into family life here.”

“It’s not bad. Everyone pulls together to help the kids, which helps a lot.”

“I hope his health is alright?”

“Yes. He and the other kids are defining ‘Mars normal’ for us, which isn’t the same as Earth normal. For example, his bones have about twenty percent less mass than they would have on Earth. This, in spite of the twenty-kilogram radiation vest he wears at least six hours a sol, and two hours of running and jumping. But experiments on animals suggest that if he were to go to Earth on an ITV that gradually increased its artificial gravity from Mars to Earth normal, and if he had a high-calcium diet, his bones would gain mass; maybe not enough to reach Earth average, but he’d get closer to the center of the normal range. Of course, no one knows what his bones will be like when he’s 70 years old after living there fifty years. They’d probably continue to adjust, but no one knows.”

“And his red blood cell count would be higher here than on Earth, too.”

“Yes, though it’s the same as people who live at 2,000 meters above sea level. Lowering the oxygen content of our atmosphere here by twenty percent, so far, has proved to be a good thing. We’ve got one or two biologists working in the low-pressure biome—where the air is almost pure oxygen at one seventh of an atmosphere of pressure—and they manage in there without space suits for a few hours. They probably couldn’t do it if they weren’t adjusted to a lower O<sub>2</sub> environment.” Will patted Helmut on

the shoulder. “Anyway, you take care of yourself, work hard but not too hard, have a good time, and be sure to come back for a visit. And keep in touch with your dad.”

“I will; thank you.” Helmut offered his hand; they shook. The young man was touched by Will’s friendliness.

Will walked back to his table and sat. Just then, Gaston Gilmartin entered the biome with Laika, the outpost’s very friendly Labrador retriever. Named after the first dog in space, she was also nicknamed “the mother of Martian canines”; she was to carry to term dozens of frozen dog embryos. Every child in the patio immediately noticed her presence; they had been fascinated for the last two weeks, since she arrived. “Dad, can we go pet Laika?” asked Marshall.

“Of course; that’s why Gaston brought her out.”

“Can we have a dog?”

Ethel looked alarmed at the thought. Will shrugged. “Maybe someday when Laika has puppies and the puppies have puppies.”

Marshall and Lizzie dashed off to play with Laika. Will put his arm around Ethel. “How are you?”

She smiled. “Pretty good. A few hours of relaxation before the grind starts again.”

“How’s that novel you’re reading?”

“So so. Carson’s a better film maker than novelist.”

“Don’t tell him that.”

“Oh, I won’t!”

“It’s too bad it’s so close to sunset; otherwise I’d suggest we suit up and walk up to the overlook on Boat Rock.”

She smiled broadly. “You’ve got a date! Let’s take some time tomorrow after lunch.”

“Okay, I could do it 1 to 2:45. I’ve got a 3:30 meeting.” He reached out and took her hand in his. She smiled and they sat there in the warm sun, relaxing together.

The pleasant interlude lasted about two minutes before Yevgeny Lescov, who was sitting at a table across the patio chatting with a group of others, began to beckon at Will. Will looked to see who was present. In addition to Yevgeny’s wife Alexandra, the table included the Commander of the Columbus 7 flight, Yuri Severin; Érico Lopes; Lisa Kok; and Ruhullah Islami. Reluctantly, Will rose and walked over.

“This almost looks like a head of staff meeting,” he said.

“Well, we’re scheming,” replied Yevgeny.

“They’ve been explaining Venus gravity assists to me,” said Lisa, who was a horticulturalist, not a physicist.

“Oh? But Yuri’s return flight doesn’t use one,” said Will.

“My flight doesn’t; it uses a lot of methane-oxygen propellant and an ion engine to accomplish the same thing,” replied Yuri. “We’re scheduled to leave here on December 1 and we’ll reach Earth on December 1 next year. About the time we reach the orbit of Venus—unfortunately, Venus won’t be anywhere nearby!—we’ll fire the shuttle engines and make a big change in our velocity.”

“It follows in the path of our first cargo flight to Venus, but six months later,” added Yevgeny. “In January two automated cargo vehicles aerobrake into Venus orbit with fifteen tonnes of water each for Magellan Station.”

“If the control systems work,” added Érico. “They’re pretty old!”

“Will, why isn’t anyone considering flights between Earth and Mars via Venus?” asked Yuri. “There’s an October 2053 departure from Earth that passes Venus in late February 2054 and reaches Mars in October 2054. And there’s an opportunity to leave Mars in January 2053, pass Venus in August, and reach Earth in early 2054.”

“I don’t know the details,” replied Will. “One reason is that we’re talking about twelve months in a can instead of six.”

“When the planetary alignments are just right, you can make the trip in ten,” replied Yuri.

“The problem is that the equipment can’t get back to Earth fast enough to make an extra round trip; we’re still stuck with one round trip every twenty-six months.”

“No, not always. There are a few opportunities in the next decade where the equipment can squeeze in an extra flight,” replied Yuri. “I’ve looked it over carefully.”

“Well, write it up,” said Will noncommittally.

“There’s tourist potential, too, Will,” added Yevgeny. He tapped a chart displayed on his attaché. “For example, Columbus 8 is scheduled to arrive here in October 2050. It could stay six months and leave during the usual launch window to Venus in March-April 2051, reaching Venus in October. After about five months at Magellan Station assisting the crew, Columbus 8 could head for Earth in March-April 2052, arriving home in July-August 2052. Total round trip: about two years, almost half on Mars or in Venus orbit.”

“Now *that’s* interesting,” said Will. “I wonder why no one has looked into that one? Magellan’s stuck with a crew of four because of budgetary limitations. If we could visit for five months with a half dozen personnel, even if some are paying tourists who are willing to get some training, *that* would be a win-win situation for everyone.”

“I’ll write it up,” promised Yevgeny.

Will turned to Yevgeny. “I hate to change subjects, but are you ready for your flight to Cassini and the trip northward?”

“Yes. Thank you so much for arranging for me to see so much of Mars.”

“Well, we have a tourist and we may have several next columbiad. We have to plan a tourist itinerary, and you seem like an excellent choice for guinea pig.”

“Thank you. I’m going up to the Dacha for a few sols on Monsol, and after I return from the northern highlands Roger will take Carson and me on a trip up Marineris. It should be quite an adventure.”

“You’ll love it. And be sure to fill out the customer service survey very carefully. Seriously, we need your input on making the trip as interesting as possible.”

“I’ll be glad to help. I’m sure Carson will also.”

Will turned to Yevgeny. “So, tonight you’ll play the Mikkado?”

“Yes. I hope I don’t totally embarrass myself!”

“You’ll do fine,” replied Alexandra. “You’ve been rehearsing for months.”

“Gilbert and Sullivan on Mars; glad I’ll see that,” said Yuri.

“And we’ll be serving our first snow cones,” added Lisa. “It’s a surprise, so don’t tell anyone.”

“How’s the transition going?” asked Will.

“Pretty well. Having seven more people on the horticulture team really will help a lot, even if five of those positions are full-time Bio-archive. We’ll start setting up the Dakota tallgrass prairie and the central Alaskan tundra next month. Of course,

greenhouses are awfully small for these ecologies; we really need biomes.” And Lisa looked at Alexandra with a smile.

“I know, I know,” she replied. “But we have to give priority to the three biomes assigned to housing and agriculture at Aurorae, Cassini, and Dawes. In six months we can get the two bubbles set up here for those ecologies. By then we’ll have the new plastic-making system functioning to the point where we can make our own biomes.”

“Meanwhile, we have plenty of old greenhouses to get the ecosystems started,” said Lisa.

“And the silane making system?” asked Will.

“Give our new silane-making team three or four months,” replied Alexandra. “They’re still adjusting to being here, most of the equipment doesn’t arrive for a few weeks, and then we have to get everything set up. The new sunwing-Ds have to be put together as well. And the silane motors are very experimental; they have to be tested and probably modified.”

“How experimental are they?” asked Lisa.

“Very. A kilo of silane requires almost three kilos of CO<sub>2</sub> for combustion, so it saves a lot of weight. But a byproduct is solid silica, which gums up the combustion chamber, which resembles an old-fashioned steam engine. We use a Stirling engine to convert the heat into mechanical energy. They should work fine, but in practice they will need refining.”

“We’ll need silane powered aircraft as soon as possible,” said Yevgeny. “With three outposts scattered across Mars, making a triangle with sides some 5,000 to 6,000 kilometers long, we really need faster air travel.”

“Soon enough, my dear,” replied Alexandra.

“So many changes,” said Yuri. “And now the ‘Commonwealth of Mars’ has a ‘Fundamental Law.’” He was referring to the “constitution” the planet had ratified almost a year earlier. He said the phrase semi-seriously.

“We sure do!” replied Érico emphatically. Yuri, seeing he had stepped into local politics, nodded vigorously, as if to mollify the others.

The conversation turned to other matters; America’s continued occupation of Turanistan, the latest political crisis in the European Union, the difficulties of establishing a common currency for the South American Union, the race riots in Miami last month. Ethel came to join them. Others drifted away from the table; the patio was the place everyone went to socialize from 6 a.m. to midnight. One of the new arrivals brought out a pogo stick and everyone was amused by the efforts to bounce on it, in spite of the lower gravity.

At one point Will went into DiPonte’s store to buy a small chocolate bar. As he was coming out, Rosa Stroger, who was walking by, stopped him. “Oh, Will, I want to talk to you.”

“Sure, about what?”

She looked around. “It’s private.” She pointed to a corner of the biome where no one would be nearby, so they walked over. “I’m concerned about Brian Stark. He’s not a team player. He skipped one training session altogether and seemed bored in the others. He’s here to work on the nukes but he seems completely uninterested in them. I’ve been trying to draw up his work schedule, but he has avoided setting an appointment with me.



I'm his boss, but I can't figure out what was the point of him coming here. I think someone pulled some bizarre set of strings to get him included on Columbus 7."

Will looked around and wondered what to say. "Perhaps," he finally said. "Stark and I are scheduled to get together at 9 a.m. tomorrow. Can you come along?"

"Where?"

"We're meeting in Joseph Hall."

"Are you going outside?"

"Can you come along?"

Rosa frowned. "I guess I can rearrange my schedule to come along. For how long?"

"Three hours. Bring your suit."

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Rosa Stroger showed up at 8:55 a.m. in Joseph Hall with her pressure suit. Will was there two minutes later. At exactly 9:00 a.m. Stark appeared. He was surprised to see Stroger.

"Let's get in," said Will, pointing to a ranger. Stark opened his mouth to say something; Will shook his head. Stroger was more and more puzzled. The three of them climbed in and pulled on their suits over their clothes, leaving the helmets and gloves off. The ranger had four life support backpacks charged up and ready to go.

Will closed the doors and drove them into the airlock. They watched the external pressure drop as they checked out the ranger's systems. Then the outer airlock opened and Will headed uphill toward Face Rock, turned east, and headed for the main trail.

Stroger was curious about their destination, but said nothing. They passed the solar power units on the left, a series of large inflated cylinders oriented east-west that

rolled along the ground in order to keep its solar concentrators pointed at the sun.

Immediately beyond them were a series of wells the Outpost had drilled as much as a half kilometer into the conglomerate and arkose under the valley floor. Compressed air heated by the solar power units was forced down the shafts and flowed back up filled with water vapor evaporated from the ice in the bedrock.

Next they passed a great plastic-covered stretch of white about 100 meters long and up to fifty meters wide. At the far eastern end was a dam fifteen meters high, the plastic buried into the top of the dam and inflated to hover above the water reservoir upstream. "That's Lake Superior," Stroger commented to Stark, in case he hadn't realized he was passing Mars's largest body of liquid water. "Twenty-six thousand cubic meters of water, fifteen percent ice, the rest liquid underneath. The waste heat of our reactors goes into it to keep it liquid. Excessive sewage from the biomes go in it as well. We oxygenated the water and stocked it with algae and a few species of fish about six months ago, and so far most of the species are surviving."

"Oxygen pressure under the ice is about a quarter of the Earth's," added Will. "We're negotiating to establish an entire ecology in here, probably from an Alaskan lake."

"Locally made plastic?" asked Stark.

Will nodded. "Not bad, too. It was a test of our capabilities about two years ago."

They all resumed their silence. About twenty kilometers down the road Will slowed, glanced at the gps coordinates, lowered the ranger's bulldozer blade, and turned off the trail onto an old dirt track. There was a momentary bump when they cut through the low berm of regolith and loose rocks along the shoulder of the trail that bulldozing

had pushed up. Will headed straight southward down the dirt track toward a mesa rather like Boat Rock.

“We call it the Tower,” Will said. “It’s 700 meters across and has a crater 300 meters in diameter right in the middle. The rim and the shock-lithified ejecta field resisted catastrophic floods, so as the floor of Aurorae Vallis was cut downward it became an erosional remnant. The crater is partially filled with wind-blown fines as well.”

Stark nodded. “That’s what the report said.”

Stroger finally blurted out “Can you tell me why we’re visiting the Tower?”

Stark turned. “Because it’s a potential site of a nuclear reactor and a uranium isotope concentration facility built by the U.S. Navy.”

“Oh.” She considered that answer. “Centrifuge concentration?”

Stark nodded. “Classified and top secret for now.”

“For fueling reactors on the moon and LANTR engines,” added Will. “We have to cooperate with the Navy over this matter. We’ll see whether it gets proposed and made public.”

“Why wasn’t I informed sooner?”

“I wasn’t informed either; Brian told me about it when he arrived. Since then I’ve had several cryptic conversations with Morgan about it.”

“Still; I’m a retired Navy Colonel,” replied Stroger.

Stark nodded. “I know, but this is how it had to be.”

In a few minutes they reached the base of the Tower. The dirt track circled it; they followed it all the way around and Stark pressed his head against the glass, surveying the

cliffs and the piles of broken rock at their bottoms. He told Will to stop at an ancient landslide at the eastern end. They suited up, grabbed their rock hammers and sample bags, and stepped outside. Stark headed straight for the landslide deposit as if he had hiked it dozens of times and began to pick his way to the top, with Will and Rosa following.

It was a tough, half hour climb. Stark avoided several short cliffs very skillfully. He always knew the way around obstacles; Stroger could tell he was following a route he had already selected using detailed satellite photos. When Stark reached the top he immediately turned toward the crater's bowl, which had been breached entirely on the side where they stood, and waited for the others to reach the top. Then the three of them headed along the rim to its highest point.

The view was quite good from the little peak, eighty meters above the rocky, rolling floor of Aurorae. The escarpment rent the sky twenty kilometers to the north, its 1,500 meter cliffs impressive and immense in spite of the distance. To the east and west the floor was rolling and hummocky; looking west, they could just see a metallic glint marking the presence of the Outpost. To the south the boulderscape grew gradually rougher, as it merged into the chaoslands of southern Aurorae.

They turned inward at the ruined crater at the center of the mesa, eroded by ancient rain and snow, then repeatedly filled with wind-blown dust. The old layers were exposed and cross-cut in a few places. The crater rim opposite where they stood had three higher, squarish prominences of rock that from a distance looked like the crenellations of the top of a medieval castle; hence the popular name, "the tower."

Stark nodded. “The criteria for a nuclear facility are simple. It has to be far enough from the outpost so that no one can walk down and back, but close enough for quick access by vehicle. It should be near a road, but far enough off it so that we can watch traffic. It has to have a five-kilometer exclusion zone around it. It has to be downwind of Aurorae, so that accidental radioactive releases blow away from the settlement. It needs to be secure; prominences where cameras can be mounted to watch the area are useful. And it needs water.”

“I checked the seismological map,” said Will. “This area, like the rest of northern Aurorae, has a thick gravel layer two to three hundred meters down saturated with ice.”

Stroger pointed to the escarpment. “Of course, the Dacha is up there, and anyone with good binoculars can look down on this place.”

“Good,” replied Stark. “Let them. It’ll allay curiosity. We won’t be doing anything that can be seen that way; everything will be inside buildings and underground.”

“It’ll be a challenge to build a road up here,” noted Will. “But with explosives, it’s doable. The road up Little Colorado Canyon to the top of the escarpment was harder to excavate.”

“We may not need to build up here anyway; if we built on the flats south of here, we could use this place as a reconnaissance point. That’d work, too.” Brian looked at Will. “Thanks for bringing me here, Commander.”

## Quake

early December 2048

Will and his leading heads of staff—Ruhullah, Alexandra, Yevgeny, and Lisa—faced a screen with Douglas Morgan, Head of the Mars Commission, flanked by his leading heads of staff.

“What’s the time delay today?” asked Alexandra.

“Thirty-two minutes,” replied Will sadly. “We get their report, we reply, then we’ll take a coffee break, so it won’t be too bad. He pointed to the “message being received” icon. “shall we get started?” Every nodded, so he pushed “play.”

“Good morning,” began Morgan. “This is a good time to review plans. Columbus 7 arrived six weeks ago, training is over, and everyone is at work; Dawes has been founded; the first scientific expedition has set out; all the cargo has been deorbited except one pallet that comes down next month with the Deimos expedition; and yestersol Yuri Severin and a fleet of vehicles headed back to Earth via the inner solar system. Pavel will begin with the tentative plans for the next opposition.” Morgan turned to Pavel Rudenkov, who had been on Mars with Columbus 3 and was now in charge of the Commission’s office of technology and planning.

“The Commission’s planning committee considered three ideas,” he began. “Flights via Venus; use of LANTR engines; and expanding the capacity of the interplanetary transit vehicles. We favor all three options.

“We agree with the report you sent last month about using the Venus route regularly, including a stopover at Magellan. You have convinced us that Mars’s fuel

production capacities can handle the extra demand. Next week we'll open negotiations with the Venus Commission about sending passenger flights via Magellan."

"Stop the transmission so we can cheer!" exclaimed Yevgeny. And he shouted a loud "yea!" Alexandra and Érico applauded.

Will paused the transmission. "Congratulations; you did it," he said, shaking Yevgeny's hand. Then Will pressed play.

"We will also propose a cargo flight to Venus every 350 days when Mars and Venus are aligned. Mars can provide Magellan water, carbon dioxide, nitrogen, argon, and food more cheaply and regularly than Earth. Eventually the buildup of mass will provide excellent radiation shielding."

"Great!" said Yevgeny. "We're a natural partnership with them. We've got lots of old heat shields and avionics we can repair, and they can send them back a year later."

Will nodded. He had hit pause again; now he hit play. "We also recommend the use of the LANTR engines and expanded annexes with their own aerobrakes for Columbus 8 in 2035," Pavel continued. "The LANTR engines have proved their reliability on the lunar runs. Columbus 8 will include two LANTRs, two shuttles, six ITVs, and six expanded and improved annexes. The LANTRS will return to Earth after trans-Mars injection; the rest will travel to Mars in 140 sols and aerobrake into orbit. Surplus equipment will head to Earth right away on an eighteen-month trajectory. The tourists and their equipment will stay six months, then return to Earth via Venus in sixteen months, including a five-month visit at Magellan Station. The Mars-bound flight will accommodate sixty-two new Mars personnel, ten tourists, two pilots, and two special passengers, who could be a Commission representative or someone providing a medical

service, such as an eye surgeon or a cancer specialist. The round trip will cost each tourist \$78 million. This special flight will only be offered in 2050-52.”

Will paused the transmission. “That’s good. The LANTRS are working out well on the Earth-moon runs, but we don’t have the hydrogen storage capacity they need and we can’t maintain them. Let them stay at Earth.”

“They’re too expensive for our use anyway,” said Érico.

Will resumed the transmission. “Finally, we recommend a separate flight to Mars that includes an asteroid encounter. It will be designated *Elysium* after the Mars shuttle propelling its ITV and annex. It’ll take fourteen personnel to the asteroid 2021QA then to Mars in January 2051. Thus we anticipate a total of 76 new Mars personnel during the eighth columbiad.”

“Wow!” said Lisa. “Lots of mouths to feed in two years.”

“And housing for sardines; they’ll be crushed into those ITVs!” exclaimed Érico, shaking his head.

“You also asked about a flight to Mars via Venus, leaving Earth in October 2053 and arriving at Mars a year later. We have decided that while the opportunity is indeed excellent, the plans for 2050 are already so ambitious we will not avail ourselves of the 2053 opportunity.”

“Darn,” said Érico.

“We need to be sure the 2050 mission will work,” replied Will.

Pavel turned to Morgan, who spoke next. “Mich, say something about passenger accommodations. I’m sure our friends on Mars are worrying about ‘sardines in a can’ and ‘rats in a cage’ right now.”



“It won’t be that bad,” replied Mich Dvorkin, the Assistant Director for Exports. “Columbus 8’s annexes will be reusable and will have heat shields. They won’t contain life support equipment; it’ll remain in the attached ITV. Four sols before reaching Mars, all people and cargo will move out of the annexes and into the ITVs. The top two levels of the annexes will be deflated and folded against the heat shield for aerobraking. The last few sols of flight will be very cramped, but should be manageable.”

“Why don’t they just develop a new, bigger ITV?” complained Érico.

“Money,” replied Will. “The ITVs cost half a billion each, but the annexes cost less than \$100 million.”

“Of course, the ITVs had to be redesigned to include all the life support equipment for twelve people instead of four and to be convertible to cramped capsules. What’s the mass of this new system?”

“Thirty-six tonnes,” replied Will. He reactivated the transmission.

“That’s everything we’ve got at this end,” said Morgan. “Over to you.”

“Their report doesn’t deal with visits to near-Mars asteroids,” said Érico, irritated.

“Then argue for it. Are we ready?” replied Will.

The others nodded, so Will activated their microphones. “Good sol to all of you, and thank you for the reports. Overall, we are very pleased by your proposals.

“We have a little news. The expedition that helped set up Dawes has started southward to Hellas, an area we have not visited at all. Roger’s expedition has reached southern Tharsis and begun to clear the Pisces trail westward. Dawes finally has a functioning well—we’re still amazed the first one was dry—and the air leak in the Mobilhab housing half the crew has been resolved safely. It appears the biome *Orinoco*

will be inflated in two months and completed in eight, as scheduled. The new robotic truck has finished its first run from here to Dawes, Cassini, and back. It took two thirds as much time as the old truck; the obstacle avoidance software is very, very good. With trail improvements and greater experience we should be able to double or triple its cargo load. The Sunwing D will be ready to fly in January, though without silane; the production system won't be ready until April because of labor shortages. Yevgeny will update you about exports."

All three companies gave me gold production projections yestersol," said Yevgeny. "With crews twice as large as last columbiad, Muller and Consolidated plan to produce fifty percent more gold, or 210 tonnes in 26 months. Productivity is slowing because the richest deposits are depleted. Sibireco is estimating production of seventy tonnes at Dawes. If the 280 tonnes of gold earn the same amount in 2050 as they can today and the Commission pockets two thirds, Mars will cover thirty percent of its operating expenses.

"But without more aerobraking capacity, we can't export 280 tonnes. We'd like permission to manufacture simple ablative ten-meter heat shields able to put fifty tonnes into Earth orbit. They'll be made in sections, launched to Phobos, and bolted together there, where the slight gravity simplifies assembly. We sent the details yestersol. If we could make five per year we'd be able to export all our gold and about two hundred tonnes of ice. It'd be a significant increase in our capacity." Yevgeny turned to Will.

"Thanks. And now to Érico will cover the most challenging set of goals."

Érico nodded. "We have six Mars shuttles, which are needed when interplanetary vehicles arrive or depart, but not in between. We have six lifters. We have four

functioning cargo landers from a decade and a half ago. They have fuel and oxidizer tanks transferred from the other landers we've cannibalized. They can be launched to orbit and refueled, where they can be used as asteroid explorers. Columbus 7 arrived with a dozen remote sensing packages designed to be placed on Mars and a dozen Prospectors to explore the Martian surface. All of them can be modified to be used on an asteroid.

“In the next two years we would like to launch two former cargo landers, each with a Prospector and a remote sensing pack. The first launch, in three months, will go to 2019XA, a 1,200 meter M-class nickel-iron asteroid that will pass about ten million kilometers from Mars. The flight will take about three months. If the equipment functions normally, after two years we can fly it back here or send it to another asteroid; the lander will have enough methane and oxygen for a delta-vee of four kilometers per second.

“The second automated mission will go to Eureka, two kilometers in diameter, one of Mars's trojan asteroids, flying in the same orbit as Mars but sixty degrees behind us. We propose to launch in June—six months from now—but the launch can occur at any time. The flight time will be 779 sols;  $1 \frac{1}{6}$  of an annum. Eureka probably formed in its present location, in which case it came from the same part of the solar nebula as Mars. It may prove useful as a telecommunications relay point when Mars and Earth are at conjunction. We propose a two-year primary mission. More information is in the document we emailed earlier.

“Most exciting, however, would be a mission to 2028CJ12. Six personnel would fly to the three-kilometer object, which appears to be a sliver of Vesta, has a half-kilometer moon in orbit around it, and which passes within six million kilometers of Mars in mid 2050. The shuttles *Hadriaca* and *Tharsis* would fly there in three months,

remain a month, and fly back in a week. They'd leave a Prospector and scientific package on the surface. Vesta is the most thoroughly differentiated of the large asteroids and the sliver appears to be a chunk broken off when the south polar impact basin formed. We should be able to verify the asteroid's origin from Vesta and possibly even verify where on Vesta it came from. Since our data about Vesta is limited to orbital reconnaissance, this will give us ground truth quickly and cheaply. Success will pave the way for future efforts that could be more ambitious and involve longer flights."

"Thanks, Érico," said Will. "Let me add that pundits have already criticized the idea that Mars would divert some of its miniscule resources into asteroid exploration. The effort will absorb ten of our people full time and a hundred or more in Houston. But we want to do this because we are, by nature, explorers. I can't tell you the enthusiasm Mars feels for this project. About one third of our adult population is involved in surface exploration as geologists, mechanics, and biologists. All of them—even the biologists—want to be involved in this effort, which they see as a natural expansion and complement to their current duties. We are not trying to upstage Project Argo, which will reach its first asteroid before we do. We just want to do our job: to push the boundaries of human experience outward.

"That's our report, we've heard yours, and everyone has received further written details electronically, so now we can switch to question and answer. According to my chronometer, we should start getting your comments any minute. I know some of us have been emailing questions to you during our reports. We look forward to the exchanges."

Sure enough, questions began to arrive from Houston a minute later. For the next hour they read or listened to comments and replied. Some discussion was a bit strongly

worded; in other cases it produced very useful suggestions. They took a break and then both panels summarized their views. Everyone was pleased with the results.

The three-hour meeting ended at 4:20 p.m. Will returned to his office for a half hour of emails and videomails, then headed for the patio in Yalta. All twenty-four kids were there, mostly running around and shouting. It was the most chaotic time of the sol; they were tired, parents were arriving, and people were beginning to gather to eat dinner.

After hugging dad, Marshall and Lizzie dashed off to play more with their friends. The play area included an overhead bar five meters long and Marshall could go all the way across hand over hand, turn around, and go back, thanks to the low gravity. Will watched, impressed, and praised Marshall for his strength. Fortunately, active children developed almost as much muscle on Mars as on Earth.

A crying child nearby caught his attention. It was Patrick O'Hare, aged 4, the eighth child born on Mars. He had been chasing his twin sisters, aged two and a half, and had fallen. Irina came over to comfort her son, carrying her four month old baby. "Is he okay?" Will called out.

Irina didn't respond at first; the one third atmosphere in the biomes did not transmit sound as well as Earth's thicker air and Will had not compensated. But then she figured out what he had said. "Yes, he's fine," she shouted back. Patrick stood up and dashed across the yard again, after the girls.

"He loves to chase them," Will said.

Irina nodded. She walked over to him. "They love his attention, too."

"Did I hear Fatima say he's writing already?"

"Yes, he's good at that and ahead of average. Of course, he can't write much."

“Marshall wasn’t writing anything other than his name until he was almost five.”

“They get good attention here, and they’re learning pretty fast.”

“How’s Mary?” Will looked at the little one she was carrying.

“She’s doing pretty well. She just had a late afternoon nap and has nursed, so she’s happy.” Irina looked at him. “I won’t be going back to work very soon. I just saw Eve this sol. I’m going to have another baby. In August.”

Will was surprised. “Wow, that’s fast. A year after Mary.”

“Eleven months, actually. I was surprised, too.”

“Well, at least you’re raising our average family size! Most couples here want one child, two at the most. You and Eammon will have five.”

“I feel guilty about it; it’ll be five years before I can go back to work!”

“Don’t worry about it. The outpost now has over 100 residents; it’s not like we need every person desperately. You and Eammon are traditional Catholics. We can accommodate that.”

“I’m grateful for that, Commander. Actually, I’m not quite as traditional as Eammon, and I think four kids are enough, certainly five! But I’m not sure we’ll do much to limit our family.”

“I understand. I don’t think the Commission should take a position about family size. If anything, we should encourage large families; it’s cheaper than importing people! We’ve got a planet to settle. So don’t feel guilty.”

“Thank you, Commander.” Irina smiled and looked a bit guilty anyway.

“What would this place be without the kids?” asked Will.

“Quiet!”

They both laughed. Just then Skip Carson entered the biome. He saw Will and waved, then walked over. "I'd like to interview you, Commander, about the philosophy of exploration. It's part of my new project."

"Sure. Tomorrow may be busy, but I could give you some time the sol after. Is the muse sitting on your shoulder again?"

Skip shrugged. "Not always, but I think my creativity will surge soon. That's how it usually works."

"I hope so. I wouldn't want you to regret your decision to stay."

"Definitely not! I'm very grateful you consented to let me stay until Columbus 8! I had no idea Mars would be so fascinating, and a safe place to work and interact."

"No papparazzi."

"Exactly. Maybe when I return to Earth in two years I'll be forgotten enough to be able to live a partially normal life."

Will shook his head. "I don't think so, Skip."

"You're probably right." Skip shrugged, then turned and headed to the food line.

Ethel walked into the biome. Will saw her and shouted, "Okay Marshall, Lizzie, let's go! Time to eat!"

The kids looked up. "Mom!" they shouted, and hurried over to greet Ethel. She picked up Lizzie, six, and gave her a hug and kiss. Marshall, now almost nine, no longer wanted to be picked up, so she just kissed him. The four of them got into line to fill their plates, then headed for their usual table for supper.

"How was the meeting?" she asked.

"Long, but it went well. Everything was approved."

“So we’re sending the *Hadriaca* to the asteroid?” Ethel was excited.

Will nodded. “To *Gradivus*. It needed a name, so we named it after Mars Gradivus, ‘Mars the Grower.’”

“That’s appropriate.” Ethel looked around, then smiled and nudged Will. “There’s Greg and Anna, eating together again.”

“You’re more of a matchmaker than I.”

“Well, Anna and I talk a lot. They seem perfectly suited for each other. She just told him yestersol that she was a former nun. He was pretty startled.”

“Anna used to be a nun?” Will was surprised as well.

Ethel nodded. “Yes. Ex-nun meets ex-priest!”

“They are suited for each other; they both have a very similar approach to life and to serving others. Eammon’s pretty nervous about it.”

“Of course, he doesn’t want to lose Mars’s only priest! Who’d baptize his horde of kids?”

“That would be a problem,” conceded Will.

“But I think it’s delightful.” She smiled slyly.

They stopped talking to help Lizzie fill her plate. Then they headed for the table. They were beginning to sit when they heard a rumbling. Startled, they looked up. The ground began to sway gently, like someone was driving a very large piece of construction equipment by.

“What’s that?” asked Marshall.

“I don’t know,” replied Will, trying to look out the window, even though he couldn’t see anything.



“Earthquake,” exclaimed someone at a nearby table.

Then it hit Will. The ground was indeed rolling a bit. “It’s a quake,” he said. “It *is* an earthquake.”

“What do we do?” asked Ethel.

Then the depressurization alarm went off; not loudly and insistently, but it began to chirp like a fire alarm with a low battery.

“Head for the tunnels!” exclaimed Will.

There were screams and cries of children as everyone began to run to the nearest tunnel. Someone opened the door to the airlock and kept it open as the crowd—75 of the Outpost’s 100 people—began to enter. Someone else overrode the other airlock door and forced it open as well, as was the procedure to evacuate the biome. The tunnels, encased in concrete and steel, were deemed the safest.

But the connecting tunnel had a chirping alarm as well. “Everything’s depressurizing!” exclaimed Ethel.

“Not very fast, though,” said Will. “And the shaking has stopped.”

“Where do we go?” exclaimed someone, fear rising in her voice.

“Don’t panic, everyone!” exclaimed Will. “My ears aren’t popping; the pressure’s not escaping very fast at all. We’ve got time.”

“There’s no alarm in Clarke Dome!” said someone. It was the next unit over, so the crowd began to move that way.

The intercom crackled. “This is emergency control,” said Kent Bytown, who was in charge of environmental control and was in the bridge at the time. “Aurorae has experienced a mild marsquake. Yalta and Riviera Biomes both have very small air leaks.

Catalina and Shikoku do not. None of the buildings in the biomes have leaks. The habitats do not, except habitat 2. We do not appear to be in any serious danger. We ask emergency workers and volunteers to report to Joseph Hall immediately. Everyone else should go back to Yalta, get their supper, and take it home to eat. Yalta is safe for transit, but we ask that people not remain in the open for very long.”

That calmed everyone down. Will looked at Ethel. “I better get to the bridge. Take the kids and the suppers home.”

“If they’ll eat. Do we know the buildings are safe?”

“They should be. This was a magnitude 3 or 4. The steel structure is designed to support the gardens through a magnitude 8.”

“I wonder when we’ll have one of them,” said Ethel, turning back to Yalta.

Will hurried into Joseph Hall—where the chirp was mild—and into Renfrew Hall, an older construction, where the alarm was louder. The geology building had quite a loud alarm and Will didn’t even try to go through it; the airlock door refused to open. So he hurried through a greenhouse to Habitat 1, where Kent had commandeered the three Prospector drivers across the hall to help coordinate response.

“What’s the status?” Will exclaimed.

“You heard the intercom? The habs are fine. Yalta and Riviera have very slow leaks; about 0.005 atmospheres per hour.” The geology facility is worst; 0.08 atmospheres per hour.”

“It was our first construction from native materials. How strong was the quake?”

“I don’t have that data yet, but it wasn’t much of a shaker. I’d go on the intercom and calm everyone, Will. Right now, there appears to be no danger.”

“Kent, how strong was the shake? You told people they could go in their buildings. Those buildings have 600-tonne gardens on their roofs. I wouldn’t confirm anything until we’re sure the buildings are safe.”

“It was 3.9,” exclaimed Zach Hersey. He pointed to a screen where he had projected the seismic waves.

Will looked, then nodded. “That’s not too bad.”

“This area’s supposed to be aseismic!” noted Zach. “This must be one of the biggest temblors Mars has experienced in a few years!”

“Wouldn’t you know it,” said Will. “Anything else damaged?”

“We’ve got a LOX tank leaking a little bit, the pressure in one of the wells is dropping. . . a zillion little things,” replied Kent.

Will rolled his eyes. “Two or three months of repairs.”

“And two or three months of uncertainty!” added Kent.

## Aster-1

early March 2049

The next three months were stressful and frustrating. Aurorae Outpost had several hundred minor leaks, most of which were virtually undetectable. The shaking had cracked silicone seals around windows and joints where metal airlocks joined plastic domes. Microscopic cracks in the concrete tunnels let air out very slowly and undetectably. No part of the outpost was in danger, but many residents did not sleep well. The electrical output was strained to electrolyze water into oxygen and hydrogen, the former gas being pumped into the outpost to keep it pressurized. Meanwhile, every window and airlock had to be recalked and every concrete surface had to be sprayed with sealant. Two months and five tonnes of sealant later, the air leakage was reduced almost to the level it had been before the shake.

Equally serious, the outpost had had no emergency plan for quakes; they had been considered too rare and weak to be a serious threat. It was exceedingly difficult to plan for a quake because it had the potential to depressurize every unit in the outpost at once, including tunnels; this rendered the notion of emergency evacuation routes problematic. It also had the potential to cut off power and communications, thereby making it difficult to notify people of safe escape routes. The solution was to provide each biome with an inflatable emergency shelter and strengthen the plastic envelope around each biome so that it could catch leaks better. The bubbles for bioarchive were inflated on top of the ground to provide additional inflated space. A study of Mars's seismic history was begun in order to define the problem more thoroughly. Plans to reinforce the buildings inside

the biomes were drawn up to guarantee the gardens wouldn't collapse on people underneath.

While Aurorae and Cassini were retrofitting and resealing, Dawes Outpost went up with newer safety standards in mind. Progress was slow, but steady. The hole for the biome was dug, the biome was inflated, and buildings inside were inflated and their metal frames were begun. Outside, Sibireco's team hit some very rich deposits of gold nuggets; within a few months production was 3.3 tonnes per month.

The excitement of the gold, however, could not make up for the chill that the quake had spread across Mars. The possibility that a violent shake could wipe out almost the entire population of an outpost, including entire families at once, was profoundly unsettling. People spoke of it, but could not relieve themselves of the fear; they had nightmares; some became depressed. The danger was immensely remote, but the gentle shaking had been traumatic nevertheless.

The impact on the terrestrial media was equally strong. Mars seemed vulnerable. The Commission's careful media plans, featuring a different success every month, were unsuccessful; the media wanted to dwell on how worried the Martian population was. The public grew more pessimistic about Mars. Sales of Martian land dropped.

Consequently, Will Elliott made sure he was on the bridge the late March morning when the Aster-1 probe began its countdown. Rostam Khan, a vehicle control specialist originally from Pakistan, oversaw the process. When it reached zero, the long-range cameras on Embarcadero showed both engines flaming alive.

"There she goes," said Will, with a smile.

“Everything’s nominal, too,” added Rostam. “It’s a good burn; thrust is right on the money.”

The bridge sat in silence watching. For two minutes Aster-1’s two engines burned at low thrust, accelerating itself by 1,000 meters per second.

“Main engine cutoff,” announced Rostam calmly. “We’re on our way to 2019XA!” he exclaimed with more enthusiasm.

“Beautifully done,” said Will. “You all did a good job refurbishing that old automated cargo lander.”

“Thanks. We spent six person months checking it out,” said Érico. “The test firing last week proved it’s trusty old technology.”

Will smiled. “We need the reminder that technology can be trustworthy, too.”

After a few minutes the probe was safely on its way. Excitement over, Will left the control room to head back to his office.

The new control room was on the third floor of North Riviera; Will’s office was on the diminutive fourth floor and had generous overhangs, which increased the garden area of the biome. Will stepped outside and walked through the gardens for a moment. Enrique Delrio and Sheila Burns were hard at work installing the second of three steel beams that ran over the yard to the Riviera South Building, to strengthen both of them against future quakes. The beams were a bit ugly, but someone pointed out they could be used to suspend banners, so they wouldn’t look too bad. Will stopped to find out how they were doing and to offer some encouragement, then went into his office.

He had a congratulatory message about Aster-1 from Doug Morgan. There were a dozen messages, including one from the moon and one from Venus, which proved routine. Pavel Rudenkov had called him as well, and he soon was listening with interest.

“Will, we’ve been looking at the idea of building larger ITV annexes; much larger annexes, in fact. It occurred to us we could build annexes ten meters in diameter and four stories high and use them for housing on the surface as well as in space. Right now we’re sending a crescent-shaped bubble six to twelve meters wide, thirty meters long, and ten meters high, with about 300 square meters per floor and three floors. It’s perfect to fit inside the curved wall of a biome bubble, but it can’t be rotated for artificial gravity in flight. But let’s say we sent you three cylinders ten meters in diameter and twelve high, with 78 square meters per floor and four floors; they would have the same area as the crescent-shaped apartment bubble, and would have preexisting wiring and inflatable air circulation vents. We could use them for annexes on the way out. After aerobraking, they could be emptied out and vacuum packed into a cargo container for transport to the surface inside a Mars shuttle, and you could use them for housing after arrival. We could redesign the ITVs to serve as emergency shelters for even more people; maybe twenty or twenty-four each. What do you think? Bye.”

He hit reply. “Pavel, thanks for the intriguing idea. I’ll send it and my reply to Alexandra, so she can follow up. Three cylinders will have a different footprint in the biome than the crescent-shaped bubble we use now, and it’ll require careful redesign of the garden roof, but we could probably come up with a way to use the space efficiently. We could use the annex’s heat shields for transporting cargo back to Earth. I hope we can

design a much cheaper and more efficient system for transporting people here safely, and this sounds like a step in that direction. Let us know what we can do. Bye.”

He ran through the rest of his messages, then came a knock on the door. Skip Carson opened it. “Can I come in?”

“Sure; I’m badly backed up with work now, but I can squeeze you in.”

“Thanks.” Carson came in with an excited hop in his step as he entered. “We’ll have the documentary *The Spirit of Mars* finished tomorrow,” he continued. “You’ve got to see it, Will. It’s really incredible. It’ll convert the minor quake into an appreciation for the heroism here. Really, I’m serious. Even when people talk about losing sleep after the quake, it’s presented as an act of courage.”

“And it is, I suppose,” said Will. “Great, I’m glad to hear that this disaster has had a silver lining. We’re so grateful that you’ve stayed, Skip.”

“Thank you. I’m glad we’ve come up with an exchange of services. I like my apartment and I’m glad to be considered a resident; I’m looking forward to voting in the election.” He shrugged. “Though I’m not altogether sure how I’ll vote in the upcoming special congressional election in my home district.”

“Oh, are you in Thad Miller’s district? That is a hot race; it’s gotten international attention, though I suppose that’s because Miller’s a prominent actor. You’ve got plenty of time to apply for an absentee ballot. We can fax it in.”

“I don’t like the President, but I think Miller’s distorting the situation irresponsibly. The evidence that the United States knew about the shipment of the nuclear bomb through Khaliestan is very slim and highly suspect.”



“I think you’re right. It makes no sense that the United States, which had been trying to get that suitcase nuke back for years, would pass up an opportunity to recapture the weapon, let alone cooperate in its shipment to the extreme French nationalist group. The part of Paris they blew up was loaded with American corporate headquarters. But the administration, I think you will agree, has presented a poor case and has covered up completely harmless details that had nothing to do with the accusation. If they had admitted that because of Khaliestan’s vast oil wealth, they had ignored reports that it was officially supporting terrorism, perhaps everything would have gone better.”

“Perhaps. At any rate, the forces that are gathering momentum in the United States are reactionary, closed-minded, isolationist, and seek to roll back the clock two centuries. I’m surprised you’re not more concerned. Even Roger’s discouraged.”

“He is. Roger isn’t as conservative as he used to be, where nationalism and isolationism are concerned. He’s still a morally conservative person who favors laissez-faire economics. The American public has had a rough few years, Skip. The Euro-Russian alliance has driven a wedge between the United State and Europe, and some sort of alleged American connection to the Paris bombing makes relations worse. The American economy has not been growing and the economic momentum has shifted to Europe and China. The Chinese have been having a lot of fun with America’s weakness. The public feels betrayed by the current administration.” He shrugged. “It’s not the first time it’s happened, is it?”

“No, it isn’t, but surely you have a preference.”

Will hesitated. “My personal political feelings are my own. As Vice Commissioner of the Commission and Commander, I can’t let them influence the performance of my duties.”

Skip chuckled. “Why not? It affects everyone else.” But then he paused. “On the other hand, you’re a Bahá’í, aren’t you? I guess that explains it, doesn’t it. Why not just say you’re a Bahá’í, Will?”

“I’m not being disingenuous; I really do believe that a leading figure in an international nongovernmental agency cannot take partisan political positions. Yes, I agree, some do, but I question its ethicality. Maybe that’s because of my religious feelings; Bahá’ís do not join political parties or hold partisan political positions. My job is to support the exploration, exploitation, and colonization of Mars, not to support or oppose presidential candidates.”

“That’s true. Of course, the opposition candidates are mostly opposed to American support of international space exploration efforts, including the moon and Mars.”

Will shrugged. “It was their party that set up the Mars Commission. So, how’s your writing?”

Carson scowled; Will was changing the subject. But he took the bait. “*The Spirit of Mars* has been taking all my energy; I think it’s good work. But I have a few ideas for a screenplay and I may turn to them soon.”

“Good; I hope you plan your next movie before you leave here, so we can shoot part of it here. I’d like to see movies made in space; they’ll be more realistic. Call me tomorrow afternoon and I’ll come down to see the documentary.”

“Great! Thanks, I’ll let you know when it’s ready.”

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Greg had noticed that lately Anna had been sitting at a different table than her usual place. It made it harder for him to talk to her, since he had switched tables to sit with her friends. He had also changed his dinner hour to be there closer to the time she was eating. So he was pleased when, after she finished eating, she came over to the table where he was sitting.

Alas, someone had just asked him a difficult question and as she approached, he knew he would be busy answering for several minutes. But Anna waited patiently and listening intently. When he finished, ignoring the person who had asked the question, he turned to her. “Good evening.”

“Evening. Did you hear I’m on my way to Dawes tomorrow?”

“No, I didn’t.” He had heard, actually. “For how long?”

“Three or four months.”

“I’m sorry to hear you’ll be gone. Say, let me buy you something in the store; maybe a chocolate bar or something.”

She smiled. “You’re very sweet.”

He rose from the table right away, pleased he had done something that looked generous without looking romantic in public. Eammon was sitting at the table, after all, and had taken to monitoring Greg’s contact with Anna.

Greg bussed his tray and waited for Anna to do the same, then they headed for DiPonte’s store. Silvio wasn’t there, but the store was open anyway, thanks to a dozen cameras that could monitor any theft, a computer checking the image for anything

suspicious, a person in India being paid minimum wage to back up the computer, and a payment computer. Greg took a large chocolate bar imported from Earth, swiped his credit card in the payment machine, swiped the chocolate's bar code, and they walked out with it.

“What's the occasion for going to Dawes?” He asked, opening the bar for them to share.

“I asked for a new assignment. Dawes needs a nurse, for which I have training, I wanted to try something new, and I wanted to see a new place.”

“I doubt there's much to see at Dawes; it's in fairly boring old cratered highlands.”

“I know, but it's different.” She hesitated. “Actually, I think our . . . friendship has been moving rather fast, Greg. I think we need some time apart.”

He was surprised. “Anna, I have never approached you about a relationship—”

“I know, but I can feel your attraction, and Greg, I feel attracted to you as well. I freely admit it. But you're a priest and have a line of service here.”

“Actually, I'm not a priest, exactly. I have not renounced my vows, it is true, but I am not here on any kind of priestly assignment. The Vatican has even emailed me and offered me an official assignment here, and I have written back and said no. I'm willing to serve as temporary priest, but I'm not the official Catholic priest on Mars.”

“Greg, official or not, you baptize everyone's babies, and that's a pretty important community service. That's something you couldn't do if you weren't a priest. So that's something to think about pretty carefully.”

“Anna, I never said I was interested in you.”

She looked at him, uncertain. “Are you?”

He paused. “Well, yes, I guess I am.”

She shrugged. “There you go. Don’t misunderstand me; I’m interested in you as well. You’re a warm, caring man, and I like that. But let’s take some time and think about this carefully. And pray about it.”

“And pray about it.” He agreed with that sentiment. She smiled at his dilemma, then leaned over and kissed him on the cheek.

“Are you going to wish me bon voyage?”

“Yes, bon voyage. The Sunwing C is pretty nice and comfortable, in spite of the lengthy flight. So enjoy it.”

“I intend to. I want to see a bit of this adopted world of mine, even if I can’t tell basalt from sandstone. And I will write.”

“How about videophone calls?”

“Sure. That too.”

They didn’t have much else to say. Greg and Anna finished the chocolate bar and he walked her home. Then he walked around the outpost, thinking about the choices they had discussed. He really didn’t know whether he wanted to continue as a priest; he enjoyed the service he provided, but he felt in his bones that he needed to start another phase of his life. He was indeed attracted to her, but he wasn’t sure marrying her was the next phase he needed to consider. He would indeed have much to think and pray about.

## Election

late May 2049

The asteroid 2019XA was a small object on Aster-1's radar screen when Érico Lopes and Rostam Khan completed the engine firing sequence. The engine roared alive, expelling carbon dioxide and water vapor at 3.8 kilometers per second in order to neutralize part of the probe's velocity away from Mars and to realign its path toward the asteroid.

For four minutes the engine fired, then fell silent. "Main engine cutoff," reported Rostam. "It looks like a perfect burn. We should have doppler shift data from the Trek-3 probe in about twenty minutes to triangulate the acceleration vectors."

"Good," replied Will. He glanced at a image of the 1,249 meter object. The Aster-1 probe had already yielded better imagery and spectroscopic data than large telescopes near Earth had. It was an insignificant object, but it marked an important symbolic step in Mars's exploration of the solar system, a step unimaginable even five years earlier.

"So, Will, can the Aurorae Golf Club get use of a ranger this weekend?" asked Érico. "We want to do a round of golf, and we'll probably spend a few hours widening the eighth hole fairway."

Will shrugged. "If a ranger is available, go for it. We have to charge the club the usual fee, of course. But the members can afford it." A dozen of them had coughed up 2,000 redbacks each to join. Progress on improving the eighteen holes was slow.

Will's videophone rang. He activated it. "Hi, Will. I need you to talk to Pavel again about the annex specifications," said Alexandra. "People will be flying in them for six months, but living in them here for years. I want the waste recycling system flown

back to Earth for reuse in space and a separate system flown here for surface use. We need a very different kind of system. He thinks it's a waste of mass—no pun intended.”

“Okay,” replied Will. “Our ecologies can handle partially processed water. I'll talk to him. The plan is coming along fairly well, don't you think?”

“Oh, sure! This saves tonnes and increases safety. The cylinders will be ugly in the biomes, but we can fix that. We just have to resolve the problems with waste recycling better. How was the burn?”

“It seems to have gone perfectly, but we're waiting for confirmation.”

“Good. Yevgeny wants to go on the mission to Gradivus, but I'd prefer that he stay here; it's a long way to venture to see a rock.”

“Well, that launch is still months away. If this goes well and Aster-1 lands successfully, we'll schedule the launch of Aster-2 to Eureka in July or August. It doesn't need much fuel. And if *that* goes well, we'll start to plan the launch to Gradivus for early November. So you have time to worry.”

“Thanks a lot! Bye.”

He said goodbye and closed the circuit. “It's going to be very tricky choosing a crew for the flight; everyone wants to go,” said Érico.

“I know. We may have to resort to a preliminary cut, then a lottery to finalize the crew,” said Will. “We have dozens of overqualified people.”

“We have dozens who've been to Phobos, Deimos, or both,” agreed Érico.

“Because of the moons, we have more asteroid experience than Earth.”

“Exactly.”

They continued to chat until the doppler shift data arrived from Trek-3, which was in the inner asteroid belt. Since it was located in a different part of the solar system, its data, combined with the doppler shift data from four satellites orbiting around Mars, gave a very precise description of the burn. “It’s 0.02 meters per second fast,” reported Rostam. “Twelve years old or not, the refurbished engines behaved perfectly.”

“Great,” said Will. “Congratulations, gentlemen, we’ve done it!”

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Helmut Langlais crossed the yard of Orinoco Biome carefully, favoring his right leg so as to avoid hurting his left knee further. He looked for something new in the yard, but didn’t see anything; two weeks ago Dawes’s humid, tropical enclosure biome had been finished. It was forty meters across, like the others on Mars, with a north building and a south building, agriculture-covered roofs above them, and a vegetation-filled “yard” in the middle. The citrus trees were skinny, yellow-leaved, and only 150 centimeters high; the grape vines adorning the sides of north building were barely four meters long and scraggly looking. The old-timers considered the erection in six months of a bubble of Earth 5,000 kilometers from Aurorae to be miraculous. Cassini’s had taken a year.

Helmut limped into south building and walked straight into the clinic. It smelled new and was sparse; the last equipment was scheduled to arrive by robotic truck next week. Anna Racan was waiting to see him. As soon as she began to feel the knee and watched him jump, she could see there was a serious problem. She put him in the magnetic resonance scanner and the resulting picture told all. “You have serious damage to the cartilage in the kneecap,” she said. “I’m not a doctor, so we’ll have to email this to



Shinji Nagatani and Cornelius Beyer to get their official view. But I can tell you with some confidence that they will recommend an operation.”

“An operation! All I did was fall!”

“Well, you fell four meters, which is a long way to fall, even on Mars. Be thankful your suit held up; last month a man fell on the moon, his helmet seals broke, and he died before they could get him into an airlock—”

“I know. But Anna, can’t this just heal if I’m careful?”

“No, because you have loose pieces of cartilage inside. You can see them. It’s a pretty simple orthoscopic surgical procedure. Shinji’s done it before. They’ll make a couple of cuts in your knee a centimeter or two in length and use tiny instruments. You’ll need two months to heal.”

“Two months! I’ll be out of work two months?”

Anna shrugged. “Pretty much. You can do telerobotic work most of that time. Don’t worry, Muller won’t be hurting. In the last few months you’ve been a demon on the job anyway; I heard your boss say at lunch a few sols ago that you have already done a year of work!”

“I have worked pretty hard.”

“Hard! About eighty hours a week, I think. So I suggest you relax and enjoy the rest. You’ll have to go to Aurorae for the operation.”

Helmut looked even more alarmed. “Anna, I want to join the astronaut corps. Will this disqualify me?”

“Only if it doesn’t heal! A lot of astronauts have worse injuries. This is a minor operation. So just relax. The Sunwing D flies back to Aurorae Outpost in a few sols; I

know, I'm scheduled to be on it. If Shinji says what I think he'll say, you'll be back here by the end of July."

Helmut shrugged. "Alright, if you say so. I suppose my job is secure, and it won't be hard for Muller to find a temp."

"It won't; they pay twice as much as the Mars Commission." Anna smiled. "Consider the positives. Aurorae's a great place to visit, with lots of eligible women. It has a lot more interior space and plenty of Prospector work to get done."

"And I'll be able to talk to the geologists."

"Yes, the ones who are around, anyway. The flight here will bring some to Dawes for the Hellas expedition. And since you can't work, you can talk to them while here."

"And attend the town meeting before the election. I'd like to be here for that."

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All across Mars, the first Sunsol after the northern spring equinox was election sol, which meant that Saturisol afternoon the boroughs held town meetings to discuss the future. In Aurorae, everyone began to gather at 3 p.m. on the patio in Yalta. Father Greg closed his new beauty salon, which was open only on weekends. At 3 p.m. Will Elliott stood at the lectern in front of the crowd. "Good afternoon, everyone," he began. "We gather this afternoon to discuss the next annum—Martian year—and our progress here. Two elections that will occur tomorrow: the Aurorae Borough government's, consisting of the Chair, Clerk, Treasurer, and two at-large council members; and five representatives to the Mars Council. Under our current election tradition, we have no official candidates. Everyone is eligible to be voted for except me, because under the Fundamental Law of Mars I am the governor, appointed by the Mars Commission, and therefore cannot serve

on any of these other bodies. That's one reason I am chairing the meeting this sol; you can't vote for the chair! This meeting exists so that everyone can talk about the issues they see, the solutions that might work, and things we can all do together to make life better here. It's also a chance to consider who might be good choices for the various posts you have to vote for. There is no reason to vote for the same five persons for the Mars Council as for the Borough Council, nor is there a reason to vote for another group of persons entirely; you are free to decide. There is no reason to reelect automatically persons currently holding the officer positions for the Borough; they are our civil servants and we are free to accept their service or prefer someone else. Above all, the tradition on Mars, so far, is that we have stayed away from noisy campaigns where people make all sorts of promises they may or may not keep, and attack others directly or by innuendo. Let us keep our process of selecting leaders above the fray of partisanship and the pettiness that can result. Let us strive to create a climate of expectation where the Council members make decisions based on what is best, not based on what will maximize their chance for reelection.

“According to the Fundamental Law, the Mars Council and Governor are responsible for Mars-wide laws, income and sales taxes, the health care system, university level education, law enforcement, courts, and artistic and cultural development. With the Mars Assembly, the body elected by all land owners, the Council and Governor are responsible for property law, land sales outside the boroughs, property taxation if any, and property services. The boroughs are responsible for education through the high school level, law enforcement, sale of land, and property taxes within their jurisdictions. The Mars Commission currently retains the following responsibilities:

agriculture and environmental management; transportation; exploration, science, and technological development; exploitation of natural resources; exports; and jurisdiction over everything in Mars space. The Commission currently pays the costs of the Mars Authority and the borough governments, and as a result there are no taxes. If the Authority establishes taxes on corporations, by contract they come out of the profits or fees owed to the Commission.

“As I hope all of you know, the list of possible topics to discuss has been on the outpost’s website for a week and we already have a list of people who have asked to speak. We have chosen six speakers randomly from that list to start our discussion. Everyone is asked to keep their comments to two minutes.

“The meetings at Cassini and Dawes will occur in a few hours and will be broadcast via the *Mars This Sol* web channel; please consider the issues raised at those outposts as well. Our meeting is being broadcast live all over the planet. Residents of Aurorae, regardless of where they are on Mars, can call in to participate.

“The opening discussion topic is general: what specific improvement would you propose for life here? The first speaker is Lal Shankaraman.”

The videoscreen behind Will came alive with Lal’s image. “Good afternoon everyone,” he said. “There are eight of us here, on the northern slope of Elysium Mons and heading to the top, we’re all Aurorae residents, and we’re all watching, even though it’s the wee hours of the morning!

“I’ve been on Mars a long time and find it hard to imagine what we can do to improve things. We have unlimited psychological counseling, sixty hours per week of day care for our children, and the best physical health care imaginable. But there is one

thing we don't have: personal time. We're still working a minimum of fifty hours per week and some of us are working much more, especially the new arrivals. Meanwhile, on Earth the work day is thirty-five hours per week, even in the U.S. We are the most highly automated population that ever was, also, so we are the most productive. If I would ask for anything, it is a pledge that we lower the workweek to forty-five hours in the next two years, and to forty hours over the four years after that. The natural growth of our population and continued automation will not result in a reduction of our economy, just its slower expansion. As far as I am concerned, that's fine." He said the last two words emphatically and many people seated at the tables on the patio applauded. A few even cheered.

"This is an important issue, and one the Mars Council should probably discuss," Will said. "Madhu Gupta-Anderson."

Madhu rose from her seat. "Everyone already knows what I want to propose, so maybe I should sit down and you can consider the plea made. The arts shape our identity as a people and profoundly develop a sense of Mars culture. Mars culture is a potent export item, highlighting our visibility, keeping the dream alive, and bolstering support on Earth. I am delighted that the task has been given to the Mars Authority; it elevates its importance. But I hope the boroughs will develop cultural offices and invest in the arts and culture also. Our ballet and folk dancing are particularly beautiful; let's develop these unique art forms. Let's import experts from Earth to help us. Our stark physical environment and its dusty-pink lighting lends a unique inspiration to the visual arts and to music. Let's develop that inspiration. Our architecture and lived environment are already exerting an influence on terrestrial spaces; let's continue to develop them. The physical

materials available to us require different techniques for creating sculpture. Many of you enjoyed the ice carvings we set up outside two months ago, especially the shapes that resulted when they degraded. We need more people and resources to continue that effort. So my plea is very simple: if you want to develop Mars, develop the arts.” She sat to strong applause.

Will nodded. “We need reminders and gentle pressure; thank you Madhu. Prince Abdu’l-Majid.”

The Khaliestani prince, who was also a capable engineer, rose. “I’ve been here less than a year, but I have already learned more than I ever imagined, and I have been changed by the experience profoundly. I don’t think a society like this has ever existed in human history before. Not only are we the most highly educated society that has ever formed, but we are also the most diverse. In some ways I think we are also the most mature and balanced society as well, notwithstanding the fact that any society made up of human beings is imperfect and prone to errors and extremes.

“Therefore I am surprised that the Mars Commission does so much and we, as a society, still do so little for ourselves. I recommend that the Commission turn over more tasks to the Authority and the boroughs. There is no reason the boroughs shouldn’t control their own agriculture and environmental management. The Commission or the Authority could set standards that the boroughs had to maintain. The Commission could turn over all surface and atmospheric transportation to the Authority; the same people would do the work. Even the exploration effort could be devolved to the Authority because we are already using non-Commission personnel to provide more than half of our terrestrial support. The Commission has already signed contracts with specific

university departments and research institutes to provide geological support for specific expeditions. Why shouldn't our exploration effort be given to Mariner Institute of Technology and all our geologists and other scientists become faculty there? Their exploration would then be done in collaborations they set up. We do a lot of chemical and engineering research here as well, and it would benefit from the existing university model."

Will nodded, impressed by some of the prince's ideas. "Thank you. As you know, some of these ideas are in active consultation. Ruhullah Islami."

The Iranian rose. "My comments follow on Abdu'l-Majid's. I'd like to see the development of more temporary shelters on the surface, especially at both poles. We need to devote a lot more attention to the Martian polar regions, working toward the establishment of permanent outposts at both. The polar environments are only twenty degrees warmer than the moons of Jupiter or Titan; they provide valuable laboratories for developing the techniques for living on them. Phobos and Deimos are the key to the asteroid belts. So I disagree with Abdul-Majid's suggestion that we follow the university model in exploring Mars; we need governmental funding, and the Commission can provide that. We need to develop this place so that there are more bases for local exploration."

Ruhullah sat to scattered applause. "Thank you," said Will. "Silvio DiPonte."

Silvio stood. "We are gradually developing some excellent private initiatives here, but they are all what could be called 'cottage industry'; something one person does in his or her own private residence on the weekend. Perhaps the best developed example is Father Greg's beauty salon, which is the only place on the planet one can get a decent

haircut. The monthly flea market is the place to see the pottery, knitting, and other items this industry generates. But as good as these enterprises are, Mars needs a robust private sector. We need to get to the point where someone can get a contract to manufacture copper cable, or fabricate plastic parts, or build a biome, or supply agricultural products. We have some of the infrastructure in place for that development; people can pay for their services here. But we don't have the financial infrastructure ready. The bank is not in the position to make a million redback loan to someone to buy used equipment from the Commission, and even if it were, the risk is still too difficult to quantify. So I am calling for a study of this matter and specific recommendations to the Mars Authority and Commission how we can begin to grow businesses here.”

Will looked at his list. “Érico Lopes is next.”

The screen came alive again. Érico sat in a room with evening sunlight streaming in a window to the right. “Good sol from Dawes,” he said. “Sorry to miss the meeting, but I was asked to chair Dawes’s first borough meeting later this sol instead. I am drawn back to the insights we gained from the ‘Living Well’ conference we held some years back. It is probably timely to run the conference again in a new form. We learned from that conference that the key to happiness lies not in outward changes such as a shorter work week, but within each one of us. I suppose it sounds strange hearing a point like that from an agnostic like me, but it is a humanistic observation as well as a religious one. If we want to live together we have to learn better coping skills, more patience with each other, more abilities to listen to each other, more willingness to search for ways to agree on the essentials and compromise on the lesser details. When we look at Earth, we see vast material prosperity in some regions coupled with crime, fear of one’s neighbor, nasty



politics, basic distrust of society, and a lack of a sense of connection with the poorer sectors of the Earth. There aren't even 150 of us here, but we're on everyone's television screens daily. We exert an influence far beyond our numbers. We have a responsibility to serve as an example to others in our lives and in our society.

“Our society is now a ‘city on a hill,’ an example to humanity. That torch is slowly but surely being passed from America to us. To some extent it seems absurd to think that such a tiny society as ours can don such a huge mantle; but that is our belief. It is no more absurd than when the first Americans felt that the torch had been passed from wealthy and powerful Europe to their own poor and weak country. We must realize that we now are being offered one of the greatest challenges any society can be given: the challenge to lead the rest of humanity by example. I think we're ready.”

Érico's comments generated considerable applause, for they resonated with a basic attitude that had been taking shape on Mars over the last two annums. It was a myth that drove Martian settlement almost as much as exploration and gold did.

Will let the applause die down naturally. Hands shot up all over the patio. “I guess I don't have to remind everyone that Érico was our sixth speaker and the floor is now open. Our six speakers have given us a lot to talk about; I don't think a panel of experts could have done better. Let's remember we don't want to delay supper, which starts in a bit over ninety minutes.”

## Meridiani

late May 2049

Helmut checked the seals on his helmet one more time and glanced at his clothes trunk to make sure it was latched properly. The ranger was approaching the Sunwing D and the transfer tunnel docked to it. For the first time, Helmut was boarding an aircraft without the need to don a pressure suit. But since the technology was still experimental, they suited up anyway.

He looked out the porthole at the flying machine. It was the greatest achievement in Martian aircraft to date. The central pod was a cylinder 2.5 meters high, 2.5 meters wide, and six meters long, able to accommodate a cockpit, six seats, a tiny galley, and a head. Alternately, it could carry up to 1,200 kilograms of cargo. The pod was embedded in a quadriplane, four wings stacked on top of each other, 2.5 meters apart, 95 meters from tip to tip, and 3.8 meters wide; together they provided 1,600 square meters of lifting surface. Flaps that could be extended a meter provided an additional 300 square meters of lifting surface per wing for horizontal takeoffs and landings. Equipment pods twelve meters in from each wing tip contained methane and oxygen storage, electrical conversion equipment, fuel cells, small rocket motors to provide vertical takeoff and landing, and landing gear. Sixteen propellers studded the front of the second wing, providing forward thrust for the aircraft. The pod had a tail extending from it with vertical flaps for control and steering. And since the entire top wing and the leading and trailing sections of the others were covered by forty percent efficient solar cells, the aircraft had 4,000 kilowatt-hours of power per sol available to its propellers.

It was a big, awkward-looking vehicle with a total mass of five tonnes, but it flew at 300 kilometers per hour through the thin air and carried people reliably from place to place. That sol there were four passengers for the sixteen-hour night flight to Aurorae Outpost: Helmut Langlais, Anna Racan, Skip Carson, and Érico Lopes. The pilot was Guillaume van de Velde.

Once the ranger docked firmly to the transit tunnel, the driver pressurized it and they all crawled up the slanting structure, pulling their luggage along with them, and entered the aircraft via the rear hatch. Guillaume climbed into the pilot's seat with Érico seated right behind, since he was certified to fly a Sunwing D as well. They stowed their luggage in the crawlspace under their seats and strapped in while the tunnel was removed and Guillaume ran through the checkouts. "Okay folks, we're ready for takeoff," he announced over the radio. "To reiterate the basics, the flight will last sixteen hours and twenty minutes and will take us nearly a quarter of the way around the world; 5,000 kilometers. I'll let you know when you can take off your helmets and gloves, about fifteen minutes after takeoff. We're expecting rough weather over Meridiani about the middle of the night, which may make sleeping difficult. I recommend that we get ready for bed about 9 p.m. with lights out a bit after that, so plan on getting anything you need to eat and drink before then. We'll rise about 5 a.m. Dawes time, when the sun comes up. The rest of the flight will be in daylight over the eastern chaoslands of the Mariner system. Landing will be a bit before noon, Dawes time; just in time for supper in Yalta Biome. So check your seatbelts, because I anticipate clearance for takeoff right away. There's no one for us to wait for."

Helmut checked his straps and eyed the airbags mounted in the back of Érico's seat right in front of him, as well as other bags mounted in the floor and ceiling. In a crash the cabin would fill with airbags. He didn't want to experience that.

Guillaume engaged the engines and the aircraft leapt forward. The aircraft was equipped with small methane-oxygen rocket engines for vertical takeoff, but a horizontal takeoff required much less energy, so the vertical takeoff capacity was saved for emergencies or flights to places lacking landing strips. Helmut looked out the window as the Sunwing reached the beginning of the clay runway. They started down it and the plane gained speed surprisingly fast as all of the propellers were given full power. Helmut was pushed back in his seat, surprised by the sharp acceleration. The end of the wing out his window lifted immediately; in twenty seconds the landing gear under the right equipment pod was airborne as well as the wings bent upward from the growing lift; finally fifty seconds after beginning its run, the central pod went airborne as well. The plane began to climb sharply and the landing gear retracted. Then the flaps began to retract as well.

Dawes dropped behind them and was invisible almost immediately. Within a minute it was almost impossible to tell how high they were because there were no visible objects of known size, such as cars and houses. Helmut finally noted a dirt road below and used the spacing of its parallel tracks to get some sense of their height.

Fifteen minutes after takeoff, Guillaume activated the common frequency. "We have now climbed to our cruising altitude of 1,000 meters. We'll be staying here until we reach Meridiani, where we may have to climb over storm cells if any are still active. Meanwhile, you can take off your helmets and gloves, but we recommend you stow them

in the restraints overhead so you can reach them quickly in an emergency. We've got the usual range of snacks and sandwiches in the galley; I hope someone can get me a chicken salad sandwich."

Helmut chuckled at that comment as he unfastened his helmet, pulled off his gloves, and anchored them overhead. Érico was doing the same and nodded at the young man behind him, whom he didn't know. "How's the mining?" he asked.

"Oh, it's going well; we've dug a lot of gold." He paused. "Congratulations on your reelection, by the way." He was not one to miss a chance to strike up a conversation with someone important.

Érico smiled. "Thanks. I'm not sure congratulations are in order, though; it's a lot of work."

"I liked the way you ran the borough meeting at Dawes; it was skillful. It must be strange not running for office and having no idea whether you might be elected."

"You might have no idea even if you did run. But I wouldn't say I didn't 'run.' Listening to the Aurorae town meeting last Saturdaysol, one gets the impression about a dozen people wanted to be elected. Our campaigning is just more subtle and indirect. And less time consuming for everyone. I don't know how long it will last because anyone who spends more time is likely to get more votes."

"It's a vicious circle."

"The trick is keeping everyone focused on saying what Mars needs rather than on what they will do. That will keep the personalities out of the picture. But if you look at the website for the 'Future of Mars' Forum, you'll see that a dozen people went to a lot of trouble stating their views."

“And two of them were elected to the Borough Council. What do you think of the analysis by the *New York Times* that the vote reflects a move away from the Commission and its personnel?”

Érico thought a moment. “I think the author may be right. Silvio and Madhu are the only two people at Aurorae who devote a substantial amount of time to non-Commission tasks. Silvio isn’t paid by the Commission at all any more; he earns enough from the store and the bank to pay his own way. Madhu works only fifteen hours a week for the Commission and devotes the rest of her time to her art or to commissioned pieces. But on the other hand, Ruhullah came in fourth in the vote and he’s Vice Commander, so I wouldn’t make too much of an anti-Commission trend.”

Helmut nodded. “True enough. But often political commentators say something’s a trend when it involves a slim majority. Consider the mess in the U.S. right now.”

Érico shook his head. “It’s really quite remarkable, with the revolt of the conservative Christian right against the moderate Republican president. You’re right, it isn’t clear what the ‘trend’ is there, but there are a lot of opinions.”

“It’s being understood all wrong, too,” added Skip from the seat behind them. “This is the death knell of Republican conservatism. The Democrats have finally figured out how to revive old-fashioned liberalism by stressing moral values that resonate with the masses. People who think the right wing will win big in the fall primaries are deluding themselves.”

“We’ll see about that,” replied Helmut suspiciously. He wasn’t a right wing conservative, but he had been raised in Texas and understood the mindset.

“Do you want to bet?” asked Skip, with a twinkle in his eye.

“No, not me!” replied Helmut quickly, and Skip chuckled.

“I suppose I should be thinking about a new script about politics on Earth instead of life on Mars,” mused Skip. “Actually, I feel like I got a lesson in Martian politics over the weekend, Érico. I much prefer small scale, shoot-from the hip, frank give and take about the issues to the canned lies we get in the U.S. I suppose it can’t continue forever, though. Elliott’s a real opponent of partisan politics, isn’t he?”

Érico nodded. “It’s against his religion. Most people who ask him about it simply can’t understand his position. I think I do now; it’s a matter of faith and integrity.”

“Well, we can’t run a secular government on faith,” snorted Skip.

Érico shrugged. “It depends on whether the faith is culturally conditioned or not. As Will likes to say, we no longer poison politicians; we just assassinate their character. And he’s right, when I go to the cafeteria to eat I don’t have to worry someone will poison my food, even though any leader did have to worry about that three hundred years ago. I guess we do make progress.”

“But can Mars really establish a moral society?” asked Helmut. “That’s the myth, but the track record’s not so good, with two people shipped back to Earth for crimes.”

“Not only does this place have a myth, but people here believe it!” exclaimed Skip.

“We’re a work in progress,” replied Érico. “And we have a palpable feeling that we are making progress because the place keeps growing. That reminds us that we are a moral work in progress as well. I suppose we’ll get disillusioned some time, but it hasn’t happened yet. Maybe it’ll take a generation; Mars is still a new idea.”

“How big will we be in a generation?” asked Helmut.

Érico shrugged. “We could have thousands to tens of thousands; in a century we could have tens to hundreds of thousands. Our size is shaped by many factors out of our control; technological breakthroughs, the will of governments to support this place, etc.”

“The optimism about the future here is really palpable, though,” said Skip. “I feel very attracted to this place. Sometimes I’m tempted to stay beyond this Columbiad. I think Elliott’s uniquely suited to generate the optimism, also. He doesn’t criticize, but calls for a higher standard. And he’s very good with diversity, thank God.”

“I wish he’d run for Governor of Earth,” said Érico, half joking. “Will has his faults, of course. He can have high expectations and gets impatient, and sometimes he runs with an idea and doesn’t listen. There are times he’s too consultative when he should be decisive. But overall, he does a pretty good job.”

“Rather than talk politics, I prefer to serve,” said Anna, interrupting the men. “Coffee and tea are ready. Who will get out the sandwiches? Skip and Érico, the powerful men present can’t look at the younger man to serve them, because he has torn cartilage in his knee and shouldn’t be walking much.”

“I’ll help,” replied Skip, immediately unbuckling his belt and heading for the galley area.

In a few minutes a pleasant supper was ready. Érico and Helmut reversed their chairs to face backward so that they could see the other two. Guillaume came out of the cockpit and joined them; he now had little to do until the landing approach.

Helmut looked out his window between conversations at the vast expanse of rolling, meteor-pummeled, gullied, sand blasted, dust-mantled, lifeless ground below. Except for a wind-blown drift here and there, the land’s appearance seemed unchanged



for 3 billion years; it was a mind-numbing, unfathomable ancientness, nothing like the dynamic surface of planet Earth. The color was distinctively more reddish-orange-pink than terrestrial deserts. The invisible cold and thinness of the air also seemed palpable to Helmut.

The sun set and in five minutes nothing could be seen below as an utter blackness descended. Overhead, a billion stars appeared.

After another hour of discussions about gold, exploring Hellas Basin, and the new fumarole on the flank of Elysium Mons, it was time for bed. Guillaume planned to sleep in his pilot's seat, but the other four folded their seats down flat and inflated air mattresses to put over the seats or in the narrow aisle. Soon they were all asleep, with lights off. Helmut's last thoughts was of a plastic bubble of air hurtling through the blackness of the Martian atmosphere, bearing five human beings across space and time to their home. . . .

He had no idea how long he had slept when the lights suddenly came on, blazing brightly in the cabin. He began to open his eyes and was almost thrown from his bed by a patch of rough air.

"Wake up, everyone," said Guillaume. "I'm afraid Meridiani is much rougher than forecasted. The doppler radar shows a serious storm ahead with dust devils."

"At midnight?" said Érico, shocked.

"Affirmative; it happens. Everyone has to get in their seats and strap in."

They all scrambled to toss the mattress pads into the aisle and set up the seat backs. The sunwing began to be buffeted pretty sharply. "Can't go over it?" asked Érico.

"No way. The storm's too high." Érico nodded as he strapped himself in.

The plane suddenly heaved upward, struck by an updraft. Helmut, who was not yet strapped in, banged his head against the helmet dangling above him. “Strap in!” repeated Guillaume urgently. “Put on your helmets if you want to protect your heads!”

That wasn’t a bad idea. Helmut finally got into his seat and strapped in. He reached up and grabbed his helmet and snapped it onto his suit, even if he didn’t need it, and then grabbed his gloves. He connected his umbilical and activated its oxygen flow, so as not to drain his auxiliary tanks; they were small and held only an hour of oxygen each.

They hit another big updraft and the sunwing yawed to the right; Guillaume fought to stabilize it. Helmut couldn’t remember feeling such a rough ride anywhere, nor had he heard of one.

A powerful blast on the right side tipped the aircraft to the left. Then there was a popping noise and the sunwing suddenly veered to the right. Alarms went off in the cockpit. The nose tipped downward.

“Crash positions!” shouted Guillaume.

Érico unstrapped himself and jumped forward to grab Guillaume’s helmet. He lowered it over the pilot’s head and snapped it in place in spite of some bumps, then fell back into his seat.

Helmut looked around, startled and frightened. He glanced out the window, but all he saw was blackness. Then he saw Érico bend over, head between his heads; crash position. So he did the same.

They were going down fast, spinning as they fell. The floor leveled out as Guillaume gained some control using the landing rockets, then dipped downward again as the sunwing took its own course, then leveled out again. Helmut lifted his head quickly

to look forward and could see Guillaume's controls. He had the terrain image on; the gps showed where they were and the computer projected a crash spot onto the surface, which Guillaume was trying to move to smoother, dust-covered ground.

Helmut lowered himself back into crash position. What had happened? There was no time to find out. *Oh God, please help my mother deal with this.* . . he thought.

Then suddenly there was a boom! and the cabin filled completely with airbags. Helmut felt them smash into his head and neck from the ceiling, into his helmet from the front, into his legs from under the seat. His suit stiffened as the airbags displaced air and pushed up the cabin's air pressure; then it relaxed as the cabin pressure explosively escaped. He couldn't tell whether the banging and bouncing he felt was from the airbags or the crash. The pod hit the ground, broke free from the wings, bounced back into the air, came back down, then rolled over twice and came to a stop.

Held in place by the airbags, Helmut was buffeted around, but was mostly unhurt. Most of the emergency lights continued to glow; each had a battery backup. He lifted his head, but the airbag above him was still partially inflated and did not allow him to move much. The cabin had depressurized, but he couldn't tell what else had happened.

There was rustling over the common frequency, and a few groans. "Érico here; bruised and maybe with a broken arm."

"I'm here, too," said Helmut. "I think I'm alright."

"Skip here," added Carson, with a gasp.

"Anna here; I'm hurt, but I'm not sure how."

Érico began to bang against the airbags around him with his left hand, pushing them flat. Helmut began to do the same, enlarging the area around him. The cabin was still a mass of life-saving bags.

“Aurorae Control here.” The voice was Rostam Khan’s, over their common channel. “Any response from Guillaume? His suit is losing air fast and his blood oxygen’s falling.”

“I’m trying to get to him,” replied Érico. “He didn’t get his gloves on. Where are we, Rostam?”

A pause. “Latitude ten point three south, longitude three fifty three point seven. Don’t worry about that now, focus on Guillaume. We’re readying a shuttle.”

“Helmut, can you help?” asked Érico, exasperated.

“I’m trying.” Helmut unlatched his safety belt, but it got tangled in the bags and wouldn’t retract. He tried to stand but realized that his left foot was squashed against Érico’s seat; the seats had broken free from their restraints and compressed forward, and had been held apart by the airbags. “I’ve got a broken foot; left foot,” he reported.

“And I think I have a broken arm. Together we’re whole,” replied Érico grimly.

Helmut finally managed to work himself free and stood carefully. Érico moved over a bit so both of them could get at Guillaume, who was limp. “Anna, is the airlock or the bathroom still pressurized?” asked Érico.

“Both,” replied Rostam. “But I can’t start an automatic depressurization sequence; the control computer’s down.”

“I can open up the bathroom,” said Anna. She rose and limped back to the bathroom door and opened a mechanical valve to bleed off the air inside.

“I can’t find his left glove!” said Érico, frustrated. “The cockpit took the brunt of the impact and broke open. The air mostly escaped that way and I think it blew his glove out.”

“Let’s get him back to the bathroom, then,” said Helmut. He reached down and picked up Guillaume’s ungloved right hand. Then he grabbed the man’s arm with both hands and squeezed as hard as he could. “We need a tourniquet to keep in the air.”

“We don’t have one. Lift him.” Helmut nodded and pulled upward. Guillaume lifted out of the pilot’s seat.

Skip, who had been banged badly in the chest, leaned forward to help, but was dazed and couldn’t do much. Hobbling, Helmut raised Guillaume and pulled him past the tumbled seats. Anna opened the bathroom door and entered; Helmut passed the unconscious pilot to her. She pulled him inside and they closed and latched the door. “The bathroom’s pressurizing, thank God,” Anna said over the radio a moment later. “But it’s slow, the air tank must have a leak.”

“I think all three of the pod’s tanks are damaged,” added Rostam.

“Then we don’t have much oxygen,” said Érico. “Rostam, when can the shuttle blast off?”

“Minimum of two hours, and that’s assuming you have adequate landing conditions. Our meteorological data right now are pretty bad.”

“Our emergency tanks only have two hours of air,” said Helmut. “We don’t even know the life support packs are functional, and they have six hours.”

“But there’s oxygen in the two wing pods,” replied Érico.

“Your impact speed was 180 klicks,” added Rostam. “Guillaume did a brilliant piloting job. He slowed you a lot. I think the rockets used up all their oxygen and methane compensating for the broken wing; it appears the starboard wing broke off, including the equipment pod. But the port pod is sending us data, and the GPS shows it’s seventy meters from you.”

“We better go look,” said Érico to Helmut. “Can you hobble that far?”

Helmut nodded. “But do we have to go now? If we have enough air, shouldn’t we wait until dawn?”

“Negative,” replied Érico. “You and I could go into shock from our broken bones. Our conditions will get worse, not better. The rule is, you go get your oxygen immediately and get yourselves in a secure place for rescue.” He looked at Carson. “Skip, how are you doing? Can you sit here and wait for us?”

“Yes, I think so. My suit’s intact. I think I may have some broken ribs, though. It’s hard for me to breathe.”

“Take it easy, then. We’re going to go find an oxygen tank.” Érico looked at the cockpit in front of him, and the huge rip in the kevlar-nomex plastic combination that formed the pod’s skin. Dust sifted in through the tear. If they had been in a metal cabin it would have torn to shreds; they had been saved by the fact that they had crashed inside a giant, flexible airbag, which in turn had been filled by dozens of smaller airbags. “We can go out that way,” he said. “Let’s check out the life support packs.”

Helmut nodded. There was a closet between the galley and the bathroom in which five life support packs were stored; he hobbled back and opened the door. Everything inside had been packed carefully and was intact except for the pod’s own main oxygen

tank, which was located below the ceiling and had been damaged when the pod had rolled over. He pulled out three life support units, helped Skip put one on, then helped Érico, who had trouble working with one arm. He put on his own last, connecting the oxygen hose and electrical umbilical to his suit with some relief. He never liked to run on emergency oxygen bottles and backup batteries.

They moved forward and pushed through the torn fabric. Pitch blackness and icy, buffeting winds greeted them. Érico turned on his helmet light, so Helmut followed. The blackness was replaced by swirling reddish gray. Some small boulders were visible a dozen meters away, but they were hard to see in the dust. “Hey Rostam, we’ve got about fifteen meters visibility,” exclaimed Érico. “Can you download to us the GPS coordinates of the pod?”

“Sure, hold on. I’ll send them to all of you.” They waited. They could hear a conversation faintly on another public channel as Anna was removing Guillaume’s suit and trying to revive him.

Helmut issued oral commands to the suit’s computer, identifying himself and giving his password. A moment later he saw an email arrive from Rostam. He ordered the suit’s computer to run the gps navigational program and input the destination from Rostam’s email.

“Let’s go,” said Érico. Helmut wasn’t ready, but he nodded, then realized his companion probably wouldn’t see a nod. “Roger,” he replied, his voice quavering a bit. Érico set out into the whirlwind and Helmut followed, frightened by the thought.

The terrain was smoother than typical Martian landscape; Guillaume had managed to crash into a dust deposit. They headed for a rock half a meter across that lay

in the right direction, then paused and found another rock that was roughly in the right direction and headed for it. Érico dragged his feet to make a clear trail in the loose reg; even with the dust storm raging, the footprints would be visible for years. They could use them to get back if GPS failed.

Helmut followed behind Érico, trusting the older man's instincts, relieved he didn't have to make difficult decisions. In half a minute their helmet lights reflected off a the engine pod, a cylinder about two meters long and almost a meter in diameter, tipped on its side, propellers ripped off. Érico approached and looked closely. "I'll steady you so you can keep your weight off the bad foot, and you use your two hands to turn the pod over," he said. "With these injuries, it's too heavy for us to drag back to the cabin. We have to open the pod and pull out the oxygen tank."

"Acknowledged." Helmut was trying to mask his shaky voice with professional language. He got down on his knees and Érico kneeled near him to help. He rolled the pod over, which was heavy even in Martian gravity. Érico handed him an electric screwdriver and in spite of the shake in his hands, Helmut was able to open the dented engine pod. Inside was a light green oxygen tank and a red methane tank; the colors were standard. He struggled with the cutoff valve and the screws holding the tank in place while Érico encouraged him.

The tank came free suddenly; several of the support brackets had broken. He pulled it out, and even though it had a mass of only twenty kilograms, it felt heavy. He shook it and felt the liquid oxygen slosh inside. They hobbled back to the pod with it.

"Head for the airlock in back," said Érico. "Anna can't get Guillaume's suit back on."



“What did they say? I’ve been too busy.”

“He’s unconscious but alive.” Érico looked at the pod as it appeared in the swirling dust. “Skip, can you come out through the break in the cockpit and walk around to the airlock?”

There was a long pause.

“Skip?” Érico sounded worried.

“Yeah, I’m still here. I think so. Hold on.” The two men stopped at the front of the ruined aircraft and waited over a minute before Skip began to poke his way out through the hole. They came over and helped pull him out.

“Can all three of us fit in the airlock?” asked Helmut.

“We’ll hold our breath,” replied Érico wryly. “Once we open the connecting door to the bathroom we’ll have more room.”

“It’ll be really tight for all five of us,” said Helmut. “I can stay in the pod for a while if necessary.”

“No, let’s all get inside and connect this oxygen tank,” replied Érico. “One or more of us can go back out later. This tank has enough oxygen for all of us for two sols. We can probably get more if we need to.”

The three men helped each other walk to the rear of the aircraft, where they entered the airlock. With some struggling, they got inside, closed it, and pressurized it; then they opened the connecting door to the bathroom. They took off their helmets; five human beings were squeezed into a space of about two square meters.

“How is he?” Érico said to Anna.

She shook her head. “It’s not looking good. I had to revive him with mouth to mouth resuscitation. He’s breathing on his own right now, at least.”

“Rostam, when can the rescue shuttle launch?”

There was a pause. “The weather’s the big problem. We have to wait until daybreak there; the pilot needs the light if there’s an emergency. You’ve got a four or five hour wait.”

Érico looked at the others incredulously. “Okay, Rostam, we don’t want to risk any more lives. We’ve got air and access to a bathroom.”

“This is Will Elliott. I’ve been here in the control room for several minutes. We’re doing everything we can to get you guys back here safely. There’s a medical team in Paris scrambling right now to advise us on Guillaume’s condition; he may have brain damage. The storm is abating and if the local winds fall enough, we may be able to launch in three hours. We’ve turned the meteosat’s doppler radar on your position and we’ve got good, detailed data coming in, so we know the weather conditions with great precision. There are several dust devils on the storm front. The whole world is watching and praying for you all.”

“Thanks, Will,” said Érico. “Except for Guillaume, the rest of us don’t seem to have anything life threatening.”

“But let me check,” replied Anna. “That’s the next step, while we wait. Skip first; I think you’ve got broken ribs.”

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Helmut stood outside the smashed pod, looking east, shielding his eyes from the dawning sunlight, looking for the shuttle *Apollonaris*. The air was still filled with dust, though

enough had settled to give a kilometer of visibility. He glanced around at the desolate terrain. They had landed on a wierdly sculpted land where a fifty-meter thick dust deposit had been steadily eroded by millions of years of wind, leaving erosional remnants, gravel lag deposits, and exposed strata. It was quite unlike anything he had seen before, though it was common in the polar regions. At least he might live to see such terrain some day. He had already talked to his father twice to assure him he would be okay.

An orange flare appeared in the sky in front of him. The *Apollonaris* had activated its engines for the landing sequence. A hundred meters of flame extended from the tiny vehicle, forming a long orange arrow with a tiny silver head. It approached with incredible speed but slowed rapidly. It settled on the tail of flame about three hundred meters to the north.

“Deactivating engines and preparing to open cargo bay doors,” exclaimed Ernesto Gomes, the pilot. “We’re preparing to rescue the crew.”

“Beautiful landing, guys,” exclaimed Helmut, who was the only one outside, since the damage to his foot was not serious. “You’re a sight for sore eyes.”

“We’re glad to see you too, Helmut,” replied Ernesto. “Just stay put and we’ll be right over.”

It was a matter of two minutes before the cargo bay door opened, swinging downward to become a ramp to the ground. Inside the cargo bay was a ranger, and two spacesuited figures were busily unclamping the flight restraints so that it could be driven out. Finished, they jumped into the ranger and drove it down the ramp, then wheeled quickly to the wreck. Helmut was there at the rear airlock to help attach the passenger tunnel so they could transfer Guillaume quickly without suiting him up.

The three of them had trouble getting the passenger tunnel to latch properly; the fuselage was damaged. But they finally got a connection that was air tight enough for a few minutes. One by one, the five of them entered, then the two crew. The ranger's cab was crowded with seven people. They laid Guillaume across the space behind the seats; Helmut sat on the right side of the seat with Skip next to him, then Anna, then the driver; Érico stood in back with the other astronaut. After a quick drive back into the shuttle's cargo bay, the two spacesuited astronauts secured the ranger for launch. Helmut insisted he could help, and just before the cargo bay door began to close he saw the shuttle *Olympus* descend from the sky and land three hundred meters south of the crash with a team of engineers to collect the parts for analysis.

“Come on, we've got to get inside and strap in,” said Kurt Hollingworth, who was directing the rescue team. “Ernesto is scheduled to blast off for Aurorae in three minutes.”

“The analysis team needs to get our luggage,” asked Helmut.

“Don't worry, when they leave here nothing will be left. It'll be a sol or two, though.” Kurt finished securing the ranger's last anchor to its flight cradle, then pushed Helmut ahead of him to the airlock. They were inside and strapped in place with thirty seconds to go.

Helmut watched his right hand shake as the engines fired and pushed them deeply into their seats. The acceleration was barely one terrestrial gee; they didn't dare use more than that with Guillaume. It didn't bother him as much as the adrenaline-induced shaking. He wondered how long it would last.

The suborbital flight, one eighth of the way around Mars, lasted only twenty-five minutes, and ended with another three-minute burst of the engines. Then there was silence and they were at Aurorae. Kurt and his assistant jumped up. He put his hand on Helmut. “No, you stay put and don’t move. We’ve got plenty of help here, believe me. No one in the outpost has slept all last night.”

“Okay.” Helmut sat back in the seat and felt the clankings and bumpings as the ranger was unlocked. With a big rollercoaster bump it rolled down the ramp and raced across the ground to Joseph Hall, where it could drive inside.

Once inside Joseph’s garage, the doctors insisted that all of them come out of the ranger and climb onto stretchers, even though Érico and Helmut both protested. Greg saw Anna when she came out. “How are you?” he said to her, and his voice broke from emotion.

“Oh, alright; nothing a week of rest won’t take care of.” She smiled wanly.

“Nothing’s broken?”

“I don’t think so; I can’t examine myself so well. We’ll know after a few MRIs are taken.”

“Get on the stretcher and we’ll get you to the hospital right away.”

She nodded and laid down on the stretcher. Spontaneously, Greg bent over and kissed her on the head; then he picked up his end of the stretcher.

Will stood in the doorway, watching and encouraging them. “Just let me walk!” growled Érico. “I’m not that hurt.”

“You’ve earned a ride,” replied Will.

“No, I’ve earned some personal dignity!” he replied. Érico shook his head at the front stretcher bearer and headed for the door. Helmut did the same.

“Don’t worry, I’m not in that bad shape,” he added.

Will reached out with his hand as Érico reached the door. “You’ve both earned our admiration.”

They shook hands, then Erico stepped out, followed by Helmut. The crowd that had gathered to watch began to applaud. Then both began to walk to the hospital. Will watched them go, then headed back to mission control in Riviera Biome. “Did you see?” he asked Rostam when he got there. “Érico and Helmut both refused the stretchers. They wanted to walk.”

“Yes, I saw a bit of it.” He pointed to the screen, which had a jerky image of three astronauts working on a section of wing. “They found it.”

“Already?”

“We knew where it was; we had gps on the equipment pod. It fell to the ground a kilometer to the west of the crash.”

Will nodded. He pushed an icon on a nearby screen. “Julia, any useful evidence yet?”

The camera stopped moving; apparently it was mounted to Julia’s helmet. “Well, this is the wing section the craft lost. I can’t tell you why it broke off yet, but we’ll take it back to the lab for examination. It appears the carbon fiber reinforcing struts snapped clean, which suggests some pretty large stresses.”

“The wind shouldn’t be able to do that, even inside a dust devil,” commented Rostam.

“Something did it,” replied Will. “Any word from Langley?”

“Not yet. They’re still running a computer simulation of the accident.”

“Four parallel wings never struck me as a good idea,” said Will, shaking his head.

“Thanks, Julia. I’m here if there’s anything new.”

“Acknowledged. Any word from Silvio?”

“He says the baby’s fine, don’t worry,” replied Rostam. Julia had given birth just five months earlier, but her expertise required her assistance with the flight.

“Will, Aster-1’s in orbit around 2019XA,” reported Thierry Colmar. “The burn went fine. Houston ran it without any trouble.”

“Oh?” Will looked at his watch. “Good. Lord knows when we’ll have time to land her. Houston may have to do that for us as well.”

“A few sols in orbit will allow good data gathering,” replied Thierry. “And the folks here who do remote sensing aren’t needed for the crash investigation.”

“Thierry, *everyone*’s needed for the crash investigation. We don’t have enough human resources to handle an emergency any other way.”

## Landfall

early June 2049

Two entire sols passed while the emergency analysis team picked up the pieces scattered across Meridiani Terra and put them inside the cargo bay of the *Olympus*. Finally on the morning of the third sol the shuttle blasted off for a half-hour flight back to the Outpost. A sol later Julia DiPonte brought a preliminary report to Elliott.

“There’s no question that loss of half of the starboard side wing caused the crash,” said Julia. “But so far all we have is a preliminary explanation for the wing separation. The Commission’s supercomputer suggests the possibility that wind shear on the wings is especially serious on the rear bottom wing when there’s a severe down draft. Once the bottom wing popped off, the stresses pulled off the ends of the other three. The sunwing encountered such downdrafts when it flew through a very large dust devil feeding off differential air temperature on the border of weather front. It appears that Sunwing-Ds require additional structural reinforcement.”

“This is the hard way to find out,” commented Érico, his left arm in a cast. “Guillaume’s sinking into a coma in spite of everything the doctors can do.”

“And he has a pregnant wife due in three months,” added Will, shaking his head. “No one said the equipment’s perfect.”

“Why didn’t the landing rockets break our fall?” asked Érico.

“If the cabin had been oriented properly they could have,” replied Julia. “But with half the starboard wing gone, the lift on the leeward wing tended to tilt the plane too much.”



“Sometimes this is the only way to find out, no matter how much you spend,” added Ruhullah. “How’s Skip?”

“He’ll be out of the hospital in a few sols,” replied Will. “Helmut’s due to go back in for a knee operation. I think we should be sure to send him a big bouquet of flowers.”

“He did really well,” said Érico. “Cool under pressure, always helpful. He spent half the night outside because the bathroom and airlock were so claustrophobically small for the rest of us.”

“He done good,” agreed Will. “Julia, how long will the analysis of the parts take?”

“Two or three months.”

“And when would you recommend return to flight?”

“That’s premature, and the Commission makes the decision anyway. But I don’t know we’ll be able to return the Sunwing Cs and Ds to flight at all. The wing defects may be too serious.”

“But surely we can fly the Sunwing As?” asked Érico. “They’ve been flown here for over a decade and they’ve never crashed.”

“I agree,” said Julia. “I think we can argue for a return to passenger flight of the Sunwing As in a week or two.”

Will looked at the others. “They’re slow and small, but they’ll keep us going. We may want to propose retrofitting two Sunwing As with the new silane engines to make them faster. Anything else?”

“Will, what will this do to our standing with the public?” asked Ruhullah.

“Our standing goes up and down; this will make it go down. But Aster-1 has intrigued the public and is a chance to redeem ourselves. We need to let this story run its course in the media—which is another week or so if the Commission conducts a proper investigation—and then get on with the landing.”

“And it has to be successful,” added Rostam. “But don’t worry, it will be. The data coming back from orbit is really good. The delay allowed us to refine the sites we’ll visit and the hops necessary to get to them all. A new study just came back from JPL last week that proposes a new second destination, an asteroid that is more interesting and one that takes 400 meters per second less delta-v than 2020GF33.”

“Let’s set the landing for ten sols from now.” Will looked at the time. “I have an appointment at the hospital. Anything else?”

No one spoke. “Good. Thanks, everyone.”

The meeting broke up. Will headed out the door at a brisk pace to get to the hospital quickly. But Lisa Kok was waiting outside. “Will, can we talk?”

“If we can talk while I walk to the hospital.”

“Sure. Any idea when I’ll get back four workers? We can maintain food production and the bioarchives, but we can’t tackle any of the research agenda.”

“We’ve got forty workers diverted to the crash investigation. That means Alexandra can’t get the kevlar and nomex manufacturing started, which means we can’t make our own bubbles. The Hellas expedition is delayed, and rather seriously, since winter’s coming in the southern hemisphere. Gold production may dip because support personnel have been diverted. Everyone’s complaining to me, Lisa.”

“I know, but we’ve had some serious problems with the central Alaskan tundra biome; the ecosystem just won’t balance. The result is too many of some species and extinction of others. We’re going crazy maintaining all the little isolation containers needed to continue the species that can’t survive in the larger environment. We need people to keep all these little ecologies going; otherwise we have to re-import species and our reputation with bioarchive suffers. Even a month with reduced staff is a serious problem.”

“Simplify food production for two or three months. We can run off of reserves of some things, and you’ll have the staff to maintain your ecologies. Be creative, Lisa. You can set up several dozen cameras in the greenhouses and the Commission can hire biology graduate students in lower income countries to watch the containers over the web and fill out surveys about the changes. I don’t know why we aren’t using more low-paid terrestrial staff. We aren’t using robotics skillfully, either.”

“Well, robots can never do as much as is claimed.”

“I know. But I can’t give back your staff now; if we can’t figure out the cause of the accident we have no passenger air travel at all, and that’s a big problem. This accident is going to affect our momentum for over a year, but there’s nothing we can do about it.”

“A year!”

“The ripple effects will last that long. You’ll have your staff back before that; probably one person in three weeks, then another three weeks later. It’ll take a while.”

He stared at her and she stared back. Then she shrugged. “Oookay,” she replied, clearly frustrated. “I guess we can be thankful this wasn’t a biome accident.”

“Yes, then we’d have a lot of dead and injured, a broken ecosystem, and food shortages.” He stopped walking. “Keep me informed how it’s going. I know the Alaskan tundra ecosystem has to be a priority, even over some manufacturing capacity.”

“Thanks. I’ll send you short reports twice a week.” Lisa turned and headed back to her office. Will continued to the hospital, thinking about the massive personnel problems the crash was causing. Even after they recovered psychologically from the crash, their work schedule would never recover. They would soon have to ask whether the flight to Gradivus would be feasible.

He entered the hospital. Skip Carson’s room was the first one, but at the time it was full of visitors, so he went to Guillaume van de Velde’s room. Suzanne was sitting there, watching her husband. “He’s back on a ventilator?” asked Will, surprised.

She nodded. “The head injury is the real problem, but the lack of oxygen has exacerbated it, and the combination is unusual. They’re consulting with doctors all over Earth about it.”

Will sat next to her. “What’s the latest from the doctors?”

Suzanne shook her head and a tear appeared in one eye. “It isn’t looking good, Will. The coma should be clearing by now, but there’s more brain swelling and less functioning.”

“I’m sorry.” He put his right hand on her shoulder. “He’s in my prayers every morning, and the Sunsol interfaith service will be dedicated to his healing. Madhu’s planning it; Anna has said she’d speak. You’re in the prayers of a lot of people.”

She smiled slightly. "Thank you. I know there are a lot of positive thoughts coming our way. Meanwhile, the baby's kicking me almost constantly." She put a hand on her belly.

"It's a boy, right?"

"Yes. We had planned to name him Jacques, which is Guillaume's father's name and my grandfather's name. But now I'm not so sure." She sighed. "Everyone tells me that I'll get plenty of help if I have to raise him myself, and not to worry if Guillaume needs constant care; the Commission will take care of him. But Will, as comforting as those promises are, I still just want him well, so we can raise our son together." Her voice broke and she looked away.

"I know; who would want anything else? Thank God we are a pretty tight community; but it can't be as good as having your husband."

"I want Guillaume and the community." Suzanne blinked away a tear.

"I understand." Will sat there silently, hoping his presence was a help, because there was really nothing he could say.

A few minutes later, Anna Racan came in. "How is he?" she asked Suzanne.

"About the same. He's responding less than he did yestersol; I guess you know that."

"I heard."

Will looked at her. "I gather you're discharged?"

"Yes, I was here overnight for observations, but other than some nasty, purplish bruises and some soreness, I'm okay. It's a miracle we survived. We can thank Guillaume for it, too; he saved our lives."

“But clearly the cockpit area needs more airbags,” replied Suzanne.

“The impact is always the worst there,” replied Will. He rose. “Let me know if I can do anything.”

“Thanks, Will,” replied Suzanne.

Will stepped out and walked down the hallway to Helmut’s room. “So, you’re back in?”

“Yes, they’re doing an operation on my knee later this afternoon,” replied Helmut. “No reason to wait. The foot will tie me up for six weeks and the knee’s on the same side, so I’ll have two reasons to be on crutches.”

Will nodded. “You did a good job, Helmut. Érico was impressed.”

“Maybe he impresses easily; I don’t know.” He smiled. “The person who is replacing me temporarily apparently is working very hard and the company’s pleased. I think the guy likes the money, too, so maybe he’ll buy out my contract.”

“That’d be great. If they’re willing to release you, let me know, because we can get you on the Commission’s payroll easily. You’ll start at the bottom of the salary scale, of course.”

“Oh, I know that, but I’ve already earned plenty in the last nine months from Muller anyway, so I’m not worried about money. And I am a bit bored by mining. Could I become an exploration geologist?”

“We’d have to look at your experience and training, but you could get certified for that.”

“Good. I had a lot of experience on the moon in the Muller training, and as you know I was able to spend some time on Deimos. At Dawes I helped plan several

excavations that yielded a pretty good gold output. So I suspect certification could be done pretty quickly.”

“Sounds like six weeks in the field will do it. Get your leg healed first and then you can see what’s available.”

“Okay, thanks Commander.”

“Call me Will; everyone does.”

“Okay, Will. Thanks.”

Will saluted him and headed to Skip Carson’s room. He passed Anna in the hallway, talking to Greg quite affectionately. He couldn’t help but notice their close friendship had survived her assignment to Dawes, but now she seemed to be responding to his friendliness more strongly. Will smiled at both of them as he walked by.

Skip was now alone. He was sitting in a chair next to his bed. “You’re looking better,” Will said.

“Yes, I’m ready for discharge,” replied Skip. “Three ribs are broken and are taped up; I have to be careful not to laugh for a month or so. I can stay here as long as I want, but I think I’d prefer to be in my own place.”

“That makes sense. They’ll arrange for your meals to be brought to you if you can’t walk very easily.”

“I know; I’ve used that robotic service before. I may use it again because I feel a plot developing.”

“Really? For a movie?”

Skip nodded. “‘Survival Mars.’ The story of an imaginary first mission to Dusty Red where the single shuttle goes off course and crashes. One survivor, and a titanic struggle to stay alive.”

“It would be!”

“Well, I know the emotional feel of the experience now.” Skip shook his head. “I need to write to keep the nightmares away. The nightmares and the \$500 bottles of Stolichnaya! There’s a real story of heroism to tell, and I can create a composite character from the many personalities I’ve met. I might actually want to set up a greenhouse a kilometer or so from here and see what it would be like to keep it going on one’s own. I can lease it, of course.”

“I’m not sure what our policy would be; there are all sorts of safety rules that a lone astronaut would not face, but we would. We’ll need a proposal.”

Skip looked disappointed. “Of course, that makes sense. Okay, I’ll draft a proposal. That should be easy enough. If I can write a screenplay, we might be able to shoot most of the scenes here before I leave. It’d be Mars’s first commercial film.”

“That’s something the Commission would want to encourage, I’m sure.”

“It’d be good publicity for Mars. I’ll give you a proposal.”

“You heal first, okay? Make that your priority. The screenplay can wait.”

Skip shook his head. “No, it won’t wait. It can’t. That’s the way it is.”

Will shrugged. “Whatever. You’re a friend of this place, so you’re important. We want you well.”

Skip smiled. “Don’t worry about me, I’ll be fine.”

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The image of 2019XA was impressively large and getting larger by the minute. Aster-1's orbital speed around the rock was a leisurely ten kilometers per hour; the landing gear could actually survive a landing at that velocity if the legs were pointed in the right direction. Ten days of circling and gathering data was about to end.

Rostam fired the engines as scheduled; a one-second burst at a quarter gravity. That's all it took to stop the spacecraft dead in its tracks and set it on a course that took it down to the surface.

"Estimated landing time, three hours forty-three minutes," he reported.

"A long time to fall a thousand meters," added Will. He looked over the controls for a moment, then headed to his office on the garden level. He had time for email and videomail before coming back for a landing. The first message—a voicemail—wasn't good. "Will, this is Shinji. I thought I should let you know that Guillaume's failing fast. I wish there was something we could do. I'm afraid there'll be bad news very soon. Bye."

Will stared out the window at the rooftop gardens and the Aurorae escarpment beyond and contemplated the loss of a second astronaut. Was two out of 140 good, or bad? In exploration some losses were inevitable, but any losses at all were always tragic.

The news cast a pall over the afternoon. Sebastian Langlais videomailed from Shackleton Station at the lunar south pole, happy that his son was recovering so well from knee surgery and was being released from the contract with Muller Mining. Then he added the latest news about the interferometry telescope system being erected at five locations across the lunar surface; together they would allow the creation of a virtual mirror almost 3,000 kilometers in diameter and a thousand-fold improvement in

resolution, which meant that Earth-like planets could be resolved around other stars. It was an immensely exciting development.

There was also an email from David Alaoui—who was now in charge of Project Hermes, which aimed to set up a station at Mercury’s north pole by 2054—with a study detailing the value of placing water from Phobos into Mercury orbit to serve as fuel for the return trip to Earth. Will skimmed it and forwarded it to Érico and Yevgeny. Then he turned to the more mundane business of running three Martian outposts and serving as Vice Commissioner, a task that sent vast amounts of reading across his desk.

He returned to the control room for the last fifteen minutes of Aster-1’s descent. The asteroid was now immensely large and the landing spot easy to see to the smallest detail. They had chosen to land on top of what appeared to be a contact between two types of material making up the asteroid; an irregular line ran across the surface, with the material on the right noticeably darker and more chondritic than the grayer, less hydrated, stonier left side of the image. 2019XA was geologically more interesting than suspected.

The landing was routine; dull in its slow-motion speed, for the asteroid’s gravity was so weak the spacecraft came down very slowly. “Docking” might be a better way to describe the maneuver because there was the possibility it might bounce back into space.

When it was ten meters above the surface and falling at two meters per second, Rostam fired the engines to slow the descent to half a meter per second. The last ten meters therefore occurred very slowly. As the six landing legs touched down, Aster-1’s computer fired the reaction control system’s jets upward for seven seconds, pushing the spacecraft downward with about thirty kilograms of force. Powerful springs were

released to drive spikes downward into the rock, one by one, in the four landing pads, anchoring the vehicle to the ground beneath it. Then the reaction control system shut off.

“We have made a soft landing on 2019XA,” reported Rostam. “Engine shutdown sequence has begun. We are activating the cameras.”

Cheers erupted in the small control room. “Good, reliable old equipment from the first robotic cargo flights to Mars,” said Will. “Now recycled for automated exploration. Congratulations, everyone, you’ve worked hard for this.”

A few moments later the two cameras on board the robotic vehicle began to pan across the surface, revealing a rolling gray surface covered by rocks, boulders, and a layer of dust and sand. “No surprise here; it looks like Deimos,” noted Roger Anderson.

“As we expected,” agreed Will. “The good science isn’t done in the first hour anyway. We’ve got months of investigation of this place ahead of us.”

He felt his attaché, hanging from his belt, vibrate; a message was coming in. He chose to ignore it, but then changed his mind and lifted the attaché so he could see the screen. It was Shinji. He immediately hit “open.”

“Hi Will. Bad news; Guillaume just died.”

“I was afraid that was why you were calling, Shinji. I’ll let everyone here know, and we’ll release a statement to the press. We have one ready. Does Suzanne know?”

“She was there.”

“I’ll be down in a little while, then.”

## Proposals

early July 2049

Three sols later, Guillaume Van de Velde was given a grand funeral at the Outpost, followed by interment in Aurorae Cemetery, a small area at the base of Face Rock surrounded by Mars's only public park. The funeral helped assuage the shock of the crash and bring about a mental adjustment in the residents of the planet, who had taken their air transportation system for granted even if it was experimental. Asteroid 2019XA was renamed Vandevelde, which gave Guillaume a measure of immortality.

Exploration of the asteroid remained prominent in the media for about a month because midsummer on Earth was a slow news time and because the Mars Commission promoted the story very successfully. Aster-1's rover set out on a traverse of the big rock and completely circled the place in a few sols, thanks to the very short time delays during Vandevelde's flyby of Mars. It also traversed pole to pole, then brought back samples to Aster-1 for analysis by its automated rock lab. Within a month the asteroid's origins and major events in its development were tentatively outlined, and several mysteries were first postulated, then resolved. Aster-1's six-month stay promised to explore the worldlet as much as it needed, and added another datapoint to the exploration of the solar system.

It also lend additional impetus to plans to send humans to Gradivus in the fall, which triggered some difficult discussions. One Sunsol afternoon, Roger approached Will, who was sitting outside his flat near the swimming pool, watching the kids swim and reading a book at the same time.

“Hey Will, can you come over to Yalta for a few minutes? We’ve got a table full of geologists talking about Gradivus.”

“What about it?”

“Who will go; and the discussion’s rather hot.”

“Okay.” Will glanced back at the pool. Madhu and Ethel were busy talking on the other side. “Can you watch the kids?”

Ethel nodded and kept on talking to Madhu. So Will rose and headed for the patio, where a table full of geologists was lingering after brunch. Among them were Lal Shankaraman, Helmut Langlais, Yevgeny Lescov, Ruhullah Islami, Husni Hijazi, and Johnny Lind.

Will felt the tension around the table as he approached. Helmut had his left leg straight out and it was wrapped in heavy bandages. “Better than a cast?” he asked.

“Yes, it’s coming along,” Helmut replied.

“How’s the Prospector work?”

“Fascinating.”

Will grabbed a chair nearby and pulled it over. “Okay, Roger, what did you tell him?” asked Johnny, who was new, ambitious, and brash.

Roger was clearly irritated. “I didn’t prejudice him.”

“Here’s the problem,” exclaimed Johnny. “Just about everyone around this table wants to go to Gradivus. So does Andries Underwood and John Hunter; at least when I left the expedition last week I asked them and they both expressed interest. And Emily Scoville told me she’d even take a leave of absence from running Cassini to go.”

“And all of you can’t go,” said Will. “Of course, there will be expeditions to other asteroids; probably one every two years. The Commission makes the decision who will go, not us.”

“If we say who we think should go, that’s who they’ll pick most of the time,” replied Lal. “The existing system for making assignments seems to work fine.”

“That’s because you have seniority!” replied Johnny. “Those of us who don’t have seniority would like to have a chance to fly on this mission.”

Will looked at him. “How?”

“A lottery.”

Will scowled. “We’ve used seniority for some good reasons, Johnny. If anyone plans to stay here a period of time, they need to have a sense of progress, of promotion, of privileges earned. This place is growing, so it’s easy to get promoted because there are new personnel every columbiad.”

“But what about merit?” asked Johnny. “Seniority can be a very unrewarding system. It gives promotions based on time served, not contributions.”

“We’re assuming everyone here has roughly equal merit,” replied Roger. “We all ended up here after a rigorous selection process.”

“And we don’t promote just on merit,” added Will. “We do take contributions to the mission in mind.”

“How many people have applied for the mission?” asked Lal.

“Thirty-seven I think,” replied Will. “We have pilot, engineering, and geologist positions available, and a lot of people are qualified for them.”

“A lot of people are qualified for more than one,” added Lal. “Érico could apply for all three positions. Others of us—like me—have family responsibilities that prevent them from going, even if they are qualified.”

“Most of the applications are from people who have arrived in the last few columbiads,” agreed Will. “Those of us who arrived near the beginning haven’t applied because of kids or existing responsibilities. Ruhullah, how many people did we figure were qualified to go?”

Ruhullah paused to think a moment. “We decided to limit the geology pool to folks who have done work on Phobos or Deimos. That’s twenty-five, I think. We have fifteen certified shuttle pilots, some of whom are also certified as geologists. The two engineering positions are more complicated because no one has all the certificates we need, but there are about forty people qualified to apply, some of whom are also pilots and geologists. I think altogether that’s sixty of the hundred adults here.”

“We have a remarkably well trained workforce,” added Roger. “Half the astronauts qualified for an asteroid flight live on Mars.”

“That’s why we only need a three month lead time for training the crew,” noted Will. “Everyone’s already trained. We know the equipment and conditions pretty well.” He looked at Johnny. “I don’t know what to say. We have to make a decision later this week, and I don’t see an alternative to seniority.”

“How about this. You have two geologist positions. Fill one of them based on merit or on overlapping qualifications, such as pilot/geologist. Fill the other position by lottery.”

Will looked at Johnny, considering. Johnny looked back at Will almost fiercely.

“Do you feel lucky?” asked Will, with a smile.

“I’ve always been lucky. I’m here, aren’t I?”

Several chuckled. “Then we’re all lucky,” replied Will. “Tell you what. One position out of four can be filled by lottery. We need a geologist, a pilot, and an engineer. We’ll fill them based on a combination of seniority and certifications. But we also need a second person to do each of those jobs as a backup, and we’ll have four positions total. If we have a geologist and a pilot who is a geologist, we’ll need a backup engineer, and we’ll choose that person by lottery. Or if we have a pilot/engineer and an engineer/pilot, then we’ll have two geology positions and we’ll fill one by lottery. Fair enough?”

“No,” replied Johnny, but he was puckish, not upset. “But close enough, I guess.”

“The best we’ll get,” added Husni Hijazi, who had relatively little seniority.

Will looked at Roger, who didn’t seem pleased with the compromise. But after a moment’s hesitation, he nodded.

“Then it’s settled. We’ll automatically put everyone who has applied into the lottery and generate a random number for them.”

That ended the argument. People sat back in their chairs and relaxed. “Have you any insights into the Republican campaign against President Krieger, Will?” asked Yevgeny. “It sounds extreme.”

Will shrugged. “I really don’t want to comment on the Khaliestan scandal. In terms of Mars policy, Speaker of the House John White has said that if he ends up as President, he’d abolish the Mars Commission and put Mars operations back under a ‘reinvigorated NASA.’ But of course the next day he retracted that. Someone must have pointed out to him that was illegal.”



“He’s surprisingly green, politically, but he’ll learn,” added Roger. “I know a few folks associated with him, and they’re pretty experienced.”

“But White is crazy, don’t you think?” persisted Yevgeny. “He’d be the most conservative President in fifty years. He has called for the end of abortions and the income tax, he’d require movie theaters to check the minimum ages of children coming to see movies with certain ratings, he wants to pull out of a dozen international treaties. . . it’s unbelievable.”

Will nodded. “The American public has both liberal and conservative sides, and sometimes it swings between the two. Krieger’s the most liberal President in forty years, and he has proved the most incapable in forty years as well. So White’s popular.”

“The President’s foreign policy has been a disaster,” exclaimed Roger. “He’s coddled too many countries harboring terrorists.”

“There’s no evidence Khaliestan has been involved in terrorism,” exclaimed Husni quickly.

“Maybe,” replied Roger, skeptically.

“Let’s not argue about politics, or we’ll be swept into all sorts of fights that don’t pertain to Mars,” said Will. “If you all don’t mind, I want to get back to Riviera. I promised Marshall I’d swim with him, and he’s in the pool waiting.” He rose.

“Thanks, Will,” said Roger.

Will nodded and headed for Riviera. Helmut rose as well. “Can I walk with you?”

“Sure. You don’t need crutches any more?”

“No, the foot’s pretty much healed. The knee needs physical therapy, and walking’s good for it.” They both started walking across the biome to the airlock leading

to Riviera. “I wanted to ask you whether you thought I could get assigned to the Hellas expedition. Anna said I need another two weeks of physical therapy and I’d be done. There’s a flight to the expedition in two weeks for a crew change.”

“Well, first we have to settle your status here, and then Roger has to decide who goes there next. That’s his decision. I gather Muller’s very pleased with the work of John Stanwood, and after surviving a crash, everyone’s willing to let you work for anyone you want. You need to send a letter to Muller asking to be released from your contract. Once they say yes, you send a copy of it to me requesting to be hired as a field geologist, and attach your resume. I’ll take care of the paperwork. We won’t have any trouble. No one wants unemployed people on Mars.”

“Okay; that’s a plan. I’ll write Muller this sol. I think I have a pretty good chance of being assigned to Hellas. I’ve been driving Prospectors for the expedition every sol for the last three weeks; I know their objectives, the lay of the land they’ve already been exploring, and what they’re looking for.”

“You’re in a good position, Helmut. I’ve heard good things about your Prospector work. Have you considered applying for the Gradivus expedition?”

Helmut was surprised. “Ah. . . no.”

“Why not? You either have the minimum field work that’s required or the Hellas expedition will give it to you, you’ve been to Deimos, and with the lottery decision you’d have a shot at it.”

Helmut laughed. “Okay, I will! Thanks!”

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Will had been hesitant to go with Skip at first, but Carson had gently insisted. “You have to see the set,” he repeated, as they climbed into a ranger. “I think it’s perfect. Better than Tower Rock.”

“That wouldn’t have been a good choice aesthetically,” agreed Will, trying to avoid the subject. “But Thelma Crater is pretty interesting.”

“You can say that again!” agreed Carson. “You’ll see.” He drove the ranger into the airlock and in a few minutes they were outside. Carson quickly drove west on Mariner Trail eight kilometers, then turned off onto a narrow dirt track. In a few kilometers they came to a mesa-like rise. He headed straight into a gap in the cliffs and after a passage of a hundred meters, they entered a big, ruined bowl. “It’s incredible!” said Carson.

“I know; I’ve been here.”

“You have? I guess it’s used for training.”

“It’s got intrusive and extrusive basalt, ash layers, a small dune field, some eroded Hesperian dune deposits, lacustrine sandstone and evaporites, and some spectacular erosion features,” replied Will, listing its features.

“Those things make it perfect for *Survival: Mars* as well. The main character can see everything within walking distance of his habitation.” Skip turned the ranger northward and drove across a flat area of the crater until he approached a hundred-meter boulder lying on the floor. “And look at this thing! A fascinating terrain feature!” He pointed to a natural alcove in the rock. “I’m going to clean up that alcove and put the survival base there. The survivor will have a single greenhouse and two docking cubes. I’m postulating that everything else was destroyed in the crash. He can live in the

docking cubes and pile regolith around them for radiation shielding. The greenhouse will provide some food.”

“How much will he have?”

“Plenty, I suppose, but the greenery is for his sanity as much as his stomach.”

Will nodded. “Water?”

“I’m imagining this crash occurs at about 40 south and that Thelma Crater, here, has snow drifts in some of its exterior gullies. I may need to figure out a way to shoot some gullies on location, since there aren’t any nearby.”

There are some east of here in Aram Chaos; we could probably make an expedition there. Energy?”

“He’ll have solar panels.”

“No habitat?”

“I’m assuming it’s destroyed in the crash.”

Will nodded. “And how will you simulate the crash?”

“The Outpost has several tonnes of trash, mostly broken computers and appliances. If we scattered them across the ground they’ll look like a crash. I have volunteers who will help set up a very realistic looking crash site on some weekend.”

“And how will you set up the survival base? That’ll be a lot of work.”

“That’s what I hoped we could talk about. I need help. I know everyone here is pretty overworked, though, especially after the crash.”

“That has delayed everything. I don’t know of any spare personnel. I suppose people will volunteer their weekends if you pay them.”

“I think I’ll have to do that, and be prepared to pay a thousand bucks a sol, too. But what I really need is a regular assistant. I can’t drive a ranger here by myself; I have to have someone with me. That’s regulations. I can get some people to rearrange their schedules so they can work on the weekends and free up time for me during the week, but it’ll be crazy; I can go out Tuessol morning because one person’s available, then Thurssol all afternoon with someone else. It’ll take forever to set up this site that way.”

“And what you really need is someone who can handle a camera, since you have to video the whole thing.”

“Exactly.”

Will thought. “You know, there’s one person who might be able to help you. Brian Stark.”

“Stark?” Carson was surprised. “Why him?”

“He hasn’t found the nuclear science team here a good fit. He plans to return to Earth at the end of the columbiad. I think some of his time could be arranged.”

Carson frowned. “A sour person to work with, if there ever was one.”

“Maybe. But he’s of average height, so his spacesuit will look like almost any actor’s, and I doubt he’ll want any recognition as an actor. I think I could persuade him to help you.”

“Then I’ll take him. I need someone.”

“He’ll probably be available twenty-five hours a week.”

“That’s all I need, because I’m still writing the screen play and storyboarding the action with a colleague in California. The Commission has agreed to loan me the equipment in return for a percent of the profits, which I think is a good arrangement for

everyone, since I have lower up-front expenses now and I'd like to see the Commission make some money off the film."

"So would we."

"I'm sure. This is a big, expensive operation. I don't have a lot of time left, either. I'm leaving for Earth in eight months."

"Time flies, doesn't it? But that should be enough to film most of the outside scenes and other parts that can't be filmed easily in a sound stage."

"Exactly. And once the set here is ready, I can send people over to film scenes we need even if I'm on Earth. Before I leave I hope we'll have someone trained in set design; you all can make a lot of money serving as a remote location for science fiction films. That's why Stark surprises me. I really want one of the journalists or someone with good camera experience to be involved in this effort, because it's another export for Mars."

"Hum." Will considered that argument. "Let's start with Stark, but I can see whether someone else can be available as well. Miranda Bytown, for example, is a video journalist and has been a stringer here for the Canadian Broadcasting Service and the BBC. She'd be good."

"Yes, someone like that."

"Alright, I'll see what I can do. She just came off maternity leave a few months ago."

Carson drove them around the crater, pointing out spots where he planned to shoot various scenes. Then they headed back to the Outpost. When they got back to Joseph Hall, Will said, "Thanks for the tour. Even though I've been to Thelma a dozen

times, this trip made your plans much more concrete. I want a report every week or two, suitable for posting to the entire outpost. That'll increase your profile here."

"Good! So, this wasn't a waste of your time!"

"No, not at all." Will waved and headed to Yalta Biome.

Right inside the airlock to Yalta was DiPonte's Store. Will stuck his head in there first; Silvio's business sense was crucial. But he stopped first at the candy to grab a chocolate bar and scan it. There weren't any available, so he looked around for Silvio, who was in his office behind the store.

"Silvio, good sol."

"Sorry Will, we're out of chocolate."

"Really? We're a month short of conjunction, too."

"That's right; it'll be eighteen months before we get a new supply. Demand was much higher than anticipated. But the assistant cook, Deborah Howe, plans to make chocolate in the kitchen on Sunsols. Quality should be pretty good, it'll be fresh, but the costs will be pretty high."

"Wow. But I'll pay. I didn't stop to talk about chocolate, though. Skip's movie plans are really taking shape. He and I just drove out to Thelma Crater, which will be his set. He's figured out what will go where and where he'll shoot various scenes. But he needs human resources. I think I can get someone assigned to him half time; maybe two folks. But there are all sorts of legal and financial implications. He needs a legal structure for hiring people part time on their spare time, and I need a contract to supply him with Commission labor."

“Okay. The contract the Commission signed with him for use of the spare greenhouse specified it did not cover labor, so there needs to be another contract. I’ll draft a contract for him to discuss. And I’ll show him the contracts we have been using for hiring people individually.”

“Excellent.”

“But can we really spare people right now? We’re pretty far behind.”

“I know, but I know of two people who could use this assignment, and since they’re unhappy in their current jobs, they might work harder at it in less time if this opportunity were provided to them. So I can see psychological reasons why this will work. I also think this is a really good opportunity we shouldn’t miss. We have a famous movie producer and director on Mars; anything he does here will make money and bring us prestige.”

“Prestige yes, but don’t be so sure about the money. I read the contract the Commission signed to provide Skip with equipment; it only calls for a payment of royalties. But these movies often use screwy accounting and they can gross a billion dollars, but on paper they can lose money. I’d specify payments to the Commission of about three hundred bucks per hour for staffing.”

“Alright, do it. Show me the contracts first and let me know what Skip says about them, if anything.”

“Will do.”

Will nodded, waved, and headed for Hab 4 and the inflatable work areas around it, which now housed nuclear science. In a few minutes he was there. He spotted Brian Stark. “Brian, we need to talk.”



Stark was surprised. “Oh.”

“Let’s go into Rosa’s office.” Will led him to Rosa Stroger’s office. She was surprised to see both of them as well. Will closed the door behind the three of them. “I have a proposition,” he began. “Brian needs to get out of this office and do more research on Tower Mesa, and needs a reason to be going out. He also needs a reason not to be working here full time. I may have found it. Skip Carson needs part time assistance on his movie. If Brian helps him, that’ll give Brian a reason to be out of the office.”

Stark looked at him puzzled. “Help with a *movie*?”

“Yes. You’ll be a star, Brian.”

Stark laughed at the idea. “How much time?” asked Rosa.

“Twenty or twenty-five hours per week. Half time. Carson will pay the Commission for your time.”

Brian didn’t say anything, at first. “What sort of movie is this?”

“Carson plans to film the story of one astronaut who survives a crash; very introspective. He needs help with the set at Thelma Crater. You’ll have access to a ranger just about any time you need it and the excuse to go look for other possible settings for scenes. I don’t know how long; several months.”

“I could use a good excuse to be traveling around the area, but it’s a lot of time.”

“You’re only working here twenty-five hours a week as it is,” replied Rosa. “If no one knows how long you’re supposed to be working here and how long you’re working for Carson, you’d have a lot of freedom.”

Brian nodded. “That makes sense. This is not something I want, but I can see the advantages. When do I start?”

“Any time,” replied Will.

“You owe me, Will,” added Rosa.

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Greg walked into Shikoku South and looked around. “Don’t you know Suzanne’s flat number?” asked Anna.

“Now I’m not sure. Damn, I wish the buildings had directories.”

“No one has mail boxes or security buzzers,” replied Anna. She pulled her palm-sized attaché from her belt and opened it. In a few swift strokes she pulled up Aurorae Outpost’s housing directory. “Shikoku South 3C.”

“Thanks.” They started up the steep ramp to the third floor. They knocked on the door. A moment later Suzanne Van de Velde opened it.

“Father Greg, Anna, you are very kind to come visit. Please come in.”

“We feel bad we haven’t been here before,” replied Anna.

“But you’ve seen me at the Patio every sol,” replied Suzanne. “So a visit really isn’t necessary. It’s not like I’m an invalid or a shut-in.”

“No, but we wanted to be sure you were okay,” replied Greg. “It’s old-fashioned neighborliness.”

“I like old-fashioned neighborliness,” replied Suzanne. She led them into her living room. The flat the Van de Veldes had shared wasn’t very large. The tiny living room had two doors in the back wall, the one on the right leading to the bedroom and bathroom, the one on the left leading to a smaller room that had been an office; the decoration indicated it would be the nursery after the baby was born. In between the doors was a floor to ceiling window that opened onto a two by three meter light shaft; a

narrow patio off the master bedroom had some potted plants and a chair. The right rear wall of the living room had a kitchen sink with an ice chest underneath for keeping cold drinks. Next to it was a counter with a hotplate built into the back corner farthest from the sink; beneath was a microwave oven and storage. Greg noticed the kitchenette furniture with a bit of envy, as many people had not obtained the stove/counter unit yet. “Sit down,” Suzanne said, gesturing at the couch. “Let me pull out some Belgian cookies.”

“We brought you a gift,” said Anna, holding up a box of tea. “We know how much you like your varieties of tea.”

“Oh, you are so kind.” Suzanne took it and looked. “Thank you, I don’t have any Chinese green tea. I used up my last bag about six months ago, and Silvio doesn’t have any. Where did you get this?”

“We have our way,” replied Greg, who was known to stock up on little gifts every columbiad.

“Let me put on the water so we can try some,” said Suzanne. “Thanks to both of you, this is really unnecessary.” She filled her kettle and put it on the single burner, then pulled out the cookies. They each took one.

“Very nice,” said Anna, trying one.

“You can’t get them from Silvio,” replied Suzanne. “We buy them from the bakery ourselves every two years. They won’t last much longer; we should finish them. Guests give me an excuse to have one.” Suzanne took a cookie as well and sat with them.

“How’s the baby?” asked Anna.

“He’s coming along. I’ve got just two months more to wait, now. I would suggest we go eat out on the balcony, but I have to minimize my radiation exposure. He kicks a

lot and it's getting hard to walk. And with all the stress I'm taking a leave from work; I don't want to lose him now. So I sit here most of the time, do a bit of office work on my computer, read, watch some television, and wait."

"How are you feeling?" asked Greg.

She shrugged. "The shock has worn off, at least. Now it's the long-term, dull pain of loss. Everyone has been very kind; they're bending over backward to help. That's been amazing."

"We're a pretty close community when there's tragedy," agreed Greg. "We can be thankful for that. I hope the baby will help."

"He'll be all I have left of Guillaume." Suzanne sighed. "I guess that will help. But I also feel trapped because I can't leave Mars."

"That must be hard," said Anna. "And knowing you, I'm sure you wouldn't put the baby up for adoption."

"Oh, absolutely not! This boy will be our flesh and blood." And tears came to Suzanne's eyes. Anna reached over and put her arm on her shoulder. Suzanne nodded. "Thank you. I really don't want to leave that badly; I have good friends here, I like the work, and I'm committed to this place. Oh, let me check the water." She got up and set up three cups for tea, while regaining her composure. She returned with the steaming cups and they all added sugar and tried the tea.

"The perfect complement to the cookies," said Suzanne. "Thanks again." She sipped. "I'm thinking of establishing a Guillaume Van De Velde Scholarship in Astronautics."

"Really?" said Greg. "That sounds like a wonderful tribute."

“Well, the life insurance is enough to pay off this place completely, and I don’t need a huge amount to live. It’d be awarded to Belgian citizens who want to become spacecraft pilots, one scholarship per year, roughly equal to half a year’s tuition.”

“That’s very generous,” said Anna. “It was a scholarship like that that got me through university.”

“Really? I hope it’ll be of some help. I want to do something to memorialize Guillaume. He loved Mars.” She sipped her tea and thought. “What I’d really like to do may not be practical. I’d like to see all of us here to start an immigration scholarship to help pay the costs of transportation of new settlers here. It isn’t very practical yet because the costs are still too high, but if they come down to ten million dollars or so, and 300 of us each donated \$33,000, it would be feasible.”

“And some people would donate more,” said Greg. “Some of the folks who have been here several columbiads, for example. The price is coming down, especially with the new plan for inflatable interplanetary housing that can be reused on the surface. That would be a wonderful tribute to Guillaume, Suzanne. He was so dedicated to this world.”

“He wanted to see a civil society here, also. We need more folks who don’t work for the Commission; businessmen, professionals, artists. But there’s no economic basis for their immigration.”

“I wonder whether we could really do it, though. Surely it would take several years to accumulate enough money,” said Anna. “But on the other hand, maybe we could do it if terrestrial donations were accepted.”

“There are a lot of Mars fans on Earth,” agreed Suzanne. “I was thinking about that. I’ve been tempted to talk to the Mars Exploration Society about the idea.”

“Yes, do it,” agreed Greg. “The more I think about the idea, the more I think it’s fantastic. You should talk to Will at some point. He could get the Commission involved. They’d have good reasons to support it; good publicity.”

“I know.” She wasn’t enthusiastic about the suggestion. “I’ll talk to him about it. Perhaps the three of us could form a committee.”

“Silvio could set up a bank account for donations,” added Anna. “You could run the charity. He’d probably be willing to help, too. He wants more non-Commission folks here as well.”

“He wants teenager workers!” added Greg, laughing. “Or smarter robots.”

“Then let’s explore this,” said Suzanne. “If the two of you are willing to help me, I’m willing to give it a try.” She stood up and walked to her bedroom to grab her attaché.

The three of them brainstormed together for three quarters of an hour; what information was needed, who to ask, what the next steps would be. Suzanne became more energetic and enthusiastic as they went. The plan was important to her.

Anna and Greg had planned to stay only half an hour and soon had to worry about their schedule. They departed happy. “This is a great plan,” said Greg. “It’ll be good for Mars.”

“My concern is that most people on Earth would not see this as a charity,” pointed out Anna. “We’re talking about accumulating tens of millions of bucks to fly one person here. I think Suzanne’s other idea—a scholarship—shouldn’t be dropped. I think we should specify that some percentage of the charity should go to scholarships as well.”

“That’s a good point. We should talk to her about that.” He looked at her. “Are you glad I invited you?”

She smiled. “We keep finding ourselves working together, Greg. I can’t get away from you.”

“I’m not complaining.” He smiled, a smile that conveyed affection as well as humor.

## Hellas

early Aug. through Sept. 2049

The sunwing approached the landing strip gradually and smoothly, the landing gears along its huge wings extended and ready. Touchdown raised a brief cloud of dust in the relatively thick air of the central Hellas basin. The machine taxied quickly to a halt, where it awaited the arrival of a ranger.

Helmut looked at his gloved hands and noted he was gripping his seat so tightly his muscles were cramped. He consciously forced them to relax. Then he briefly flashed back to the crash he had survived two and a half months earlier and his hands automatically tightened their grip on the seat again. He was always amazed he could trigger such a visible automatic reaction from his body. The crash was not going to fade very quickly.

“Well, Helmut, we made it,” said Vanessa Smith. She rose stiffly from her seat; it had been a tiring twenty-hour flight. She headed for the rear of the vehicle, grabbed her suitcase, and entered the airlock. He followed right behind her. They were the only two on board the remotely piloted vehicle.

Lal Shankaraman and Jacques Deschanel drove up in a ranger and stepped out with their gear about the same time Helmut and Vanessa exited the sunwing. They saluted the two arrivals. “Welcome to Hellas,” Lal said. “How was the flight?”

“Pretty good,” replied Vanessa. “We alternated between emails, watching movies, and pedaling on the stationary bike.”



“Sounds about right,” replied Lal. “Congratulations, Helmut. You’re a courageous man to get on a sunwing again.”

“Thanks. It was alright. Have a safe trip home.”

“Thanks. Radha can’t wait for me to get home. Aditi has been a handful lately.”

“And I’m looking forward to relaxing in my flat,” added Jacques. “Good luck; you’ll have some pretty interesting geology in the next month.”

The two men climbed into sunwing and zipped the airlock shut behind them. Meanwhile, Helmut and Vanessa got into the ranger, stowed their stuff, and waited in case they were needed.

A minute later, as the sun approached the horizon, the sunwing turned and began to taxi back up the landing strip. Since the accident, the rocket assisted vertical takeoff and landing system had been used as little as possible, to preserve its fuel for emergencies. The aircraft began to rise into the sky, then turned northwestward toward Aurorae.

“There they go,” said Vanessa. “Let’s get to the expedition.”

Helmut nodded; he heard anticipation in her voice. He put the ranger in drive and steered them over the rolling, dusty plain to the cluster of vehicles nearby.

They went up a low rise and had a perfect view of the station ahead. It consisted of a Mobilhab and a Conestoga, which were docked together for the night. The Mobilhab was the largest and most advanced vehicle on Mars, eight meters long, 2.4 meters wide, and two stories high. With two four-bunk sleeping compartments, two bathrooms, a cooking and dining area, and a science lab, it was able to accommodate up to eight personnel, a dozen in an emergency. The Conestoga, the trusted workhorse of Mars

exploration, was a single-story, eight-wheeled vehicle 5.5 meters long and 2.4 meters wide and high. Massive bulldozer blades mounted in front could clear a track up to four meters wide; a light crane was attached to its roof. The Conestoga normally accommodated three, but could hold six in an emergency. Both vehicles had rooftop solar panels that could power their life support systems. The Conestoga cleared routes that the Mobilhab followed in.

Docked to the rear of the Mobilhab was a ranger, a vehicle about the size of a humvee. Three hundred meters to the north, behind a boulder, was parked the expedition's 150-kilowatt reactor. The robotic truck that pulled it had front-mounted water, oxygen, and methane tanks and a sabatier reactor that combined water with atmospheric carbon dioxide to make oxygen and methane. The other vehicles periodically docked to the truck to replenish their methane and oxygen supplies and offload water. When the expedition was on the move, the reactor rolled along the cleared route slowly under the control of its own computer.

Closer to the Mobilhab was a Prospector carrier, a vehicle that could transport up to six of the two-hundred kilogram telerobotically operated vehicles. Helmut was pleased to spot the carrier; since arriving at Aurorae Outpost two months earlier he had spent most of his time driving Prospectors for the expedition.

In a few minutes Helmut had successfully docked to the Mobilhab. They opened the ranger's rear door.

"Welcome, welcome!" exclaimed John Hunter, the expedition's commander, from just inside the door. Helmut entered and shook his hand.

"Thanks, I'm excited to be here."

“We’re glad you’re here,” John replied. He looked beyond Helmut to Vanessa.  
“Welcome to Hellas.”

“Thanks, John.” She smiled; they kissed.

The others in the Mobilhab greeted the new arrivals. Tang Enlai, their chief eobiologist, was there; he had been on the expedition for months and was legendary for his long stays in the field. Andries Underwood, the expedition’s assistant commander, shook hands with both of them. The other three personnel present were Tina Hvitmer, a geologist who had just arrived a week earlier and was scheduled to rotate home in a month to help take care of her six month old; Kimberly Irion, an “eobiochemist” or expert on the biochemistry of the rise of life; and Daichi Furukawa, an engineer and mechanic. Helmut greeted everyone and was again aware of being the youngest person present. He usually was.

Daichi brought out the supper and Helmut helped Kim set the dining table in the Mobilhab’s lower front room, which had its four bunks folded against the walls. “So, are you ready to set out?” John asked Helmut as they sat.

“Sure; when are we on our way?”

“Tomorrow. How much bulldozing have you done?”

“About fifty kilometers.”

“That’s enough. I’ll put you in the rotation to bulldoze with ranger 2, then the Conestoga a week later. I know you run Prospectors.”

“And I’ve done geology field work in Dawes.”

“I know. You’ll be in the field rotation as well.”

“How long before we get to the ice chimneys?”

“Three weeks.”

“That will be very exciting,” exclaimed Vanessa.

“I’ve driven the Prospector waiting there for us; they’re spectacular.”

“Have you?” John looked around. “I think all of us have, or we’ve replayed the virtual reality of the exploration. You’re not the one who almost brought chimney three crashing down on the Prospector, are you?”

“No,” replied Helmut. “That was Greg. But I was there; it wasn’t bad judgment, we just didn’t have all the information we needed. It’s a good thing he explored that chimney, though; now we know the ice is discolored.”

“Possible biotic discoloration,” added Enlai. “It’s too bad we don’t dare drive in closer and grab a sample for air transport back to the Outpost.”

“Even if that were possible, we’d want to visit the chimneys anyway,” said John. “It’ll be fascinating. But first we have some pretty interesting terrain in Hellas to cross.”

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Will Elliott looked up from his desk when he heard the door to his outer office open. He wasn’t expecting anyone. He glanced out his window at the gardens and the escarpment beyond; no one was waiting outside his office. Then Brian Stark knocked on the doorway of the inner office. “Is this a good time?” He looked upset.

“Yeah, sure, Brian. How can I help you?”

Stark walked across the room and stood leaning on the other side of the desk. “Is it true you’ve authorized setup of six new solar power units?”

“More than six, Brian. We have six smashed wings from the crashed sunwing; they have 720 square meters of solar panels. Don’t you think we’d be crazy not to recycle them?”

“Commander, you’re dejustifying the nuclear development program.”

“Colonel, we do not use the ridiculous word ‘dejustify’ here on Mars!” Will stared fiercely right back at Stark. “Dejustify is just a fancy word for saying don’t do something intelligent and useful because we want something else later. Well, Colonel, you have my full support for a reactor and a uranium enrichment program, but we won’t have a functioning reactor for three and a half to four years; and that depends on who’s the next President—”

“No, Commander, don’t use that as an excuse. President Krieger is behind this, and so is John White.”

“It’s irrelevant anyway; we need the power now, not years from now—”

“If you undermine the need now, you won’t have the reactor later!”

“Colonel, the Outpost needs an extra five hundred kilowatts right now; can you give that to us? Cassini would like to have five hundred more. Dawes would like three hundred more. All three mining companies have said that they could be more efficient if they had more portable power, so they can prospect more. Can you provide that *now*? Because that’s the request. Yes, we can wait. Yes, we can forsake the expansion and the higher cash flow. But I have a better idea: make solar power units from the wings and fight like hell for the nuclear power project. How does that sound to you?”

“Politically naïve.”

“Fine.” Will shrugged.

Stark shook his head. “Don’t play with us, Commander. If Krieger resigns and White becomes President, he can make a lot of trouble for you and for Mars, and I’m well connected with his staff. They have plans for this place, and I wouldn’t get in the way.”

“You’re beginning to make me think that the rumors are true, Brian.” In recent weeks the *New York Times* had published a story saying the United States military was seeking an off-earth source of uranium and plutonium for their space defense system, and Will wanted to ask Stark about it.

“I better not hear you were one of the leaks behind that story!” Stark replied.

“Not me; I haven’t leaked anything. Do you deny that you’re part of the group proposing the use of Martian uranium in orbital weapons systems?”

“Commander, can you at least postpone the solar power units?” Stark asked after a split second of hesitation. His tone was conciliatory.

Will thought about the request. “No. We need the electricity now. Brian, I repeat, you have my support, but not at the expense of engineering artificial power shortages. That would be irresponsible. I should add that if it comes out that your group has proposed using Martian uranium for military purposes, this planet will see a sort of revolt, the Mars Commission will pull the plug on the plan, and my support will evaporate.”

“Alright, have it your way.” Stark turned and walked out, closing the door behind him. Will watched him go. The Colonel had not revealed anything, but in failing to deny he had essentially admitted he was connected to the plan.

Will rose from his desk, disturbed, and began to pace. Mars, a world named for the god of war, had to remain a world of peace. That was the determination of everyone residing there. Stark's arrogance bothered him.

Tired of pacing, he walked around the Outpost to calm down. He started by heading north to Huron. The biome was mostly set up and the buildings inside were almost finished. As he entered he felt Huron's chilly spring air against his skin. He looked up; there were still tall, black skirts covering the lower parts of the dome to reduce the total number of hours of daylight entering the biome, simulating an early March climate. There were also plastic screens over the inner dome to reduce the sunlight shining inside. A pile of snow three meters deep covered part of the northern wall, exuding cold air throughout the yard.

But the agricultural areas overhead were flourishing, thanks to warmer air closer to the top of the dome. The yard was covered with spring grass and had pairs of new apple, pear, plum and peach trees. In the western end of the yard, Lisa was overseeing the planting of two sugar maples. Will walked over to watch.

"Those trees get really big," he observed.

She nodded. "Imagine, if this biome still stands a century from now—and I suppose it will—the two trees will touch the dome and their roots will fill the box around them! And they'll be giving us maple syrup every spring."

"We need some oaks."

"We have some seedlings growing, but they'll be planted in another year in the 'Shenandoah' bioarchive biome. Ultimately it'll be a patch of climax forest."

Will looked around. “The additional ten meters of diameter is really noticeable in here. It feels so much more spacious.”

“It is. The additional height is what I appreciate; the additional volume of air makes the environmental control systems easier.”

“I gather we have plenty of people wanting to move in.”

“Correct, demand for housing here has been as strong as in the other biomes. The winter every 334 sols won’t be that severe, nor will it be as long as on Earth. The walkways won’t be icy. Six weeks of cold and snow, followed by spring flowers.”

“And Marshall is looking forward to the winter sports, especially the sledding. He doesn’t want to wait for the first full winter!”

Lisa laughed. “Well, we can’t advance winter, can we. It has to occur when the sun is as far from the equator as possible and the shadowing in here is at maximum: the solstices for each hemisphere. It’ll come along in good time.”

“I know.” Will looked around. “How’s everything going?”

“Pretty well. We’ll have the yard landscaped by next week. We have a few stray insects that got in here from the Alaskan tundra biome; they probably came in on someone’s clothes. Migration between biomes will be a constant headache and a problem for our agriculture, though the new genetically modified crops arriving on Columbus 8 will help a lot.”

“We’ll have to increase the isolation.”

“We can’t if people are going to use the biomes. Meanwhile, our two bioarchives are stabilizing in the bubbles and Alexandra says the kevlar manufacturing will be far



enough along to allow fabrication of domes by the end of the year. So we're looking forward to starting construction on Shenandoah in a few months."

"That will be exciting." Will looked around. "Thanks, you've made my sol. Or maybe I should say the bracing fresh air has."

"You look a bit run down."

"I was, but the batteries are recharged now. Have a good sol, Lisa."

Will headed out of the biome, inspired by the future he could see in the new space. Lisa was right; in a matter of months they'd be able to enclose large spaces themselves. It was very encouraging.

It also occurred to him that he needed to talk to Rosa Stroger. She was the other person on Mars who knew Stark's mission, and she was a former naval officer. Possibly she'd be able to extract more information from him related to the *New York Times* article.

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Clarke Dome had been nicely decorated for Catholic mass, but as he walked around taking down the artwork and banners, Greg had a nagging feeling of discomfort. He nodded goodbye to Eammon and Irina and their brood as they left the area.

"See you at lunch, Father," said Eammon, who always invited Greg and Anna to sit with them at Sunsol dinner on the patio.

"Thanks, Eammon, but I'm skipping lunch this time," Greg replied. "I need some prayer time."

"Okay, Father; see you at supper, then."

Greg nodded and watched the O'Hare family leave. Patrick, the oldest, would be five in December; the twins were three and a half; then the toddler, Mary, was thirteen

months and the baby, Theresa, was almost two months. The O'Hares were by far the largest family on Mars.

He put the two banners on top of his pile. "Can you help me with the trees?" he asked Anna.

"Sure." She placed another banner on the pile as well and turned to an orange tree two meters tall in a large wheeled pot. They had moved it against the other trees to make room in Clarke for the mass; they hadn't had to move very many trees that Sunsol morning, so it was pretty easy to push them back to their spots. They moved a banana and a grapefruit as well, then slightly adjusted the position of a pomegranate.

"You're going to pray rather than eat?" she said.

Greg sighed. "Oh, I don't know."

"It's too bad more people didn't come this sol."

"The O'Hares are half the crowd most of the time. More Catholics go to the interfaith service than to mass."

"But the ones who never come to mass go to the interfaith service irregularly anyway. I had hoped more would come to pray for the Pope."

"We even had some Protestants come for that! I was impressed." Greg thought about the Pope, who had started his third month in a coma. His illness was causing a leadership vacuum and immense controversy over what to do about it.

"Is that what's bothering you?"

"No. Come on, let's walk."

Anna nodded. Greg glanced around Clarke again to make sure they hadn't forgotten anything. Then he placed the banners and the communion silver in a big box, closed it, and put it in its place against one of the walls near the airlock to Yalta Biome.

"Done. Let's go sit up on the roof."

"Okay," said Anna. They walked into Yalta and across the patio, crowded with people enjoying their midday meal, then crossed the yard to Riviera. They climbed the stairs to the roof of Riviera south, where they were alone amidst squares of corn, wheat, and vegetables. On the western end of the garden was a small area two meters square with a few chairs where one could look down on Riviera's yard or out at the escarpment twenty kilometers to the north. Greg plopped down into a chair there and unbuttoned the top button of his shirt; it was a warm, humid afternoon near the top of the dome.

Anna sat and said nothing, waiting for him to open up. "It seems that my life is undergoing a change of direction," he finally said. "And to some extent I don't like it. I want to get into serving others more and stop serving as priest."

"Really? You do it so well, Greg; you're a natural. And how better to serve others, than as a priest?"

"Or as a nun?" he replied. "No, I came here to serve as a nurse or as anything else Mars needed. I ended up serving as a priest because I still could—I had never renounced my vows, just stopped functioning as a priest—and because of two people. Will Elliott encouraged it because he loves religion, and Eammon O'Hare encouraged it because he needed a priest for him to be Catholic."

"That's true. Without you there'd be no mass, no sacrament of marriage, and no baptism of kids."

Greg said nothing at first. “I know, and I feel bad about that. The mass can continue without me; I could consecrate a great quantity of bread and wine before leaving the priesthood permanently, and after that it could be imported from Earth and distributed by deacons. Half the Catholic churches in the United States have to do that now because of the priest shortage.”

“Yes, unless the big, mostly empty churches have been closed and consolidated together into fewer parishes. That’s true across Europe as well, except where we have lots of Catholic immigrants from Africa.”

“I’m not needed to baptize, either, because any Catholic man can do that.”

“True, but it doesn’t feel the same, especially to someone like Eammon. But why can’t you continue baptizing and marrying?”

“Because it feels wrong, Anna. I stopped serving as a priest on the Earth eleven years ago and only started up again here because of pressure from others. Besides, the church can manage without a priest. Catholics will have their marriages recognized by the church if a priest is unavailable. If Roger Anderson wants to become a Baptist lay preacher, I’ll be glad to lay my hands on him and convey that continuity to him.”

“But people will do civil ceremonies, or even Bahá’í ceremonies.”

Greg shrugged. “Let them, Anna, if that’s what they want.”

“Does this have anything to do with me?”

He looked at her. “Yes and no. I’ve been getting tired of serving as a priest for a very long time. But I love you, Anna, and I want to marry you. That has accelerated my thinking some. But I’m not saying all of this to put you under pressure.”

She laughed. “Thank you! I feel pressure anyway. I don’t want to be the cause of your abandonment of the priesthood!”

“You have to make your decision separately.”

“Decide about what? You haven’t asked me to marry you.”

Greg stopped and looked at her. “Well, I can’t say I’m much of a romantic. But as has been obvious for months now, I love you. You’re a truly remarkable woman, Anna, and you share my desire to serve others.”

“We have common values because you’re an ex-priest and I’m an ex-nun! That’s no reason to get married. But I have to admit, I love you, too, Greg. And I think we could be pretty good partners and helpmeets to each other. We even seem reasonably compatible.”

“We get along well, though perhaps if we live together we’d fight, I don’t know.”

“No, neither of us are the fighting type, though your bad jokes will get on my nerves pretty fast.” She smiled. “Have you thought what Eammon and the other active Catholics will say?”

“Eammon won’t be happy at all. I like Eammon, but he lives in a religious world of his own. I don’t think even Irina shares it. The other Catholics here are all liberals. I can’t continue to serve as a priest just because he needs me to make his world function.”

“I agree with you there.” She looked out at the escarpment. “The Church is really suffering terribly right now, with the huge numbers of inactive Catholics, the priesthood shortage reaching crisis levels, the hierarchy getting more conservative and out of touch, and now the Pope in a coma. . . . But Greg, I love the church, and I want to see it spread and flourish here on Mars.”

“I do, too, but it’ll have to spread without me as a traditional priest. Maybe the church would be willing to let me serve as priest and be married; they’ve done that in other places as an emergency measure.”

“There were married priests in Czechoslovakia under the Communists.”

“Exactly. I gave up being a priest eleven years ago because I didn’t want that type of life any more. I came here and found myself falling into the old pattern. I’ll support and strengthen the church here, but not as a traditional priest.”

“And we see eye to eye there. I have been focused on Christian service for years.”

“So; will you marry me, Anna?”

She was startled he asked her. “I think I need to consider the question a while. Are you sure you want to ask?”

“Yes, very sure.”

She paused. “Yes, I will, Greg. But I don’t know who here can marry us!”

“We’ll have to ask!” He leaned over and kissed her on the cheek. She looked at him and smiled, and it was obvious she was thrilled. He reached out and took her hand. “I guess we have a few things to learn about relationships. I haven’t dated a woman for twenty-two years!”

“I’m not much better; I entered the convent when I was eighteen. Slowly, Greg. Let’s do this right.”

“I agree.”

## Ice Chimney

Sept. 2049

Rose Stroger knocked on Will's window, startling him. He looked up and saw her outside. She beckoned him to come out.

Will hesitated. It was a strange request. Then he rose from his desk and strode outside onto the roof of Riviera south. "What is it?"

"I want to talk to you a few minutes, beyond the reach of microphones."

Will nodded. Every room in the Outpost was intentionally bugged so that they could be checked for injured people quickly in an emergency. He pointed to the corn field nearby. Rosa walked over and opened a gate, then the two of them pushed into the dense field of corn stalks.

"This is amazing!" she said as soon as they were swallowed by the corn.

"Let's hope no one sees us here; they'll wonder what we're doing! You'd never know you were on Mars. It's like being under a green blanket. Is this about Stark?"

She nodded. "I've tried talking to him about his naval experience; we're both graduates of the same nuclear power program and we know the same people. But I never got anything from him. Then it occurred to me that I could email a few old friends and ask about him on the excuse that I'm dissatisfied with his work. I finally hit on a friend who gave me some information about his assignments and with whom he worked. My friend said he had worked for the Firebox Team right before coming here; that's the team studying the use of nuclear reactors in earth orbit to power antimissile lasers."

“Bullseye. That’s the group who was studying off-earth sources of uranium for reactors.”

Rosa nodded. “So, he’s connected with them. He may not know about the plans; they may have been developed since he left Earth. Will, should we say something about this? Most of the residents here will not tolerate the production of Martian uranium for the United States military.”

“I know. Say nothing for now. I’ll send a confidential memo to Morgan about it. We’re lucky that he’s a Republican and will have contacts with that particular group of people. But he’ll be on our side on this issue. I could see him issuing a statement in response to a reporter’s question—a planted question—that Martian uranium, if it were ever an export item, would only be available for peaceful uses. I’ll work on him.”

“Okay. This isn’t the time for such a statement; no one knows about the idea of producing uranium for export. But if the plan is made public the *New York Times* article will be remembered.”

“Exactly. But I’d rather see a statement come out now, when the matter isn’t controversial.” Will smiled. “Did you know that Carson’s actually happy having Stark work with him?”

“Really? The radical liberal and the right-winger? Stark seems happy. I’m surprised.”

“I talked to Skip this morning. He said Stark’s personality is perfect for the character he has been writing for the movie, and it turns out Stark’s a half-decent actor! Who would have thought?” Will laughed.



Rosa laughed, too. “It gives Stark a good cover. He hasn’t been working in the nuclear power department at all for the last two weeks!”

“I don’t think he’s been doing much for the uranium project either; he’s been helping Carson all the time. They’ve actually become friends.” Will shrugged. “We live in a funny world.”

“Speaking of a funny world; can you believe the political situation?”

Will rolled his eyes. “The President has totally destroyed his credibility. I suspect he’ll have to resign. But he did nothing when the CIA told him that a nuclear bomb was being shipped to Europe through Khaliestan.”

“And a quarter of Paris got incinerated. It makes it look like the U.S. wanted the terrorists to strike, even if they didn’t.”

“It gives the Republicans grounds for impeachment, and White has been determined to destroy Krieger for three years.”

“Krieger really has created a mess.”

“He has. The Euro-Russian alliance has grown stronger than ever. U.S. relations with the European Union and the Russians are worse than they have been in three decades. It’s really unbelievable. We need these major power blocks to be working together, not undercutting each other.”

“Not only Mars; Earth needs them working together, or the world economy is threatened. Things are too interdependent.”

“And interdependence is dependent on the good will of too many people.” Will shook his head. “I have a bad feeling about the near future.”

“So do I. Well, I better get back to work.”

They walked out of the corn field. Will waved goodbye to Rosa, who headed for the ramp. He headed back to his office and sat for a long time, reflecting anxiously about the growing mess on Earth. The world economy was threatening to go into a tailspin and reactionaries were poised to take over the United States. It was not be a good time to be stuck on a little, isolated planet.

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John Hunter's expedition moved across Hellas at the deliberate pace of thirty-five kilometers per sol. Every sol a pair of personnel rode in the Conestoga and a pair in the lead ranger, rotating the job of driving as they cleared a smooth, straight dirt trail across the terrain. Three rode in the other ranger and detoured off the route to make geology field stops. One worked in the Mobilhab as it robotically drove itself, analyzing samples, cataloging them, or driving local Prospectors. An eight-person, four-vehicle expedition with advanced scientific equipment in the Mobilhab, highly intelligent software, detailed aerial photography and remote sensing data, and abundant nuclear power required very little support from Earth or Aurorae.

Helmut rotated from the road clearing team to the Mobilhab support team and finally to the field exploration team, which was the assignment everyone wanted. Hellas was a vast impact basin; its central floor was the lowest point on Mars and its ejecta blanket was Mars's highest cratered highland areas. Hellas's thick air was dusty; its low altitude meant that it had been filled with a sea in the planet's early years, which had laid down thick sedimentary deposits. Nearly every sol the geology team visited eroding strata filled with microfossils. The eobiologists identified two new species per week.

A month after Helmut and Vanessa arrived they approached the ice chimneys, a series of volcanic vents in southern Hellas that released water vapor into the atmosphere. They skipped several possible geological stops to reach them more quickly. Everyone was sitting in front of their vehicles straining for the first sight.

“There they are,” said Helmut to Kim Irion, pointing. They were in a ranger right behind the Conestoga but ahead of the other two vehicles.

“Wow!” said Kim. “Ice chimney’s a good description, isn’t it!”

“The tall one’s twenty-four meters high and fifteen meters in diameter.”

“The ground all around is white!”

“It’s all the water in the air; it produces frost here every night. Better start to suit up, Kim. I’ll keep driving.”

She nodded and walked back to put on her suit. John, in the conestoga, speeded up; Helmut noted that the trail was rougher, but he kept up with John anyway. There were four big chimneys and six or seven smaller ones; a slight plume of steam could be seen rising from two of the big ones. There were also circular stains on the ground, the traces of ancient chimneys that had evaporated after their steam vent dried up.

John headed for the chimney that had collapsed about five weeks ago after a Prospector had tried to extract a sample. The Prospector stood on a low rise nearby, its cameras pointed toward the broken heap of ice. The chimney had begun to rebuild as water vapor, hitting the frigid Martian air, converted into walls of ice.

Helmut stopped his ranger behind the conestoga and jumped out of his seat to suit up. Everyone was going out and no one wanted to be last. Kim was already pulling on her

helmet and heading for the airlock. Helmut tried to be fast and carefully systematic at the same time; one could not hurry the task of suiting up.

He got outside ahead of the other drivers, but Vanessa, Kim, Daichi, and Enlai had already cautiously climbed onto the heaps of broken ice and were patiently picking up samples. The conversation was serious, but with a note of excitement in the air.

“There’s really good discoloration there,” said Enlai. “Let’s be sure to get that sample.”

“I got it,” replied Vanessa a moment later. She was using sterilized tongs. Helmut looked down at the plastic socks covering his boots so that he wouldn’t track any organisms into the ranger; if there was Martian life, they had no idea whether it might be dangerous to the scientists studying it.

“What could make discoloration like that?” he asked to Kim, who was standing next to him.

“Water droplets coming out of the vent, carrying minerals.”

“But this looks biological in origin to me,” replied Enlai, trying to sound calm.

“It does look like algae in Antarctic snow,” agreed Vanessa.

They grabbed a few more ice samples, then they worked their way up the broken chimney toward the lip. John was the first to look in. “It’s an oval space about a meter long and three quarters of a meter wide,” he said. “The ground has two parallel cracks running the length of the oval; the vapor is coming from the cracks. I see very slight quantities of vapor coming out of the crack. The ground around the crack appears to be wet, also.”

“The air pressure here is high enough for liquid water,” noted Enlai. “What’s the color of the ground?”

“It’s yellowish and appears to be a clay. I’ll get a sample.” John took the tongs and pushed them into the ground, which yielded pretty easily. Up came a sample of yellow clay, which they all examined carefully and described aloud to their terrestrial coworkers. “I’d say it’s discolored as well,” said John. “Rather strongly, too.”

“It’s more like a scum in the clay,” said Enlai, excitement creeping into his voice.

He got more samples; they put them in closed plastic containers. Then Enlai took them and ran to the Mobilhab with Vanessa and Kim. John had to smile; the biologists were excited.

Be careful walking around these things; they’re fragile,” he said, pointing to the other three big chimneys.

Helmut and Daichi approached a small chimney, only two meters high and less than a meter in diameter. It was eroded; the wisp of vapor he could see occasionally was not enough to keep up with the sublimation caused by the summer sun. They took out their rock hammers and whacked away at the ice, breaking a hole in the chimney until they exposed the central vent. The ground was skinned with white; the vent was essentially dead. They broke free a sample of frozen ground, which had the same characteristic discoloration.

While the geologists explored the chimneys, collected more samples, and studied old chimney rings, the eobiologists prepared to study the samples they had collected. Enlai pushed them through the vehicle’s exterior sample door and closed it tightly. The door admitted the sample straight into a biologically isolated chamber inside the Mobilhab. The eobiologists entered the Mobilhab’s airlock, sterilized their suits with powerful ultraviolet light, and entered the vehicle. They pressurized the sample box with

argon and carbon dioxide. The discolored ice samples were cold and hard, but they yielded to the sample saw. In an hour they had a slide under the microscope.

The microscope image was displayed on a large screen and transmitted live to scientists on Earth. When the sample came into focus, they all gasped; it was filled with cell-like structures!

“Look at that,” said Enlai, in awe. “They certainly look cellular, don’t they!”

“No question,” agreed Kim. “And the chimneys are contemporary; no more than a century old.”

“Contemporary Martian life. We’ve been looking for it for decades, and here it is,” said Vanessa. Then she frowned. “But you know, these cells really don’t look like the microfossils.”

“They’re bigger and more robust,” replied Kim. “Of course, the microfossils are usually puckered up.”

“But even the microfossils that are well preserved don’t look like this,” agreed Enlai. “The cell membranes are much more primitive and the interior is completely unorganized. These look like terrestrial cyanobacteria.”

“God, they do,” agreed Vanessa. She sucked in air. “But how’s that possible?”

“We’ve been on Mars for fifteen years, contaminating it the whole time,” replied Enlai. “I’m surprised the microorganisms could travel thousands of kilometers by air, survive, and find a conducive environment.”

“Is that possible?” asked Kim. “We need more magnification. That’ll clinch the question of provenance.”

Enlai cranked up the magnification to maximum and slowly moved around the sample until they could find a good cell. The third one they examined was sliced open nicely. He shook his head. “Damn; mitochondria!” Martian cells lacked mitochondria.

“How do you like that; terrestrial life in a Martian ice chimney!” said Kim.

“We’re going to be a laughing stock,” groaned Vanessa.

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For a week the team explored the chimneys, sampling the interiors of the others without breaking them—an exceedingly tricky task—examining the remnants of ancient chimneys, and doing extensive studies of the minerals that had formed because of the volcanic vapors escaping from the ground. Geologically it was one of the most fascinating areas on Mars. With its geothermal energy and water vapor, “Chimneys” was an obvious location for a future scientific outpost.

But biologically, Chimneys was more than a disappointment. “We’re extremely concerned about the impact this will have on Martian biological research,” the biologists said in a videoconference with Will. “We’ve got a paper almost ready to submit to *Nature*. It’s sure to be accepted; it’s good research. But we’re already hearing from people who know the funders that this will be the straw that broke the camel’s back. We can expect a big decrease in biological funding next year.”

“And we can’t spin our way out of this one,” replied Will. “The public’s disappointed, too. Until now they’ve remained interested in the quest for contemporary life on Mars without anticipating that the quest has run out. Now, they think the quest has ended. We’ve got to stress the excellent and important research that still has to be done

on the microfossils and the evolution of life on Mars. We can't study the origin of life on Earth; the rocks are gone from that period. They still exist in abundance on Mars."

"But that research, as fascinating as it is, does not engage the public," said Tina Hvitmer. "I've been doing my best to give this story excitement, but it just doesn't work. The chimneys expedition, from the point of view of public relations, is a failure."

There was silence as everyone considered her comment. "Still, the funding agencies are less swayed by public opinion and more by quality science," exclaimed Vanessa, after a moment. "Maybe this won't impact funding that much."

"It will cut our research funding," replied Will. "Especially grants to university biology faculty who follow up on our research. It will slow the growth of our eobiology facility here, too."

"There's important research to do on the species inhabiting the chimneys," noted Enlai. "We haven't identified any of them yet, but we haven't got good data on terrestrial extremophiles. Several terrestrial teams are working on the problem."

"There will be comparative research," agreed Will. "There's the question of how they got here and when; that can be determined from genetic mutations. But that work will mostly be done on Earth. How much longer are you staying at Chimneys?"

"Three sols," replied John. "We'll need to plan another trip to Chimneys next year. Then we're heading south until we enter the seasonal snowcap. This is a good time to explore; the weather's calm. We should reach the Antarctic Circle in another month. That's as far as we can go, since we won't have daylight beyond there."

"Good luck. And don't be disappointed. We may find contemporary Martian life yet; who knows?"



“Thanks, Will.”

“Bye.” Will closed the link. He looked around his office, disappointed. In many ways the jig was up. Eobiological research got the bulk of Mars’s research funding. In the last week several prominent newspapers had declared the search for current life on Mars to be over; every major terrain and known favorable environment had been explored. Finding life of terrestrial origin in the chimneys added insult to injury.

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A week later the expedition moved 250 kilometers further south, into colder, snowier terrain. Helmut was intrigued to see Martian snow falling. It was not like most snowfalls on Earth; the air was filled with a haze of tiny particles, and after a sol’s time perhaps a quarter centimeter had accumulated on the surface. The ground was crusty and hard to bulldoze, so the vehicles stuck to clearing rocks.

At Aurorae Outpost, the ground was finally broken for the Vandavelde Industrial Building due north of their original four biomes and close to their water and solar energy park. Will and Alexandra both presided over a brief ceremony, then the regolith moving equipment started digging the hole for the ten meter wide, forty meter long facility.

“Good luck on this one, Alexandra,” Will said, as they watched the first excavations being made. “This is an ambitious building.”

“We couldn’t have done it a few years ago,” she said. “But we’re ready now. The fifteen-meter height of the space is a particular challenge; it requires a lot of digging.”

“I’m more concerned about the anti-explosion features of the building,” said Will. “The steel reinforcing, the heavy duricrete and concrete curtains, and especially the three meters of regolith on the roof. That’s a lot of work. But the new equipment should help.”

She laughed. "I'm not worried about any of that! The explosion vents; there's an engineering challenge! Since this building will have no windows, the walls and ceilings are actually simpler to build than Renfrew or Joseph. And its long, thin shape simplifies ceiling reinforcement. This should be big enough for our metal and plastic production for a decade."

"And the containment bubble around it will be good for low pressure agriculture unless an explosion contaminates it, so Lisa's very happy; this thing kills two birds with one stone. Just let me know if there are any problems. I get the impression Rudenkov and his team in Moscow won't be paying close attention, even if this is a design he has favored for a long time. We need to be extra vigilant."

"I know, especially after losing Guillaume. You're right about Rudenkov's team; their budget has been cut and morale is low. I'll monitor everything carefully."

"Thanks." Will nodded, then turned away. He headed back to his office.

While walking to the nearest airlock he listened to, and watched a bit of, the impeachment hearing in the House of Representatives. Krieger clearly was losing support. Once inside he took off his pressure suit and headed for his office. There was a videomessage from Shinji Nagatani about a field accident. He called back immediately.

"What's happened to Andries?" asked Will.

"Nothing serious; a broken wrist. He's on his way to Cassini, which is a hundred kilometers away. They'll set the bone. He'll be back to normal in six weeks."

"How did it happen?"

"He was climbing up a rock outcrop to get a sample and fell. He put out his hand to catch himself. It's not a compound fracture and they got his suit off pretty easily."

“Six weeks.” Will considered. “He was scheduled to blast off to Gradivus in three. He was the mission geologist.”

“Not any more. Choose someone else.”

“We will. It was one of the positions awarded by lottery, so I guess we’ll draw another name. When can I call Andries to commiserate?”

“I’d wait a few hours, so he can get the bone set. I’ll let you know.”

“Thanks, Shinji. Bye.”

“Bye.” They closed the circuit. Then Will went downstairs to mission control to see Érico and Roger. “How’s everything?”

“All’s well,” replied Roger. The screen in front of him showed an asteroidal scene; he was driving a Prospector around on 2019XA. “This so called ‘southern continent’ region is definitely a composite of three different impacting bodies. I just wish we could find more pieces of the parent body from which 2019XA was ejected. We need more data to determine the nature of the impacting bodies.”

“Well, they were quite a mix. It explains the crazy compositional data.”

“Yes. This one is a candidate for mining, since it has water and metal,” agreed Roger.

“How’s Aster-2?” asked Will, turning to Érico. They had launched it six weeks earlier; it would be flying to Eureka two years.

“Nominal,” replied Érico. “I’ve been helping Roger and keeping one eye on the impeachment debate.”

“What a joke,” added Roger.

“I’m disappointed by the partisanship,” agreed Will. “We have a problem with the Gradivus mission. I just got a call from Shinji. Andries was out doing field work, fell, and broke his wrist. So he won’t be flying for six weeks.”

“He was picked randomly, right?” asked Érico. Then he answered his own question. “We’ll run the program again and see who is selected this time.” He turned to his console and pulled up the list of volunteers. “We’ve got eleven qualified volunteers for the geo position; no, twelve, because Helmut Langlais now meets the standards. Shall I run the random selection software?”

“Yes,” replied Will. “That’s what we promised to do.”

“Okay.” Érico selected the list for the random selection process and clicked an icon. They waited two seconds; then up popped *Helmut Langlais*.

“He’ll love it,” said Érico, a bit disapprovingly. “Should I run the program again?”

“No; the geologists were the ones asking for the random selection among the qualified! They can only blame themselves. We’ll have to fly a sunwing to Hellaspontus to get him.”

## Launch

late Oct/early Nov. 2049

Helmut was surprised to hear a bit of applause when he entered the patio with his lunch.

Greg and Anna were sitting together nearby and their clapping was for him.

“Survivor of yet another crisis in the air!” said Anna to him.

“Well this wasn’t a crash or anything dramatic,” replied Helmut, with a smile. He put his tray on the table and joined them. “The sunwing lost two of its silane engines; there was a lot of dust in the air and the filters got clogged, so there was no CO<sub>2</sub>. The propellers kept going using solar electricity, and the flight took longer than expected.”

“Your mom and dad must have been worried,” said Greg.

“Mom was biting her nails and dad was pretty unhappy; but what can you do?”

“How did you manage?” asked Greg.

“Oh, alright.” He changed the subject instead. “So I hear you’re getting married!”

“Yes; December 15,” replied Anna. She looked at Greg. “It’s a bit of realignment of our plans and priorities.”

“Not that drastic; it’s an adding of priorities,” replied Greg.

“But you won’t be serving as priest any more,” noted Helmut.

“That’s not so clear; the new pope is relatively liberal. Of course, he was just elected a week ago, so it’s too soon to know what he will do. He has to be careful about pleasing the more liberal North Americans and Europeans; it’ll alienate the conservative Africans and Asians. But there’s a proposal to establish a Diocese of Mars and move us

from the Archdiocese of Houston. The Diocese of Mars will be under the Vatican Directly and the Bishop will be in Rome. That will allow some experimentation.”

“Including a married priest?” asked Helmut.

Greg nodded. “As an emergency exception until someone else becomes available. The church does have married priests under some circumstances. Czechoslovakia under Communism had married priests, and if a married Anglican priest converts to Catholicism he can be Catholic priest without getting a divorce, and there are some uniate churches—these are Eastern Orthodox churches that accept the Pope’s authority—whose priests are married but are considered valid Catholic priests. Personally, I would be just as happy retiring from the active priesthood, but there were some folks here that want to keep me.”

“Yes, like Eammon. They wouldn’t have anyone to baptize their children.”

“Their herd of kids! That’s not really a problem, if you ask me.” Greg shrugged.

“John and Vanessa are getting married, too,” exclaimed Anna. “She called me the other sol to tell me.”

“Yes, John asked her on Sunsol. It may be the first wedding of a Maori and a Lakota,” said Helmut.

“They want to get married about a month after us,” Anna added. “That’s four weddings since Columbus 7 arrived.”

“Not bad,” said Greg.

“Can I join you?” asked Suzanne van de Velde, who had just come out of the buffet line with a tray.

“Sure, there’s plenty of room,” said Anna.

“How are you, Helmut? And congratulations on your new assignment!”

“I’m fine, Suzanne, and thank you. I still can’t believe it.”

“You live a charmed life,” agreed Greg. “Let’s hope it continues.”

“I hope so. Suzanne, how are you doing?”

“Oh, fairly well. The shock has worn off. I’m back to work, now. And we’re about to incorporate the Van de Velde Migrant Grant Program. Silvio’s finishing up the last incorporation paperwork.”

Helmut frowned. “What’s that?”

“It’s an organization that will pay all or part of the cost of a migrant to Mars. We already have three million euros in pledges, and once the incorporation is finalized and we can announce it, we’re sure to get a lot more. There’s a proposal to give the nonprofit a special land grant; fifty thousand square kilometers of terrain east and a bit north of here in the chaoslands and drainage channels leading to Chryse. There are mineral deposits, water, and we already have several roads cut through the area. The land should be worth between thirty and one hundred million euros.”

“But how much is a ticket?” asked Helmut.

“Columbus 8 will cost seventy-five million per passenger, but Columbus 9 may see it halve because of the new annexes they’re adding to the interplanetary habitats,” she replied. “Our goal is to pay for one migrant on Columbus 9.”

“That’s cool,” replied Helmut. “What would the migrant do here?”

“The idea is to import people with skills the Mars Commission or the private sector won’t pay for; artists, writers, historians, small businessmen.”

“We’re hoping to convince the Commission to contribute to this or similar funds regularly,” added Greg. “Because Mars will soon get beyond the point where it’ll need just scientists, engineers, miners and support personnel.”

“Governments can help, too,” added Suzanne.

“I heard the Commission is flinging open the door to more governments and organizations,” said Helmut. “But I hear they rejected a request from the Mormon Church to send a group.”

“Correct,” said Greg. “They have also rejected an offer by a large Islamic missionary organization. But they will accept religious offers if they are backed by a request from an existing Mars population and if the person contributes more than just religious proselytization.”

“In the next ten years, this place could grow a lot,” added Suzanne. “Once tickets fall below twenty million, one could easily see a small country deciding to pay for several people to immigrate to Mars, just so that their citizens are part of the mix here. There will be maintenance fees of several million dollars per year, but a twenty million dollar endowment, invested in Martian land or mining company stocks, would do the same thing.”

“So, maybe we’re at another turning point,” said Helmut. “I may want to stay after all! The European Space Agency’s plans to explore Mercury are delayed, the Venus Orbital Station is permanently frozen at four crew, and it appears Mars will be doing regular asteroid exploration.”



“It’s really miraculous to see the growth,” agreed Greg. He saw Skip Carson walk across the patio and waved. Skip headed for their table. “How are all of you? Helmut, congratulations.”

“Thanks. I’m not sure what else to say.”

“‘Thank you’ works well. I may want to buy the movie rights of your book, assuming you write one, of course. You have a great story.”

“I’m living a charmed life.”

“You are! Be grateful, it may not last.”

“How’s your movie?”

“We’ve actually started shooting. Needless to say, this is a much smaller budget effort than anything I’ve done since college. But it’s a good story. When I get back to Hollywood, we’ll do some high-powered editing and add special effects.”

“So, you’re going back?” asked Helmut.

“Yes, of course. I’m here one Columbiad only. I wasn’t planning to stay that long, originally.” He looked around the table; the others had expressions on their faces that indicated either surprise or some sort of embarrassment that they were surprised. “Don’t worry, I’ll be a big supporter from Earth!”

“And we need them, too,” said Greg, with a smile.

“If anything, too many people who come here stay; we need more ex-Martians on Earth, spreading the good news,” added Anna.

“And working in administration on Earth; half the time they don’t understand what we want, even after Will explains it,” noted Helmut. “It sounds, Skip, like your movie will be one I’ll want to see about ten times.”

“I hope so; I hope everyone wants to see it that much. The Commission gets a cut of the profits.”

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Will wondered where Lisa Kok was. He glanced at Alexandra Lescov; reading his mind, she shrugged. They could see that the message from Louisa Turner, their coordinator of public relations and Douglas Morgan was already arriving.

Then they could hear Lisa’s footsteps outside Will’s office. The door opened and she hurried in. “Sorry; Ann wouldn’t go back to class after lunch,” she said. “It took an extra half hour. She’s been doing that, lately.”

“No harm; the message just started to arrive,” replied Will, pointing to the screen on his wall.

“What’s this about? Bioarchive?”

He nodded. “And politics in Washington.” Lisa groaned. He reached out and pushed a button on his attaché. The screen flickered and “a video message from High Commissioner Douglas Morgan” flashed on it, then the screen split in two to show Doug Morgan in Houston and Louisa Turner in Colorado.

“Good day to you all,” began Morgan. “We have to mobilize some lobbying in Washington. I’m not sure how much you’re following the situation down here. The votes in the Senate to impeach Krieger appear to be there, since the Republicans control the chamber. They don’t care they’ll be accused of throwing him out in order to get the Speaker of the House in, after rejecting four nominees for Vice President. The stock market plunged this morning over the uncertainty. At least one economic forecast is predicting a recession if the matter is not settled quickly. White has again declared he’d

pull the U.S. out of the Mars Commission. All of this has tied up the budget for fiscal 2050. Today White attacked bioarchive as a massive pork barrel project. There's a group of conservative Republicans, the Prairie Caucus, that has issued a press release calling for elimination of Bioarchive from the budget. In a few minutes I'll be calling the caucus members about this. Will, you know quite a few Senators on both sides of the aisle; or maybe it's now all four sides of the aisle, since this issue has split both parties. I need your help. I wish we had a Democrat in the Commission who can shore up support among them."

Turner was startled by that comment. "Doug, what about me? Do you think I'm a Republican or something? I have a passport and speak French."

Morgan looked a bit offended. "Hey, I have a passport and speak some French, and I'm Republican!"

"Doug, you really don't speak French, believe me. I've heard your French. But seriously, I have excellent contacts in Washington and I've been yearning to lobby for the Commission."

"Louisa, you're head of public relations, and you can't do everything."

"I'm not trying to do everything, but I can do this; my contacts are quite good. Give me talking points and I'll get on the phone."

"Alright." Morgan was reluctant. "I need an update where bioarchive stands for the talking points. Over to you, Will." He turned to stuff on his desk; a second later a still picture of him flashed onto the screen. Louisa turned to her morning coffee and pushed a button; her screen switched to a still picture as well. They were working and waiting for a reply from Mars.

Will looked at his colleagues. “We’ll give you a detailed report in writing by email. I can devote several hours this afternoon to calls. Alexandra, can you give us an update about the bioarchive construction?”

“Sure. From my point of view, the biggest accomplishment of bioarchive was the technology for manufacturing enclosures. The equipment cost a billion to design and make and it has taken us a year to get it assembled and functioning. We’re hard at work on Columbia, which will house a Pacific Northwest interior ecology. The kevlar primary net will be completed in mid November; the finer secondary net was finished in August. In December we’ll mate them together and cover them with their first two airtight membranes. Columbia’s foundation is complete and in January the enclosure will be installed and inflated with argon and nitrogen at 0.02 atmospheres. Then we install layer after layer of plastic, and with each the interior pressure will increase. By mid February the pressure will be enough for breathing and we’ll start installing the steel framework to support the rooftop gardens. By June we’ll have the enclosure and its two buildings completed. Subsequent biomes should be completed at the rate of one per year. The next two are Dakota and Kauai.” She turned to Lisa.

“Well, I’d dispute the comment that Bioarchive’s main accomplishment is finished! Spoken like an engineer, Alexandra. The ecology is meant to be Bioarchive’s accomplishment. The Dakota and Alaskan ecologies are functioning fine in their imported thirty-meter bubbles. We’ve also put together a partial temperate forest ecology and a partial prairie ecology from species already here and Columbus 8 will bring many more species for them.

“There are two aspects of the Bioarchive research: here, and in the U.S. Even the research about the value of bioarchive to us—the roles its reserves of air, water, and soil will play, and how to coordinate them—involves a hundred million dollars a year of research by ecologists, engineers, and computer programmers at universities all over the United States. Easier to justify is the ecological research being done all over the U.S. to determine what species go into bioarchive; that’s twenty-five million a year for ten years for each of twenty-three ecologies. That research is staggered over a fifteen year period. It contains a lot of ‘pork barrel’ spending, in my opinion. The number of ecologies being studied keeps increasing and the length of study keeps growing. It isn’t clear all those ecologies will ever find their way here; six are marine or lacustrine, which would be immensely difficult to fly here! There’s talk of adding several river environments as well. The advantage from a political point of view, however, is that it sends a lot of money in a lot of congressional districts, and the money is for two causes popular with the public: the environment and the space program.”

“I’m sure you’ve pulled out the list of congressional representatives benefiting from local research spending,” added Will. “The other lobbying angle worth pursuing involves genetic engineering. Columbus 8 is bringing genetically modified seeds for twenty-five food crops, and we anticipate a thirty to fifty percent increase in our harvests. If we could get an agricultural experimentation facility up here to verify the safety of the seeds, and that would help the public accept them.”

“I’d mention that if the U.S. doesn’t fund our bioarchive research, other nations will,” added Lisa. “I’ve interested the Dutch government in a biome which would be

filled with a typical Dutch forest ecology. The Belgian government may fund a study of the coordination of the air and water reservoirs in our ecologies.”

“Other points?” asked Will, looking at Lisa and Alexandra. They both shook their heads. “Then back to you, Doug.” He put the videophone in his office on “pause.”

“This is a potential mess,” said Lisa. “Even if they don’t pull the plug on Bioarchive, I bet they’ll pull the plug on research being done in some districts for purely political reasons. We could have a biome scheduled and half the species already here, and no money for the other half.”

“That’s politics,” agreed Will. “Let’s hope we can preserve funding for the whole project. Support has always been soft.”

“At least we have the equipment already,” said Alexandra. “We can move toward our goal of increasing our interior space to 125 square meters per person. The computer models indicate that waste recycling requires less equipment and intervention at that point; even less if we can get the interior space above 150 square meters per person.”

“I’m more concerned about the shortsightedness,” said Lisa. “This isn’t just for us; it’s for Earth! This is a whole new kind of quantitative, computerized ecological research. Bioarchive will allow us to predict biological systems for the first time; to estimate how many predator insects have to be added to a field to eliminate a pest long term; to model multiple cropping systems so that fields can be planted with more than one crop at once, thereby yielding higher harvests; to develop ecological management systems so that endangered species can be saved on limited park lands. It has immense potential. Here on Mars we have to create our entire environment and manage it. This has huge implications for saving the Earth!”

“I know,” replied Will. “But this won’t be the first time valid scientific research has been stopped because politics. Bioarchive’s budget has ballooned in the last three years to three times its original estimate. People are trying to ride a gravy train and load on as much of their own ecological research as possible. But they may derail the gravy train for everyone.”

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Residents of Aurorae rose Frisol morning to a shock. Skip entered Yalta for a cup of coffee and a muffin, and stopped to stare at the tv screen. “So, why did Krieger resign?” he asked a nearby table where Érico, Brian, Helmut, Greg, and Anna were eating breakfast.

“Some graybeards in his party told him the votes to impeach him were definitely there,” replied Greg.

“Really?” said Skip. “That’s incredible.”

Brian smiled. “And that means White will be the next President.”

“But it makes no sense for someone to be President of the United States and represent the ideological extreme!” replied Skip.

“The extreme right, or the extreme left?” exclaimed Brian. “Krieger’s pretty extreme, too. His administration has made new automobiles almost impossible to purchase, doubled the price of electricity to protect the environment and make alternative sources economic, pushed up unemployment with a much higher minimum wage, endangered the nation’s security, and bungled efforts to curb terrorism.”

“The increase in terrorism inside the U.S. has nothing to do with him; it’s your silly gun laws,” replied Érico. “Besides, every country in the worlds is now dealing with school shootings, drive by snipers, letter bombers, and all sorts of sick chaos.”

“That’s because of the decline of moral standards,” replied Brian. “The United States needs leadership that will protect its values.”

“Yeah, like White,” replied Skip derisively. “He’ll outlaw abortions again, eliminate welfare entirely, and foster new gun ownership laws so people can ‘protect’ themselves. And let’s not forget he has said he’d invade terrorist countries; we’ve seen what that does, haven’t we? He’ll undermine the entire fragile system of international order. And don’t forget he said he’d disband the Lunar and Mars Commissions.”

“I can’t believe that the most powerful nation in the world could be run by a bunch of hillbillies lacking passports,” added Érico.

Brian was angered by that. “I suggest you look and see how many Yale and Harvard educations those so-called hillbillies have! If you don’t like White’s ideology, too bad. He’s what the country badly needs. I think he’s what the world needs, frankly.”

“They may have educations, but they don’t have passports,” replied Skip. “They have no experience of the rest of the world, and at a time when the world can no longer be ignored or bullied. White will be a real disaster; mark my words. I may stay here anyway. For all I know, it’ll be impossible to make decent Hollywood movies anymore.”

“I am worried about Mars,” said Helmut. “White certainly is no internationalist, and if there’s one thing all of us are, we’re internationalists. It’s the only way we can survive together up here. But I’ve seen enough of rural Texas to know that conservative peoples are good and decent. So I’m not so worried.”



“I hope you’re right,” said Skip. “But I doubt it.”

“Problems arise whenever ideological extremists at either end of the spectrum get power,” said Greg. “That’s the sad thing lesson of the Krieger administration. Americans have been getting more and more polarized for years. Now we have to worry about a pendulum effect; the population gets disillusioned with extreme liberals and elects extreme conservatives, then gets disillusioned with them and swings back the other way.”

“That’s why the Supreme Court has three vacancies,” added Helmut.

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*Launches are never routine.* Helmut pondered the words of a late NASA administrator as he looked at the countdown chronometer in the passenger cabin of the *Hadriaca*, which was frozen momentarily at t-minus one minute. The Mars shuttles had a perfect safety record—so far—after thirty-three missions. Since it took less than half as much delta-v to reach Mars orbit as Earth orbit from the worlds’ respective surfaces, and far less fuel, and the heat shields had far less heating to deal with—even when approaching Mars from the Earth—the Mars shuttle was a much simpler vehicle than shuttles that hauled people and cargo to orbit from the Earth. On the other hand, maintenance and repair had to be simpler because of Mars’s tiny population, and that necessitated some safety tradeoffs.

He wondered how many “launches” the mission would count for. The *Hadriaca* and the *Tharsis* were heading for low Mars orbit with thirty tonnes of gold and four tonnes of equipment each. There they would dock with the *Swift*, a Deimos-based Lifter, refuel, and fly to Embarcadero Station, Mars’s interplanetary transportation hub, which was in a high elliptical orbit around Mars. They would unload the gold, refuel again, and fire their engines to head toward the inner asteroid belt. The shuttles would dock together,

nose to nose, and rotate to produce artificial gravity for almost three months. Then they would fire their engines to place their vehicles back on a course that would cross Mars orbit, following the orbit of *Gradivus*. Small maneuvers would allow them to land on the asteroid and its moon for a month of exploration. Finally, a week before Mars flyby, they'd head for Mars and aerobrake into orbit. They'd be home in late February, two weeks before *Columbus 7* was scheduled to fly back to Earth.

"Is everyone ready?" asked Neal Stroger, commander of the *Gradivus* mission, over the radio. He was up in the cockpit.

"The shuttle's ready for the final launch sequence," replied Ernesto Gomes, their pilot and systems expert, who was in the cockpit with Neal.

"We can't wait down here," added Charles Vickers, their asteroid expert, seated next to Helmut in the passenger area.

"Any time," added Hutan Hijazi, geologist and engineer, who was the copilot of the *Tharsis*. It was sitting on pad six about five kilometers away and was just beginning its launch sequence.

"Light her up. We'll be right behind you," added Zach Hersey, their expert on Prospectors and machinery. He was the pilot of the *Tharsis*.

Helmut had nothing to add, but everyone else had spoken. "Let's go," he finally added, feeling a bit uncertain that his reply was adequate and slightly giddy at the prospect of flying into space again. He was indeed living a charmed life; assuming, of course, the luck held and the shuttle didn't explode.

"*Hadriaca* to *Aurorae* control. We're ready for launch," exclaimed Neal.

“Acknowledged; we’re releasing you from the automatic launch hold in three seconds. . . mark,” exclaimed Rostam Khan, who was the capcon that sol. Helmut turned to the chronometer, which had resumed at t-minus one minute.

“So, you’re ready?” Charles asked Helmut.

He nodded. “I can’t wait. I can’t believe I’m going to see another world.”

“Two other worlds, including Gradivus’s moon. That pushes you to six and me to seven, since I’ve been to both Phobos and Deimos.”

“In the next few years there will be people who have visited ten or more,” noted Zach over the radio. “If this mission works, at least.”

“Which it will,” replied Charles. “If we had two more shuttles, Mars could explore asteroids almost constantly.”

“We’ll need more personnel for that, too,” replied Hutan. They were all aware that in addition to a hundred support personnel on Earth, the mission tied up the six of them and three on Mars, which was a substantial fraction of the planet’s work force.

The countdown reached ten. Helmut silently watched the numbers follow one another; no one spoke the countdown aloud. Then the shuttle’s three engines rumbled alive and the *Hadriaca*, after a moment on the ground, rose into the sky and headed for orbit.

13.

## New Year

late December/early Jan 2035

Will Elliott and Thierry Colmar stood in front of a small manger scene with a cross behind it. “Commander, it isn’t the manger scene that bothers me, but the big cross. This is the Patio, after all; we eat our meals here. This is as public as public space can get.”

“It is indeed the most public space in the outpost; that’s why the display area is here,” replied Will. “And we have quite an interesting series of displays planned. Ernesto Alves will put up his watercolors of Martian scenes in mid January, Arieih is planning an educational display about cancer for later that month, there will be a Valentine’s Sol display in February. We’d love to have a Bastille Sol display in July, Thierry, if someone can do the work. And at important religious times we will have a manger scene, an Id display, something for diwali, Chinese New Years, etc. In short, religion is being treated as a part of the Outpost, just like a cultural, popular, or secular event.”

Thierry answered slowly, just like Will, so as not to raise his voice. “Commander, religion is not something. . . ethnic. It has caused terrible bloodshed on Earth. Consider the terrorism in Kashmir last year, or the bombings in Morocco, or the bombing of the mosque in Granada last year. We have to consider very carefully what we portray here, and what we might be encouraging on Earth.”

“But surely you would agree that the religious people here on Mars harbor no desires for terrorism? Yes, religion has been badly misused; but so has science, which still threatens humanity with nuclear devastation. When something is misused, it is the

obligation of the people involved to correct the problem. And surely the religious people here are concerned with strengthening the positive side of religion.”

“Well, perhaps they are; I don’t know, I don’t go to any services. Neither do about half the people here, either. They meet at various times in Clarke Dome. Maybe that’s the best place for religious displays; it’s easy for people who want to avoid such a display to walk around the dome.”

“But here, in this very public spot, the religious identity of some of the residents is recognized and valued, just like we want to recognize and value some of our ethnic groups. Thierry, you can always take the matter to the next town meeting. I authorized the inclusion of religious displays here not as Commander of Mars Operations, but as Manager of Aurorae Outpost. This display space belongs to the Aurorae Borough and its voters can decide.”

“Thank you, Commander, I’ll consider that idea,” said Thierry, disappointed that Will wasn’t coming around to his position. “Surely as an American you understand the separation of church and state?”

“Of course I do, but it would be inappropriate to apply that very American approach to the relations between religion and state to Mars. You should talk to Andries Underwood, who is not particularly religious. He told me that in South Africa, separation was viewed not as freedom from religion, but equal recognition and access of religion to civil society. A display about humanism or even atheism would also be welcome in this display space, as long as the display does not attack or tear down something else. That’s where we’re drawing the line.”

“I see. Well, thank you again, Commander. Have a good sol.” Thierry turned slowly and headed for DiPonte’s store. Will watched him go. Then he looked around the patio; almost everyone had finished their lunch and left, including Ethel and the kids. Will walked to Catalina Biome, the enclosure north of Yalta, where Lisa was waiting to explain a complaint to him.

She was waiting on the edge of “Catalina Pool,” and Will immediately could see that the water was as murky as people had complained. Catalina had the largest body of water inside the outpost; the forty-meter biome had a pool thirty meters long, with a bulbous eastern end ten meters across and a long, thin—five-meter wide—channel extending west from it. A rope extended across the western end of the channel to demarcate the kids’ wading pool. The bulbous part was up to seven meters deep, but Will could see only a quarter of the way to the bottom. “It looks pretty murky,” he said.

“Yes and no,” replied Lisa. “When you get out you may want to take a shower; but we have one. The turbidity is unpleasant, but it isn’t a health danger. We take water samples daily.”

“We can’t filter it?”

“No. You see, right now between Christmas and New Year’s, almost everyone is taking some vacation time, and that means there are three times as many people swimming in here as usual. The biology in this pond is another year older, too, so there’s that much more organic buildup on the bottom. The filters just can’t cope with so many more people stirring up the bottom. It’s not doing the biology in here any good, either; but we anticipated the problem and made a major fish harvest last week. As a result we had enough fish for the big Christmas dinner and there are fewer fish in here to feed.”

Will looked at the oxygenator's air bubbles rising thickly from the middle of the bulbous area. "The water still has oxygen, too, so that's not a problem. Is there a lot of algae?"

Lisa nodded. "Sure! If you stir up the bottom, you add nutrients to the water! The water doesn't smell, though, because of the oxygenator. My main concern is that we not overreact by chlorinating the water and wiping out the ecosystem. This is our main fish supply."

"No, we won't do that. My concern is the opposite; that we won't close the pool to swimming. Yalta's pool is too small."

"At least it's clean. If anyone is upset about the water quality here, tell them to use Yalta."

"I will. Okay, Lisa, I feel better about the situation now. This isn't dirtier than a cousin's farm pond where I swam as a kid. The person who complained was raised in a city and is used to public swimming pools, not natural ponds. We really should call this Catalina Pond, not Catalina Pool. I'm sorry to take time from your other tasks."

"Oh, that's alright." She shrugged.

"How's bio-archive?"

"Pretty good. We've got everything put to bed for winter; it's really cold in the central Alaskan bubble! You need a heavy coat. They're getting three hours of daylight per sol and there's half a meter of snow covering everything. But it's surprising how much biological activity is going on underneath; we can measure it because there's carbon dioxide buildup in the greenhouse's atmosphere."

"Interesting. When will it start to snow in Huron?"

“We’ve delayed winter there by a month because construction was delayed and we wanted the trees time to get established before we hit them with cold. Next week, though, the nighttime temperatures will be below freezing every night, and ten sols later they will be below freezing most of the sol as well. At that point you can tell Marshall to bring a sled! We’ll make up to three meters of snow in some places.”

“Good. He and I plan to take some afternoons together in there.”

“You should talk to Alexandra. She has some ideas for future biomes—the larger ones we’ll be building in a few years—where the floor will have a slope to it. The results should be aesthetically pleasing and good for sledding. Maybe even a bit of skiing.”

Will laughed. “That’s an interesting idea. Thanks, Lisa.”

“Have a good sol, Will.”

He nodded and headed across Catalina to its western end, where a short tunnel took him to Riviera. He crossed through and entered Huron. He felt fall in the air; it was crisp and chilly. He walked across Huron’s yard between the two completed buildings, reflecting about how each biome had its own unique appearance. If anything, they were becoming more different every year, too. Some of Yalta’s condos, including Will’s old flat, would soon be converted into more space for businesses; Yalta was becoming a commercial space. Riviera, on the other hand, had their administrative headquarters and no doubt would eventually be a government biome. Catalina had their university, Mariner Institute of Technology; it still used a small part of the buildings, but now they were thinking of moving science facilities and maybe the hospital there. That meant that Huron and future biomes built farther to the west would be residential.



Will walked out the eastern end of Huron and followed the tunnel to the western end of Riviera, where he entered and headed for the south building, on whose roof was located his office. He stopped first at the control room right down the stairs from his office. Rostam Khan and Kent Bytown were there.

“Anything new?”

Rostam shook his head. “Not really. We were just chatting with the crew of Argo 1, by the way; they called to say hello.”

“They’re pretty close, actually.”

“Yes, about seventy million clicks. They said Mars is quite pretty in the night sky at 2017KB63.”

“I want to send them congratulations for the landing. You’re still able to reach them directly?”

“Yes. Tape a message and I’ll forward it to them.”

“Thanks. How is everything on the *Hadriaca* and the *Tharsis*?”

“Fine. They’re getting bored of training.”

“They’re more than halfway there.”

“By the way, Will, any further word from Houston about Columbus 7’s return to Earth?” asked Kent.

Will shook his head. “Everyone heading home wants to go with Columbus 8 and stop at Venus; who can blame them? We’ll send a lot of equipment back empty, by remote control. I don’t see a problem.”

“Oh, I’m taking off the next two sols,” said Kent. “Miranda and I are going up to the dacha overnight; Leona’s being watched overnight by Tatiana and Boris. Their little girl and Leona are really close, as you may know.”

“Have a good trip. The dacha’s hopping this time of the year.”

Kent nodded. “A lot of people are taking vacations up there. Are you doing anything for New Year's?”

Will shrugged. “We’ll go down to the patio with the kids for the countdown to midnight, then go to bed! Then relax on New Year’s sol.”

“And then see what happens with White’s inauguration,” said Kent, worriedly.

“Don’t worry. Everything will work out.”

“You may be the only optimist in the Outpost, Will!”

“No, I just know that a century from now, the U.S. will be around, the world will be around, Mars will be around, and the nail biting will have been long forgotten.”

“I suppose that’s true,” agreed Kent.

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Most of the outpost arrived at the patio by 11:30 p.m., New Year’s eve. Only people with small children were absent. Marshall, a month short of his tenth birthday, insisted on being there; Lizzie, seven, didn’t want to be left behind. Soon she and her friend Corazon were asleep, wrapped up in blankets on the grass.

They watched the count down to New Year’s in Honolulu; that year, coincidentally, Honolulu’s new years was just twelve minutes before Aurorae’s. Then they counted down their own clock and shouted “Happy New Year!” as 2050 began.

Most people drank toasts or kissed a loved one. Then the dance music began again and many danced, while others said good night and collected their bleary-eyed children.

“Good night, Will!” exclaimed Ruhullah.

“Good night, Ruhullah, and happy new year.”

“Thank you, happy new year to you, also.” The greeting seemed a bit empty, exchanged between a Muslim and a Bahá’í, both of whom used non-Gregorian calendars.

“I hope it will be good.”

“So do I,” replied Will. “I’m sure it’ll be good here. I’m not so sure about Earth.”

“No, the international tensions are worse than they have been in decades. Perhaps it’s just as well that we’re up here!”

“Perhaps. We may be safer here! Good night.”

Will nodded greetings to a few others, then walked to the lawn to pick up Lizzie, who stayed sound asleep as he carried her back home. He helped Marshall a bit to get in bed; it was too late for family prayers. Ethel tucked Lizzie in.

“Well, my dear, another year,” he said to her as they got in bed.

“Yes. The year you turn 49 and I turn 48.”

“The year we will have been on Mars fourteen years. That’s hard to believe, too.”

“It really is.” She looked around the room. “But let’s plan to stay in this flat a while, okay? I’m tired of moving.”

“This has all the space we need anyway. It’s our fourth flat here together.” He leaned over. “Happy new year.” And he kissed her.

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New years sol was peaceful on both worlds. But Will didn't sleep well the first night of the year, and rose a bit before dawn on January 2 to watch White's controversial inauguration. He had been sworn in as President almost two months earlier, but had insisted on preparing a formal ceremony and parade, as if he had been elected to the position. It had not caused the stock market to cease its fall; the world economy had slowed noticeably.

Ethel came out to watch as well. Then the kids rose, so Ethel ran to the patio to grab breakfast for all of them. "I'm glad you didn't go," she told Will. "The big screen is on, live from Washington. Everyone's watching and debating."

"I don't want to make any comments, that's for sure," said Will.

They ate breakfast, then Will took the kids to school and went to his office. Aurorae Outpost took several hours a sol to manage; there were personnel assignment changes to approve, disputes between workers and bosses to adjudicate, reallocations of power and consumables to consider, reports about leaks to read, and expenses to watch. He passed several on to Ruhullah, who had proved very capable at management.

Then the attaché beeped with a message from Doug Morgan. Will pressed the play icon. "Good sol, Will. I'm sure your people are very worried about White. He's the opposite of internationalism, which is an inevitable value in Mars culture, and he represents a few other positions that will worry our people. But I know White some—not well, but I worked with him when I was a Senator and he was a White House staffer—and I can say that we can handle the threat to abolish the Mars Commission. I know what to do and who to talk to. So tell people not to worry about that. White is in favor of

nuclear power in space, so that will be to our advantage. Overall, we can make this election work for us. Bye.”

A bit relieved, Will hit record. “Thanks, Doug. I’ll assure people privately. This should help, unless by ‘nuclear power in space’ you mean bombs.

“Alexandra is proposing a revised industrial equipment manifest for Columbus 8. The gold production remains strong and with the price of gold creeping upward, we should be in good shape financially. Otherwise, no news up here. The Gradivus mission is moving forward. We’re in touch with Argo 1 daily. Aster 1 is on its way to 2016MN and Aster 2 is doing fine en route to Eureka. It appears we may be able to move her to 1998VF31, the other L5 trojan, if we can conserve fuel. Lal’s expedition in northern Argyre has found some fascinating glacial deposits, and Roger’s down in Alba Patera is tracing its volcanic history. So we’re doing well. Bye.”

Will sent the message, then rose from his desk. He knew the residents of the outpost would be upset and unlikely to work, so he went on a walk. There was a small gathering in the patio, where people went for a coffee break. They saw Will coming.

“So, what does this mean, Commander?” asked Anna.

“We’ll see. Morgan thinks he can mute their criticism of the Commission, so there’s nothing to worry about.”

“But won’t he put money into NASA and not into the Commission?” asked Lisa.

“Maybe, but our gold will be worth about 30% more than expected because of rising prices, so we can handle a cut in American support. Besides, White is in favor of nuclear power in space, which will benefit us in the end.”

“True,” said Lisa, skeptically.

“But he wants to ban abortions!” exclaimed Anna. “He’s a crazy man.”

“And he said on the campaign he would not tolerate it if Turanistan continues to harbor terrorists,” added Érico. “Of course, there’s no evidence they ever have, and solid evidence the U.S. ignored it when their ally, Khaliestan, was involved in the Paris bombing!”

“I know,” replied Will. “But remember; he will be a weak President. I doubt he’ll be able to do very much. And frankly, if he manages to ban abortions, it may be the best way to legalize them once and for all. The fight over abortion has been going on for seventy years. Americans won’t tolerate back-alley abortions. They tried prohibiting alcohol, and once they saw that didn’t work, they never tried prohibiting it again.”

“We’ll see,” said Érico skeptically. “Don’t forget he has said he’d withdraw the U.S. from quite a few international trade treaties. That could wreck the world economy.”

“Which is probably evidence he won’t do it,” replied Will. “We have to run this place so that it benefits regardless who is in the White House. That means staying politically neutral and finding advantages where we can. With White, the advantages are more nuclear power and higher gold prices. With any luck, Morgan can build a relationship with this White House; he wasn’t welcome at the last one, after all.”

“Hey look! White’s making a speech!” exclaimed Anna. They all turned to the large screen. It was a quick, conciliatory speech at a party of supporters. “Well, he certainly comes off as a nice man,” concluded Lisa. “He knows how to call for unity and letting bygones be bygones.”

“A wolf in sheep’s clothing,” sneered Érico.

Will said nothing at first. “White is very courteous; everyone seems to agree on that,” he finally said. He left the patio feeling a bit better about the election. The people gathered there felt better as well.

He walked around the Outpost, stopping to talk to people, assuring them Morgan knew what he was doing, and encouraging them to listen to White’s speech. A few people were happy about his election, but ninety percent were opposed. Will reflected on the power of culture to shape attitudes; Mars was more like Europe than America, with a communitarian rather than an individualistic slant, and an internationalist rather than a nationalistic attitude.

He finally ended up at Ethel’s work station in Joseph Hall. “You heard the White’s little speech?” he asked.

She nodded. “The next three years should be interesting.”

“Yes.” Will paused to reflect. “Of course, it made people feel better, but I doubt it changes anything.”

“I agree. He strikes me as an ideologue.”

“Exactly.” Will looked at her. “My hunch is that the stock market will now recover for a month or so, until he does something drastic, which he might. So I’m inclined to wait and see whether we can pull some of our investments out of the money market funds and put them into Martian gold companies. If there’s economic instability in the world, the price of gold will skyrocket, and we know the companies are doing well.”

Ethel nodded. “I wouldn’t mind investing more in Martian land, too. It’s a long-term investment, but it’ll make money eventually.”

“I agree. But the mining companies are looking at big profits. Production has been good, there have been no accidents, and the shipment of gold is insured. If it’s alright with you, I’d shift about half of our portfolio there.”

She was surprised, but nodded. “Alright, let’s do it when the stock price allows.”



## Virus

Late Jan 2050

In late January, Will Elliott was coming out of the new Vandevelde Industrial Facility and heading for Riviera Biome when he encountered Skip Carson in the north main tunnel. “Good sol,” he said.

“Good sol,” replied Skip. “So, is it now definite that there won’t be a Columbus 7 passenger flight back to Earth?”

Will nodded. “Everyone who had planned to fly back on 7 wants to stay an extra year and fly back via Venus. That’s fine with you, right?”

“Yes. I had planned to fly back via Venus last year, so now I get to stay on Mars longer *and* see Venus. There won’t be a problem, flying all the cargo vehicles back unstaffed?”

“No. We’ll send the shuttle *Olympus* with six automated cargo vehicles. It will have a remote manipulator arm and can dock to any vehicles with problems.”

“Good. Say, Saturdays I’m inviting a few people over to see the film as it exists so far. Can you make it?”

“Oh, I’m sorry; I’m leaving for Dawes on Frisol and won’t be back for a week. I’m taking the automated cargo caravan from there to Cassini, then flying back here. But let me know if there will be other screenings.”

Skip nodded. “Definitely. Brian’s a pretty good actor; who would have thought!”

“A man with hidden talents. How much shooting do you have left?”

“It’s mostly done. Originally I had planned to head back to Earth on Columbus 7, so I set my filming schedule to finish everything up in January, and leave February and March to wrap things up. Now I’m glad I have more time; we can get everything just right. I hope you don’t mind my tying up two people for that much longer.”

“I hadn’t counted on it, and we are shorthanded. On the other hand, I had expected to lose six folks flying back on Columbus 7 in April and now I have their work until April 2051. How are you and Brian getting along, politically speaking?”

Skip laughed. “We fight every sol! We usually schedule it for the late afternoon, after we’ve gotten our work done. When White gave his inaugural address Brian was gloating. It burns me up; the man will do terrible damage to our country and possibly to the world. But Brian thinks he’ll be the greatest President since Reagan.”

“Which is supposed to be a compliment, too,” added Will. “But he gave a masterful inaugural speech and avoided all the hot-button issues. Perhaps he will bring the U.S. together.”

“Perhaps. I doubt it, though.”

“So do I. Partisanship’s too deeply engrained in the political culture. He couldn’t heal the partisan divide if he wanted too; the other side wouldn’t trust him and his own party would resist.”

“I am always amazed by your resistance to partisanship and parties, Will. It really makes no sense to me; they are inevitable, even here.”

“Not necessarily. We Bahá’ís have no factions in our decision-making bodies or election conventions, and we’ve managed that for almost two centuries, in spite of having a lot of members and handling millions of dollars of funds.”

“That’s an achievement, but it requires a lot of religious conviction to work!  
Anyway, enjoy your trip to Dawes. When you get back, I’ll give you a private showing.”

“Excellent.” Will waved goodbye and headed for his office, where he had a pile of work to do.

The next four sols were packed with tasks to do before the flight to Dawes. He got on the sunwing with some relief Frisol evening for the long overnight flight to Dawes. A bit before noon Saturdaysol, the solar-powered quadriplane—it had finally been recertified for carrying people—was closing on Dawes’s landing strip. After landing a conestoga approached and attached a docking tunnel to the rear of the sunwing so Will could exit without a spacesuit. Feodor Velikovsky, Commander of Sibireco’s operations was inside. “I’m so glad you could make it to Dawes, Governor!” he said, using Will’s new, formal title. “How was the flight?”

“Not bad.” They shook hands. “I got a pretty good view of operations on the way in, too. I’m glad I’m finally able to visit.”

“We’re glad you came. I hope you can visit again; say, at least once a year. It’d smooth out communications.”

“Oh, I agree.” Will placed his suitcase under one of the beds in a secure spot while Feodor closed the tunnel. Then he followed Velikovsky to the front of the vehicle.

“Let me take you past the gold mining operations on our way to Orinoco,” suggested Feodor.

“Sure.”

Feodor turned a key and got under way. “We just hit a particularly rich spot and recovered half a tonne of gold in three sols. That’s a fifth of our usual monthly yield.”

“You all are making us work hard to export all the gold. The three operations combined are digging ten tonnes of gold per month. That’s 120 tonnes per year and a third of the Commission’s annual operating costs, but it’s also quite a strain on our infrastructure.”

“Yes, but what a profitable strain it is!” Feodor laughed. “At least the new flight software has increased the shuttles’ launch capacity, and the new cargo capsule we’re designing with Muller Mining should simplify the interplanetary cruise.”

“True, but we have to do a lot of work to put the capsule together here from the parts imported from Earth! And we’re worried about the effectiveness of the heat shield. Aerobraking twenty tonnes of gold on a direct descent to northern Kazakhstan will save on space capture and deorbiting; but you could have a shield failure and a rain of molten gold instead.”

“Our experts say the shield should be fine. We’ll have to import about a tonne of equipment to build it make right, and we’re importing all the avionics and the reaction control system. But they’ll be reusable.” Feodor sounded a little touchy about the capsule, a simple spherical “cannonball” 5.5 meters in diameter with a heatshield covering the bottom and a parachute built into the top. The development had cost the two companies about twice as much as expected and Aurorae would have almost twice as much work to do to manufacture and assemble the spheres as expected. Finally, the spheres had to be launched as two halves because of space constraints in the shuttle’s cargo bay, and the halves had to be snapped and bolted together in orbit, which would require two tricky spacewalks. One shuttle flight would be able to carry two spheres and their cargo to low Mars orbit, minimizing the number of flights necessary.

The conestoga topped a low rise—a very old, almost totally erased crater rim—and in front of them was the rolling highlands just east of Dawes crater where the gold deposit had been found. Will could see the outpost about eight kilometers away, a silvery bubble in the midday sunshine. Between it and them was a rolling stony plain pocked by scattered large pits. “As you can see, we have found gold all over the place,” said Feodor. “We’re gradually turning this area into the scene resembling a World War Two bombing campaign!”

“So I see. But you’re maximizing return, and Mars has plenty of desolate land.”

“I suppose we’ll grade the area after the gold is exhausted, but meanwhile it looks pretty bad. We only dig where the deposit exceeds two hundred parts per million gold; but that’s still five thousand tonnes of rock for every tonne of gold, and we only recover 75% of it. The cyanide process recovery equipment we’re getting on Columbus 8 will get most of the rest, and the new centrifugal recovery equipment will be more efficient as well. So yields should keep climbing.”

Will saw the gold recovery unit working about two kilometers away; it was hard to miss because it raised quite a cloud of dust. “Wow, that thing is big.”

“I’ll drive you past it, if you’d like.” Feodor turned the wheel and drove the vehicle onto an intersecting dirt track that led toward the behemoth. “It consists of two mobilhab chassis welded together, fourteen meters long. It’s been widened to five meters in front so that it has room for three diggers—we call them ‘mouths’—to break apart and ingest regolith. The diamond-tipped steel teeth can haul in boulders. Everything goes through a crusher, then through a sieve. The silt-size particles that result go through the centrifuges, concentrating the gold particles. Behind are two trailers that fill with the

waste rock; they're robotic and can go dump themselves, then come back and dock to refill. Each mouth can feed its own equipment or the equipment of the adjacent unit. That way we can always keep at least two units running."

"I gather all three are operating 75% of the time, too."

Feodor nodded. "The equipment is pretty good, and we do intensive maintenance. In between the gold recovery machinery in front and the waste trailers is a large pressurized repair chamber; it actually occupies about forty percent of the total volume of the vehicle. Parts can be moved there and repaired on the spot; some parts, in fact, are mounted on rails and can be pulled back into the repair area, fixed, then pushed back into place. It's a state of the art facility. If you'd like a tour, we can do it right after supper time when there's a change of staffing. It used to be top secret, but now we have a deal with Muller Mining to sell one to them in return for sharing the research and development to improve it."

"Thank you, I'd love to see it. I gather the newer model will be more energy efficient."

"So I'm told; the input rock is scanned with a neutron activation instrument and rock with low gold content is rejected. This baby sucks up four hundred kilowatts; over two and a half tonnes of methane and oxygen per sol. But it can process twenty-four tonnes of rock an hour."

"Really impressive, but energy efficiency will help a lot. Aurorae Outpost had been running under emergency conservation until the sunwing crashed and we converted its panels to power production. But since then demand has crept upward again."

“I know, we’re feeling the pinch here as well.” Velikovsky stopped the vehicle so they could admire the gold recovery unit in action. A steady stream of rock dust poured out of three spouts in the back, kicking up a huge cloud. As they watched, one of the two trailers catching the powder, now full, detached and drove itself to the tailings area to unload. Another “docked” to receive tailings.

“It’s much taller than I imagined,” said Will.

“The sieving units are eight meters tall,” agreed Feodor. “The biggest mobile surface feature on the planet.”

“And there are two people on board at all times?”

“Yes, they work a twelve hour shift.”

Will looked at the remarkable vehicle for several minutes. Then Feodor put the conestoga back in drive and drove them past the tailings area, where neat haystacks of ground rock dust covered several hectares. Then he drove toward Orinoco Biome. “We might as well go inside,” Feodor suggested.

“I gather building one is completed.”

“It is, and the bubble for building two is in place, though we won’t get a complete building inside it until the middle of Columbus 8. We’re rather cramped and could use more space.”

“Of course. Cassini was stuck in the same situation for almost two years. But we can only get so much done.”

“I know, but I thought I’d ask.” Velikovsky sounded a bit disappointed. “Orinoco is hot and humid. We’ve been complaining for a few months. But Lisa turned down the humidity, the vegetation has adjusted fairly well, and we’re more comfortable.”

“I heard. We need to create a real rainforest biome some time, but I guess it’ll be at Aurorae, where people can avoid it if they don’t like the climate.”

“We’re planning a big town meeting tonight so you can meet everyone and answer their questions.”

“Excellent. Usually the meeting breaks the ice and a lot of people come up to me privately later about one thing or another. I don’t get in the field much any more.”

“Are you sure you want to take the robotic truck caravan to Cassini? It’s the slow way!”

“I want to see the sights, and we have a field stop scheduled in Tikhonravov Crater; the so-called ‘coal deposit.’ I’ll get plenty of office work done on the trip, too.”

“Okay, suit yourself,” replied Velikovsky with a shrug.

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The town meeting proved to be lively, with a lot of unexpected questions. The next sol Will met people all morning, then got a tour of the gold recovery vehicle. That evening the monthly cargo caravan arrived from Aurorae after a nine-sol trip: a conestoga, a cargo trailer with nine tonnes of stuff, and a nuclear reactor on its own robotic cart. As usual, there was a big meal to celebrate its safe arrival, and the Outpost store opened to sell some of the new items that arrived.

The next morning the caravan left for Cassini. The two-sol trip included Adam Haddad, a tall, lanky, young driver who was Mars’s deputy transport officer and a master mechanic; Raul Gonsalvez, a geology technician; and Will Elliott. The trailer, bound for Aurorae, had three tonnes of gold. On the conestoga was fifty kilograms of tropical fruit from the orchard inside Orinoco Biome, bound for Cassini.



They set out in an upbeat mood, sitting up front, watching the terrain roll by, and chatting. In fifteen minutes the Cassini-Dawes Trail entered a tight stretch between two crater rims furrowed by ancient arroyos. “This is one of my favorite stretches,” said Adam, with a smile, while he drove them down the road at fifty kilometers per hour. “Three months ago the two of us on the trip got out and climbed up an arroyo to the rim. We were surprised to find a trace of snow under the eolian drifts in the arroyo, too!”

“Really?” said Will, surprised. “That’s unusual, on the equator.”

“I’ve seen it, too,” replied Raul.

“Now, you’re going to Cassini for three months?” Will asked Raul.

The Spaniard nodded. “I’ll run mining equipment from inside the outpost, do some routine gold exploration, and help repair broken equipment. Leona Verdi’s rotating home.”

“And I’ll drive her back to Aurorae,” said Adam, pleased.

“You drive this route just about every time, don’t you?” asked Will.

Adam smiled slightly. “Once a month. Seven sols to Cassini, two sols to Dawes, two sols back to Cassini, then seven sols back to Aurorae, with up to sixteen tonnes of cargo each time. Of course, I don’t really drive; the vehicle drives itself. I’m along to maintain and monitor. When I get back to Aurorae I complete routine maintenance on the vehicle, take a week off, then repeat the whole thing again.”

“You must know the route real well, by now.”

“We’re talking about 8,000 kilometers of dirt roads, which is equivalent to driving from Florida to Alaska, so it’s a lot of terrain! Some of the flat, boring stretches don’t stand out very well, but I know the road pretty well now. This is my. . . tenth run.”

“Wow,” said Raul. “I think it’d drive me crazy!”

Adam shook his head. “I love it. You see, I’m a landscape painter as well; having an entire free week per month to paint is great. The trips are very good for my landscape painter’s eye. There have been some very subtle colors I’ve seen out here, and there are some stretches of terrain I feast my eyes on. Tiu Vallis, for example, or the Cassini rim crossing, or Henry Chaos.”

“Spectacular,” agreed Will. “I didn’t know you painted. Have you seen Ernesto Alves’s work?”

“Yes. He’s more literal than I; I do more abstract work. But he’s good and I like some of his pieces.”

“We should do an exhibit of the two of you some time,” suggested Will. “Do you do e-canvas work too?”

“Sometimes. I prefer watercolors, but I’m running out of supplies, so electronic paintings are the next best thing!”

“They’re easier to export to Earth, too. Say, with your eye, I bet you could name all the good spots along the trail where we could sell plots to small landowners. We want rolling terrain or land with vistas; people don’t want to buy five square kilometers of boring plain. They want at least to have a gully on their land, and they prefer land with meteoritic iron on it as well.”

“I can’t tell you where the iron is, but yes, I have a long list of favorite spots, and since we’re allowed to stop up to an hour a sol, I’ve walked around some of them, too. In fact, there’s one spot I’d like to buy myself. I often wonder whether, thirty or forty years from now, I could retire on it.”

“Where is it?” asked Raul, startled.

“Oh, out on the middle of nowhere. No one could live there now, but by the time I’m old enough to retire it might be possible.”

“Buy a used mobilhab and put it there with some solar panels, drill a well for water, and you’d be set,” said Will. “Are you guys both planning to stay here?”

“Assuming I can find a wife!” replied Adam.

“Ditto,” added Raul. “Unless I can get a position on a future Mercury mission. I’d like to go there for a few years, then settle here.”

“If there is a Mercury mission,” noted Will. “The new administration in Washington may complicate the plans. Adam, I want to thank you for your broadcasts. They’ve been well received.”

He smiled. “Thanks. My Christmas broadcast was really popular among the Eastern Orthodox around the world and among Arab Christians.”

“And you were the one who got Ariele Feldman and Fatima and Husni Hijazi together for a joint broadcast about peace in the Middle East last time things escalated. Getting the Arabs here to work with the Israeli was symbolically very important, even if it is something we actually do routinely.”

“The appearance that was important to me was when Fatima and Husni agreed to appear with me, not with Ariele! Six months ago we did a broadcast about Arab Christians and Muslims working together. Husni’s conservative parents in Saudi Arabia were outraged. Their anger about his appearing with an Israeli was muted by it. In both cases he blamed Fatima, since she’s Palestinian!”

“Were you sponsored by Lebanon?” asked Raul, curious.

Adam shook his head. “I went to the U.S. for university and got citizenship. But Lebanon did make a contribution, since I’m still a citizen there.”

Raul nodded. “A lot of the people here are dual citizens but work for NASA or ESA. Commander, what are the chances we’ll be able to fly?”

Will was surprised. “Everyone wants to fly and everyone asks that. As long as we have six shuttles here we’ll send pairs to asteroids, as long as they’re back for the arrival or departure of a Columbus mission. The main reason we’ll do it is because we can and we want to. It would take less human resources to send robotic vehicles. But it’s part of our strategy to attract the best people and to keep our profile high.”

“Still, if you’re talking about one mission per year, it’ll be a long time before everyone gets to go.”

“About five years.”

They continued to chat for another hour, then Will headed to the rear of the vehicle to do office work. It was difficult because the vehicle bounced a fair amount; fifty kilometer per hour was the maximum speed for the dirt trail. When Raul and Adam switched the vehicle to robotic mode, it proceeded at thirty kilometers per hour and the bouncing was much less.

The next morning they rolled over the battered rim of Tikhonravov and entered its ancient bowl. They stopped for a half hour to see the “coal deposit,” a seam of biotic carbon a centimeter thick; Tikhonravov had had a lake on part of its floor for a million years or so and it had been biologically quite productive. They all took samples; Will got a few for his collection, then filled a bag with several kilos of the stuff. It was likely to be

a popular export item, and the seam had hundreds of tonnes of carbon. A quick look through the microscope showed that the carbon was pure fossils.

They continued on northward and reached Four Corners, the point where they crossed the Circumnavigational Trail: it consisted of an emergency shelter, a water well, a small solar array, and a sunwing landing strip, all set on a featureless stonefield. Adam pushed a button and detached the trailer with the gold; he'd pick it on the trip to Aurorae. They stopped to fuel up from the nuke's tanks and filled the nuke's water tank from the shelter's cistern. Then they were on their way robotically. They'd reach Cassini before dawn.

Before going to bed Will went to the conestoga's driver's cabin and called Ethel, who was on her way to meet the kids. "I don't have much time to talk," she said. "I'm almost to Yalta. You need to call back in an hour or so to talk to Marshall. After lunch we went to the store to shop for his birthday. He didn't want any of the things Silvio has; he was pretty disappointed. He said he saw a Roman soldier set on tv the other sol and wanted that. I explained to him that we can't get it from Earth for over a year. He understood that and was disappointed, but then he didn't want anything."

"Oh." Will thought. "I'll surf for software; a Roman soldier game. Are you sure this isn't something we can make from company specifications?"

"Maybe we could, but it'd be expensive and I'd have to do the work, and I don't have the time. You know how overworked we've been."

"We never recovered from the delays caused by the Sunwing D crash, and we really bit off more than we could chew."

“Especially in terms of fabrication and construction. See what you can find, okay? I’ll talk to Madhu also; they may have bought something for Sam that we can trade for. How’s the trip?”

“Pretty good. We stopped at the coal bed this afternoon. It was fascinating. Not much new from here. David Alaoui emailed me; the Mercury mission is almost certainly postponed three years because the French don’t want to deal with the new President.”

“Just to rent a nuclear engine?”

“They may partner with the Chinese! That’s probably a threat to get American attention, but who knows? That’s confidential.”

“I’m sure. Anyway, call later.”

“How was your sol?”

“Pretty good. We’re fabricating fifty toilets; enough to last us two or three years. They’re not flushing well, for some reason, so we’re seeking expert advice from Earth. It’s been more fun fabricating pseudo-wood grain finish for the new run of plastic chairs, tables, desks, cabinets, and sideboards. It looks real. I’m glad to say that quality—”

Then the phone went dead. Will listened a moment, puzzled. Then he picked up his attaché and looked at the screen. The connection had been lost. He punched redial.

Nothing happened. Before he was able to investigate, the conestoga suddenly began to slow down, then stopped completely. Will looked at the controls.

Then Adam opened the door and hurried in. “What happened?”

“I don’t know. It stopped. I lost a phone call, too.” He pointed to a screen. “Huh. No GPS coordinates.”

“The satellite network must have gone down.”

“Impossible.” Will pointed. “We’re on the backup computer.”

“Weird.” Adam switched on the main computer and looked at another screen. The machine began to boot up. Will watched and wondered. It occurred to him that the backup computer would still have GPS coordinate information and would have prevented the call from being interrupted.

Raul came into the cabin as well and watched. The computer booted up very slowly and the three of them began to run diagnostics on it. Meanwhile, the backup machine continued to run the vehicle’s life support systems, but had no access to the global positioning system or communications.

“There’s something wrong,” said Adam, after a minute. “It comes on, but won’t boot up properly.”

“Where are the shortwave controls?” asked Will. “There’s something wrong. The computer going down shouldn’t have anything to do with loss of GPS or of communications.”

“Right.” Adam reached over to the main screen and pushed a few icons, transferring the shortwave radio controls to a screen in front of Will. He opened a frequency and began to call over the common frequency “Aurorae, this is Cargo Run 39, do you read?” He repeated it every few seconds and was greeted by a hiss. He flipped through different frequencies and repeated.

He came back to the common frequency and called again. Then he heard, in the background, “Aurorae, this is Dawes Outpost. Do you read?”

It was Feodor Velikovsky's voice, for the boss of the Sibireco operation was also Commander of Dawes and Chair of the Borough Council. "Dawes, this is Cargo Run 39, do you read?" Will exclaimed.

A pause. "Cargo Run 39, this is Dawes. Have you been able to contact Aurorae?"

"Negative, Feodor. We just lost GPS, satellite communications, and our main computer on the conestoga. We're attempting to restore."

"The same here, Will. Half of the computers in Dawes have gone down; no, more like two thirds. Life support was out for thirty seconds, though it's now restored. Mining operations have stopped. We are attempting a link with Earth via Phobos to bypass the satellites, but that link is down as well."

"The link to Earth is down? Please acknowledge that, Feodor."

"Acknowledged. The link to Earth is down. The problem does not seem to be our equipment. I doubt the backup on Phobos has been knocked out, too. There is nothing coming here from Earth. No BBC radio and television signals, for example."

Will looked at Adam and Raul, shocked. They looked a bit frightened. "Roger would say it might be the end of the world," commented Raul.

"Maybe he's thinking that right now," agreed Will. "Let's get the computer back on line, Adam."

"I'm trying, but so far it isn't cooperating. I'm running diagnostics on it right now."

"Give me the comm controls, okay?"

Adam nodded and shifted all communications to Will. He left the shortwave on; Cassini had come on the line as well and was talking to Dawes. They had lost half their



computers also. “Looks like a computer virus to me,” exclaimed Emily Scoville, Commander of Cassini.

“A virus?” said Will, interrupting. “How’s that possible? We update our antivirus software daily and run everything that arrives through filters.”

“She’s right,” said Adam, nodding. “This looks like a virus.”

“I don’t know how it’s possible, Governor, but that’s what I see,” she replied. “It has taken out the computers on the satellites as well as the computers in both outposts and the conestoga.”

“That’s impossible. The hardware and software are not all of the same type,” said Will.

“But all our systems have standard computers or standard operating software playing a role,” noted Emily. “They seemed to be the parts that are knocked out, and that brings everything else down.”

“I suppose that’s possible,” said Will.

Just then Ruhullah Islami called from Aurorae Outpost, confirming that they, too, had lost satellite services and computers. “Is there danger?” asked Will.

“The biomes have no power or environmental management,” replied Ruhullah. “We’re not evacuating them, however, because they appear to be safe for now and there’s no place for everyone to go. The computer controlling the liquid oxygen and liquid methane tanker farms is down.”

“Oh my God,” said Will. He looked at the screen in front of him, wondering how this could happen. He resumed his scan of the Earth channels and suddenly he got

something. "Voice of Beijing is still broadcasting!" he exclaimed. "Of course, it's in Chinese!"

"Tang's down stairs; we'll get him," said Ruhullah. He turned and ordered someone else in the room to go get Tang.

Meanwhile, Will resumed scanning the channels. There was burst of talk; Will leaned close to listen.

"Peru and Columbia are down as well as all of North America," said the announcer, a man speaking English with a slight Indian accent. "We now have a report from Bengaluru Customer Services, Limited, that their telephone service professionals have lost all incoming calls from customers in the United States and Canada, and they cannot call the various companies with whom they have service contracts."

"And Rajiv, we now have a report from All-India Communications that they have no telephone or internet contact with the United States," added a woman's voice.

"Chitra, I tried the Toronto Globe and Mail site and it is down as well, so it appears there is no internet for all of North America," responded Rajiv.

"My God, this is incredible," said Will.

"Someone did something big," said Adam, still working on the computer. He shook his head. "I think this computer is fried."

"If it's a virus, we had better keep this other computer isolated until we can get antivirus software from Earth," said Will. "How far are we from Cassini?"

"About 150 clicks," said Adam.

"Let's drive it as fast as we can," said Will. "We can be there in three hours. We had better not get stuck out here."

“I wonder how the expeditions are doing?” asked Raul, thinking about the teams exploring the North Pole and Alba Patera.

“I wonder what’s happening to the Gradivus mission,” said Will. “Meanwhile, in North America, the power grid may be down.”

“And what about the several thousand passenger aircraft in the air right now,” added Adam. “I wonder whether there are any prisons rioting, too.”

“And operations in hospitals being disrupted,” said Raul.

“Raul, you drive,” said Will. “Adam can keep working on the computer.” He turned to his attaché and pushed an icon. It didn’t respond. “My attaché is fried, too.”

Raul got into the drivers seat and took off down the road at 55 kilometers per hour, which was as fast as they could drive safely. At least they were pulling no trailers; that gave them a greater safety margin.

“Aurorae calling all points,” said Ruhullah over the shortwave. “We think we can get Marscom back up using backup computers. We will be trying in ten minutes. We have to stabilize Aurorae’s environmental control systems first.”

Will heard a fragment, “. . . Islamic army of Turanistan . . .” over the Indian radio broadcast. “What did he say?” he asked.

“The Lashkar-i-Islami-i-Turanistan has taken responsibility,” replied Adam. “Phone call to the Turanistan Office of Al-Jazira. We should be listening to Al-Jazira right now!”

“We’re not getting it. Both India and China send their media signals to Mars via their own satellites. The conestoga doesn’t have enough power to receive video, just

audio.” Will shook his head. “This means war. If North America’s computers have been fried by a virus, there will be war for sure.”

“I wonder what percentage of all computers survived,” said Raul. “Macs, I suppose.”

“Maybe, but nowadays they share many of the same chips with the other standard types,” said Adam. “That’s the weakness; nowadays almost everyone uses the same chips. And it’s also a clue to figure out what is broken. Probably ninety-nine percent of the parts in these machines are fine; one component has been destroyed.”

“But we can’t import that one component for a very long time!” replied Will. “This is a disaster for us.”

“Of course, back at Aurorae we have every computer that was ever shipped to Mars and has broken or is obsolete; something like fifty or seventy-five of them,” noted Adam. “They’re not even turned on, so they don’t have the virus. They’ll have a lot of spare parts we can cannibalize.”

“That’s true,” said Will.

“Hey, they’re saying something else!” exclaimed Raul, pointing to the radio.

“We repeat, there is a speculation over Al-Jazira television that the virus was designed to be triggered in computers set for certain time zones,” said Chitra. “This would explain how the United States was targeted. It would explain why Peru and Columbia have suffered, but the rest of South America was spared; most of the continent is east of the United States. We have also learned that the Atlantic time zone of Canada seems to have been spared, with only scattered problems. Many web sites in the Atlantic

province of Nova Scotia are still functioning, although service is spotty because most of it is routed through the rest of Canada, which is out of communication.”

“It would also explain the Agence France Press reports that Tahiti has been hit,” added Rajiv. “Its clocks are the same as Hawaii’s.”

“And ours!” added Will. “If I remember correctly, this sol Aurorae’s clocks were roughly the same as Hawaii’s. Our clocks here, in Dawes, and in Cassini are the same hour as New York’s.”

“The Conestoga’s computer is set on Aurorae time,” corrected Adam.

“If this theory is right, Shackleton Station will be in trouble,” said Will. “Their clocks are set on Houston time. The Chinese station may be okay; they operate on Houston time, but I bet the computers are set on Beijing time. And the Venus orbit station should be okay, since they’re on Paris time.” Will looked out the windshield. “Let’s get to Cassini. We need to muster all our resources in one place so we can figure out what we’ll do.”

## Gradivus

Jan 25- Feb. 1, 2035

Adam took over the steering wheel and drove like hell to Cassini. Will and Raul retreated into the rear bathroom—the safest part of the vehicle—and listened to the radio on an attaché that had been turned off and had not acquired the virus. The Islamic Army of Turanistan released a video statement confirming that they had used a computer virus.

They reached Cassini in two hours; average speed was a teeth-clenching seventy-eight kilometers per hour. As they arrived the Marscomm satellites came back on-line, complete with the global positioning system. Aurorae’s ten minute prediction had proved optimistic.

Will and Emily retreated into her office and opened a video connection to the Aurorae Control Facility. Ruhullah and Érico were both there. “We’re taking a census of functioning computers,” said Ruhullah. “All four of the shuttles are alright because they were shut off. We still haven’t heard from Gradivus, though.”

Will shook his head in worry. “In two hours. A thousand things could have happened up there. Keep trying.”

“We couldn’t have heard from them at all until ten minutes ago,” noted Érico. “The Marscomm system is essential to be in touch with them.”

“Here in Cassini, all the main computers but one were knocked out, but the backups were alright,” said Emily. “All the primary mining computers were fried as well, and one backup that came on immediately. We have found that half the attachés were

affected. We're in the process of programming our spare attachés to serve as backups for environmental control and mining."

"Our situation's about the same," added Feodor. "Dawes lost the environmental control system of its biome, but we got the backup going in ten minutes."

"Our situation is much more complicated," said Ruhullah. "The biomes were run in tandem; Yalta's main computer was the backup for Catalina and vice versa. So we lost environmental control over all four. We're in the process of shifting control to the shuttle computers, but their different design makes that complicated."

"Thank God the shuttles are okay," said Will. "What about the expeditions?"

"The Alba Patera expedition was asleep at the time and they had no damage at all. The North Polar expedition lost a few computers. Both are on their way to Cassini as fast as they can drive."

"How much of our communications are back?"

"Intraplanetary, about thirty percent," replied Ruhullah. "The satellites need to be visited and repaired to restore full capacity. I'm afraid we won't be watching much television for the rest of the year. Our interplanetary capacity is barely adequate for the voice and emails flying back and forth. We're receiving media from Europe and Asia—the signals have been rerouted via other satellites in Earth orbit—but we still have nothing coming from North America. Euronews has transmitted a photograph of North America from the Chinese South Polar station that shows it dark; there is still no power after two hours."

“What an incredible disaster,” said Will. “Thousands are going to die down. Have we communications with the Paris office of the Mars Commission? Houston will be knocked out for quite a while.”

We haven’t tried,” replied Ruhullah. “But it’s six a.m. in Paris, so we should wait. Enlai reached colleagues at the Space Institute in Beijing by email. We’ve heard over Chinese radio that they’re serving as mission control for all lunar facilities at the south pole. Shackleton’s struggling with the same problems we are.”

“What about the pressure suit computers?” asked Will.

“Almost everyone was inside,” replied Ruhullah. “The computers were off, so they should be fine. They will be our main source of spares.”

“Oh, we just received a radio call from the Gradivus mission!” exclaimed Érico. “We’re piping it through to this conversation.” There was a pause, then a hiss of interplanetary static. They were six million kilometers from Mars, so the round trip communications time was 40 seconds.

“Acknowledged,” replied Neal Stroger, to a previous message from Rostam Khan. “We’ve ridden quite a rollercoaster up here. About two hours ago, all the systems on both shuttles suddenly crashed: the main system and the backup. For about forty minutes we had no controls at all, except the few systems we could control manually. The main computers, it turns out, appear to be okay, but the attachés all went down, and we haven’t been able to restore them. We had to shift their functions to the mains.

“Communications were down as well, and when we called Mars we got no response, so we called Earth, then the moon; still no response. We were beginning to half think an alien invasion had wiped out humanity. But then we emailed Venus and they



emailed back with a brief description of the trouble on Earth. It's unbelievable that the virus was written to insinuate its way even into our computers; it must be incredibly sophisticated. We're still in the process of checking out all our systems to verify we have no other damage. The next step will be to reassess the mission. Back to you."

"Acknowledged, Gradivus," replied Érico. "Send us the email you got from Venus; they may be in a better position to brief us than anyone else. Prepare a transfer of the complete record of your systems for the hour before the crash, but don't send it yet; our communications bandwidth is severely impaired. We've started reviewing records and know that computers started failing at slightly different times. We were dealing with some difficulties at least a half hour before everything went down, and when it went down it was really quick; maybe 90 seconds. We want to know how the virus took down your systems."

"Gradivus, this is Will Elliott. I want to add that we are immensely relieved you guys are alright. You should email relatives and assure them you're okay. Run communications to Earth via Venus to save our communications systems. We'll use you as a relay, in fact, because we can broadcast more to you at a lower power for relay to Venus than we can send to Venus directly. We'll have to ask Venus to relay for us, but we can be confident they will do so." Will turned to the screen showing the people at Aurorae and Dawes. "We have three hours before we can contact the Paris office. I suggest we make a damage assessment of all systems by then. I assume, Ruhullah, that a team is assembled to figure out what happened?"

"There are several people here who want to investigate, but we're still busy with emergency conditions. Give us three hours and I think we can start to shift to

investigation of the cause. Of course, probably fifty thousand people on Earth are investigating as well, and they will make more progress than we can.”

“What have we heard about the cause?” asked Will.

“Just that the Islamic Army of Turanistan claims responsibility and calls the attack a ‘computer program.’ They did not use the term virus. The United States government is up and running in spite of losing most of their computers and through their Turanistani Embassy, they have demanded the government of that country to arrest the entire leadership of the organization immediately. The Lashkar-i-Islami-i-Turanistan, as it’s called there, is semi-public and is not in hiding.”

“They will be now,” replied Will. “The United States is in mid winter and the power won’t be restored for days or weeks. That means millions of Americans will have burst pipes and ruined houses, and their workplaces may not be much better. There will be a war over this; a big war.”

“Don’t forget the overflowing shelters, the looting and riots, disruptions of the food supply, the marshal law, and the economic depression. This could trigger use of nuclear weapons,” said Ruhullah.

“The stock market and banks will be closed for a long time, the banking machines won’t be working; this is major hardship for everyone,” agreed Will. “We may be lucky to be here. But let’s focus on the tasks at hand. I want reports in three hours and a meeting together in three and a half to plan our next sol or two. We should assume we will have no expert advice from the Commission for the next week. Goodbye everyone.”

Will thanked Emily and headed out of her office to the cubicle down the hall where he could work. They had provided him with a spare attaché. He logged in and set

up a few things, then turned to his email. There was a message from his sister, Molly Nuri, who lived with her Iranian husband, Taraz, in Santa Cruz, Bolivia. Will immediately turned his thoughts to their mother, in southern Connecticut, and Molly's son Paul, a college student in central Connecticut.

*Will, at least acknowledge this. I need to know you all are alright up there. I hear Mars has been hit by the virus as well. We're fine here; Santa Cruz is normal and the computers are functioning fine. I'm trying to reach a Bahá'í who lives near mom and has a satellite phone. So far I haven't found his number, but I still have a few contacts up on the altiplano; he was there a few months ago. Keep in touch with me and I'll get in touch with mom. I may need to fly her down for a few months. Reaching Paul will be tricky, but I have some options. Fortunately, the campus should be safe and warm. Bye."*

Will read the email again and felt slight relief. The reference to a satellite phone prompted him to remember that Louisa Turner had such a phone as well, and it was a French phone, not American. He turned to his address book, which had been backed up on the Mars network and thus was accessible. Yes, he had the number. The email address for the phone was guessable so he sat and pounded out a quick message.

*Dear Louisa: Let me know immediately if you get this. We've lost all the active computers except shuttle mains, but we have enough backups to keep environmental management and other essential services running. We've restored about one third of our communications capacity. No one is in danger. We're preparing a preliminary report for completion at about 9 a.m. Paris time with a heads of staff meeting following to make plans for the next two sols. We're assuming Houston headquarters will be unable to help*

*us for at least a week and that the Paris office will provide limited support, possibly with ESA cooperation. What are the conditions there? Let me know. Will.*

Then he dug up David Alaoui's email and sent him a similar summary of their situation, but concluded with *We assume the Paris office of the Mars Commission will provide some ground support, but the staff there is secretarial and diplomatic, not technical. Can you help? We have no idea what help we need yet, besides help with the computers. The systems on Magellan Station, Venus orbit, are very similar. The virus will be figured out sooner or later. Some of the damage may be reversible. Maybe the Venus-Mercury Commission can assist. We will certainly return the favor.*

Then Will sat and stared out the window at the darkened landscape, dimly illuminated by the light of Deimos. He felt helpless and enraged. For a moment he thought *if the United States nukes Turanistan back to the stone age, who will blame them?* But then he contemplated the innocent lives in that country. He pulled out his Bahá'í prayer book and said prayers.

Finished, he turned to the BBC coverage, but an email popped into his box. It was from Molly, confirming receipt of his email. Then, most unexpectedly, Louisa responded.

*Will, I'm shocked to get this from you! I had no idea you knew my number. I've been using the phone to maintain essential communications only. I was in my apartment in Houston when everything went down. Houston has no power, phones, anything. Several radio stations are now back on the air, though, and martial law has been declared to stop the looting. Morgan and I are at the Commission headquarters. He says to email the report to him via this phone. The battery won't last much longer, but he's got some guys working on power. About a quarter of our computers are functioning, the ones*

*of the same type as the shuttles'. The attachés are down unless they were shut off at the time of the attack. Only the night shift was here and a lot of them have gone home to their families. It'll be months before we can recover from this. We may even have to cancel the Columbus passenger flight. They say tomorrow morning there will be a big run on all the supermarkets, but only by people with cash because checks and credit cards will not be honored. The President has said this means war and there will be no stopping until the terrorists are caught. His message had to be relayed by satellite telephone to the BBC because the US media networks are still down.*

*I'm glad I'm not in Boulder right now; I'd be freezing in the dark. Houston's not bad this time of the year. But I go to Paris every spring, and I think I'll be going early this year! Bye.*

He was relieved to be in touch with someone in Houston. He turned to the news, to get a better idea of the context, then began to compose a statement.

Up on the *Tharsis* and *Hadriaca*, the inventory of systems proceeded quickly. Stroger called a meeting after it was finished in the great room of the *Tharsis*. "Okay, we now know that the damage is confined to the regular computers," he said. "We have spare spacesuit computers and can use them as backups if necessary." He gestured at the window. "If you look out there, you can actually see Gradivus. Our rendezvous burn is scheduled for twenty-one hours from now. We can replace it with a burn that will return us directly to Mars in about four weeks. If we make the rendezvous burn, we can abort to Mars at any time up to three and a half weeks from now. If we miss that, in three months there is an abort that gets us to Earth in seven months, but we'd be very thin, because

we'd be living on half rations. Mars can send us emergency equipment unless all their vehicles lose their computers."

"It makes no sense to come all this way, then perform a flyby," said Helmut. "If we rendezvous, the danger is only marginally raised, and at least we'll have access to resources."

"Not much resources," replied Neal. "Gradivus is a stony asteroid, with relatively little water or nickel-iron."

"We should be able to extract some water, though," said Charles, the meteorite expert. "But we wouldn't need it because if we don't fire the engines, we'll have tonnes of liquid oxygen and methane on board."

"We'll also have extra radiation shielding from the asteroid," noted Zach. "I'm in favor of going in. I agree with Helmut; we've come a long way to change course for Mars now."

Hutan nodded as well. Ernesto considered. "There's no real risk as long as we keep some computers turned off so they can't get infected. We could run the shuttle engines without a computer if we had to. It would be hard, but it's theoretically possible."

"I'm surprised we're unanimous," said Neal. He looked around. "Okay, I'll tell Mars we want to go to Gradivus. It's late; we can go to bed. Hutan and I have the watch."

People gradually drifted out of the great room. Helmut headed back to his tiny quarters on the *Hadriaca*. He closed the door and sat, staring at the wall. He had had no time to think about the dangers they had faced while they were busily handling the crisis. Now that he thought about the situation, he saw his hands starting to shake involuntarily.

He looked at his attaché, which had been turned off during the virus attack and therefore was alright. He turned it on and composed an email to his father and mother.

*Hey dad, I hope you're okay at Shackleton. I have no idea how to get this to you; actually, I guess I'll email it to Yan Guo, she can get it to you and her email should be functioning. Our crisis up here is now over for a time. We had no functioning computer control for forty minutes. Charles had to take physical control of the two shuttles' orientation and spin because the nav computer was off line. We had no life support, which means the fans stopped. I kept thinking about how sharks can't live in the water unless they kept moving and thought about the bubble of carbon dioxide around me, so I kept rocking back and forth to keep the air around me moving! It was weird and frightening.*

*But then we shifted the functions to the mains—their operating systems were unaffected—and everything came back up. We've checked out the systems and everything else is fine, so we're planning to rendezvous with Gradivus tomorrow on schedule.*

*I hear Shackleton went down, too. I suppose you've turned to the Lifters; their computers should be fine, just like ours. Please let me know you're okay. I'm copying this to mom, too; she must be frantic. I'm frantic about her, too; I'm outraged by this attack. Send me messages via Guo, since I have no idea when your email will come back on line. Mom, I hope you get this somehow. Looking forward to hearing from you. Bye.*

Helmut sent the message, then went to brush his teeth. He took off his clothes and climbed into bed—the two shuttles, docked nose to nose and spinning end over end, had normal Martian gravity. But even though he turned off the light, he laid in bed a long time, uncertain whether he dared to sleep.

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It was the middle of the night—3 a.m.—when the various reports began to arrive in Will’s inbox. He forwarded them to the other heads of staff, Louisa, and David immediately. Then he met with his staff by videophone. “We do have a plan,” said Will. “Or maybe I should say plans, since Cassini and Dawes have ideas different from Aurorae. Thanks to the pressure suit computers, our supply of spares, and dead computers we can cannibalize, we can manage to return to basic functionality in one to two weeks.”

“One week at Dawes and Cassini because we have simpler systems to repair,” added Emily. “But we won’t really return to normal until replacement parts arrive or until we can repair equipment locally. We can jury-rig solutions that will give us eighty or ninety percent of our old capacity.”

“We’re looking at the question of repairing equipment, so our plan is longer,” agreed Ruhullah. “We can have Aurorae’s systems functioning pretty well in two weeks. We’re resetting the clocks of every functioning computer we have for the 24:00 time zone; it’s an option no one on Earth has, thanks to our longer day.”

“It sounds like there will be an anti-virus patch coming out of Sweden in about three hours, too,” exclaimed Will. “Who would have thought that the Lashkar-i-Islami would have a collaborator inside an antivirus company who could get the virus sent out as an anti-virus update! It’s really shocking.”

“We all dutifully and routinely loaded it into our computers, too,” added Érico.

“And the guy wasn’t even Muslim, but a British convert to Buddhism,” added Ruhullah, with relief in his voice.



“It shows the international face of terrorism nowadays,” agreed Emily. As a British citizen, Ruhullah’s relief was her discomfort. She added, “There are now random shootings in a European high school or restaurant every other month, and even more often in the United States. Just last month they caught that pipe bomber in the U.S. who had set off a dozen bombs.”

“And let’s not forget the nuke set off in Paris two years ago,” added Will. “Life on Earth is getting pretty scary, and now there’s going to be a war and probably a big economic downturn. If history teaches anything, we can be sure the war against Turanistan will trigger more terrorism, not less. So let’s work on making Mars more stable and diverse. We’re small, but we can be an example.”

“Are you thinking of making another address?” asked Érico.

Will nodded. “But I need to wait until Louisa can focus on the matter, because I don’t want to say something that will complicate our relations with the United States government. Morgan’s been working very hard to build bridges.”

“That’s a tough problem,” agreed Érico. “We have one more matter to discuss: Gradivus. They’ve decided to go for the landing.”

“We should let them make the decision,” exclaimed Will. “They’re out there, they know their equipment. Houston’s out of communication. We may want to cut the mission short, though, if we later find any damage to their systems. Right now the delta-v to return to Mars and land on Gradivus is about the same, and the delta-v from Gradivus to Mars will be pretty small for at least a week.”

“They should implement the one-week scenario,” agreed Érico. “Get the basic stuff done. If they can stay a month, so much the better.”

“I agree,” agreed Will. “Thanks, everyone. Have your people get some rest. Let’s plan another meeting for 8 p.m. Aurorae time tomorrow night to see how we’re doing.”

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By the end of the next sol, the situation on Mars had stabilized. The virus had finally been identified on Earth and an antivirus program written to remove it, and once the program was sent to Mars their machines were free of it as well. The damage done by the virus was irreversible, but the chip that was damaged was replaceable, so all the computers could be repaired once the parts arrived toward the end of 2050.

Knowledge about the nature of the virus gave them added confidence that the Gradivus mission could proceed. The sol after the computer crash, the two shuttles stopped their rotation, separated, and prepared to fire their engines. As Gradivus loomed up out of the darkness of space, the *Tharsis* and *Hadriaca* fired their engines for several minutes. When they finished they were slowly being pulled in by the asteroid’s gravity. The next morning everyone prepared for landing as they drifted in at a kilometer per hour. Periodically the reaction control system fired briefly to hold the approach speed down.

Helmut watched the grayish surface loom larger and larger as he ran the spectral analysis instrument. The sensor package was confirming that Gradivus was a slice of Vesta, but Helmut was impressed by the range of compositions the screen showed. Debris from chondritic asteroids and meteoroids showed up in yellow; stony meteorites produced orange craters and aureoles. Vesta material itself was reddish in the false color portrait; Gradivus was covered by a patchy regolith of smashed fragments of the stuff.

But one crater surprised Helmut; not far from where they were landing there was a bluish patch. He pointed it to Charles, who was surprised.

“Huh. I haven’t seen that before.”

“What is it?”

“I don’t know; we’ll have to take a look. Purple often reflects calcium minerals in this particular display mode. This is close to that.”

“Anorthite?”

Charles considered. “No, I don’t think so. It doesn’t have enough calcium.”

“Anorthite would be from the moon?”

“Maybe. It’s the product of magmatic differentiation, and that has occurred in the belt, as Vesta herself demonstrates. We’ll see.”

Helmut nodded. Soon it was time to stow the instrument, so he sat back and waited for the landing.

When touchdown occurred it was so gentle that it was barely noticeable. Both shuttles touched down within a minute of each other. Then came an hour of shutting down systems, suiting up, and going outside in the prescribed order.

The EVA was broadcast back to Mars and Earth; Aurorae’s cafeteria was full for lunch at the time. Helmut was the sixth and last person to exit the shuttles. Experience on Phobos taught Helmut to stick to his compressed gas propulsion system and not try to walk; its gravity was about a ten thousandth that of Earth and virtually useless. He jetted about five meters from the shuttle and fired the jets on the top of his backpack gently so he would come down on a patch of regolith. He had long metal cleats on the bottoms of his boots and “ski poles” in both hands and pushed all four of them into the regolith

immediately so that he could stop himself without any gas. He was pleased that he managed to stop without embarrassing himself.

“Mars-based exploration of the asteroids continues,” he said. He had to say something, even though no one paid attention to “first words” any more.

“That’s all of us,” said Neal. “Don’t forget your buddy system; it’s pretty easy to get out of sight of everyone and to lose track of where you are. Gradivus has twenty-eight square kilometers of surface, and even though you can’t get more than five kilometers from the shuttles, you might not find your way back for hours. When in doubt, jet 200 meters from the surface and look around. Questions?”

No one said anything. “Okay, let’s go.” They began to turn toward their predetermined destinations. Ernesto and Neal were heading for North Crater; Hutan and Charles were heading for a fissure east of North Crater which exposed considerable bedrock; Zach and Helmut were staying close to the shuttles so they could get inside to provide support if necessary.

Helmut reached down to pick up a few grains of regolith to examine them. The fragments were a mix; some were differentiated igneous rock as expected on a Vesta-class asteroid and some were fragmentary pieces of chondritic, stony, and even nickel-iron meteorites. “Hey Zach, there’s a crater over there—” Helmut pointed, “—where the false color spectrometer showed material with unusual calcium concentrations. Shall we check it out?”

“Sure,” replied Zach.

Helmut looked around again. There was a boulder about eight meters in diameter that was being studied by Hutan and Charles. It was his landmark. He took off and aimed

himself to the right of the boulder and headed up about twenty meters so he could see around. That was one advantage of asteroid exploration; one could fly from place to place. He took his time and never went faster than a meter per second.

The little crater was about ten meters in diameter and he soon spotted it. He turned toward it and fired the jets again to coast over. He and Zach took two minutes to get there even though it was only a hundred meters away. As soon as they landed, they looked around to spot landmarks that would help them head back. The top of one of the shuttles was still visible.

“This is strange,” said Zach, picking up a big chunk. “Carbonate, sort of.”

“Not quite, though.” Helmut grabbed a small boulder very carefully and lifted it. The crystals were large and gray. Helmut turned on his helmet lamp to improve the light, and pushed a button to rotate a magnifying lens inside the helmet in front of his eye.

“It’s wollastonite!” he said excitedly a moment later.

“Really?” Zach looked closely with his magnifying lens. “You may be right. It’s a mix, I think. Some of it looks like sandstone. Fairly uniform grain size. Definitely not a breccia. Smooth, rounded grains.”

“This is a planetary fragment; it has to be,” said Helmut. He switched to a stronger public frequency. “Hey Charles, the blue false-color crater is full of impact debris. It’s small grained, the grains are rounded, and the composition appears to be a silica sand-carbonate mix that has been converted to wollastonite.”

“Really? Hutan and I are on the way,” said Charles excitedly.

“What do you think it is? This could be a chunk of Earth.”

“Possible, but the wollastonite tells you it was in a hot environment, right? On Earth, it’d have to be a carbonate-rich sandstone affected by an intrusion. Venus is a more likely venue.”

“Venus; I hadn’t dare think it’d be from there.”

“He’s right,” said Zach. “It looks to me that the impactor was a couple hundred kilos. There may still be a hundred kilos of stuff left on the ground here.”

“There will be fragments scattered all over the surface, too.”

“Yes. Helmut, they’ve recovered about one hundred kilos, total, from Venus, and maybe forty kilos more of tiny fragments from the moon. If this is Venus, we may double the total quantity known!”

“But from only one locality on the planet’s surface, and an unknown locality.”

“Even so, it’ll be useful for chemical analysis.”

They saw Charles and Hutan on their way. Helmut began to photograph every square centimeter to document the find. The crater was perhaps three meters deep; the impact had been fairly low velocity, for a shattered block still rested in the crater. He briefly imagined a large asteroid punching through the atmosphere of Venus so fast that it created a corridor of vacuum for several seconds, and the impact tossed surface material up fast enough to shoot through that corridor into space. Some of the ejected pieces entered orbits around the sun until they encountered another object: the moon, Earth, Mars, or in this case, Gradivus.

A minute later Charles and Hutan landed on the crater’s rim, sinking into the loose material until they came to a stop. Charles immediately scooped up some pieces and flipped his magnifying lens into place.

“Amazing,” he said. “I’m sure of it. Helmut, this is a piece of Venus. We’re flying past Mars on a chunk of Vesta, examining a chunk of Venus.”

“It’s a small inner solar system,” quipped Helmut.

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Will Elliott watched the Gradivus expedition from his work area at Cassini while he coordinated the recovery efforts. About the time the crew went back into their shuttles, he was pleased to see an email from Douglas Morgan pop into his in-box. *Congratulations, Will. I’m glad to see the expedition was able to proceed without us. And who would have thought they’d immediately find a chunk of Venus! I hear the news received headline treatment on several international media outlets, and that’s impressive with all the news on Earth right now. It looks like Gradivus will prove to be a gamble that was worthwhile.*

*We’re recovering here gradually. The Commission has power because of emergency generators; Houston has twenty percent of its power back on line and there are rolling blackouts. The computer systems for managing the power are so badly damaged, they can’t handle full restoration; the estimate now is for fifty percent power within a week and one hundred percent in four to six weeks. The rest of the U.S. is pretty much in the same boat. This will knock five percent from the GDP this year, the experts say. The communications systems are at about ten percent capacity right now, so all we can do is email. The radio and television networks are back up, but they’re covering the U.S. plans to invade Turanistan and little else. About fifty percent of the Commission’s employees are unavailable because they have to be home for various reasons; the kids aren’t in school yet, air and rail transport is disrupted, gas is unavailable, stores are closed, etc. Those who are working have to focus on rebuilding computers. Spare parts*

*are unavailable except at fifty times their old price; functioning used computers have increased in value tenfold. We won't be able to provide full support to Mars for some time. I gather from your report that recovery there is going better than it is here, and we're grateful for that.*

*This situation has effected our lobbying in Washington, too. No one in the White House or State Department has the time or functioning equipment to return our calls, and even if they physically could, the war is distracting them. The attack has turned them away from all international cooperation, including Mars. It'll be some months before we can build bridges with the new Administration. At least they're too distracted to pressure the current NASA administrator to step down, so we can be sure we can continue working with him for some time.*

*Keep in touch and we'll do what we can to help. Thank God the gold exports will be strong. The price of gold has skyrocketed to one hundred twenty million dollars a tonne and they say economic uncertainty will keep the price high for at least a year. That will help us a lot. Doug.*

Will immediately replied and included the latest report. Then he headed off to bed; it was late.

The next morning at dawn he boarded a sunwing bound for Aurorae. The sunwings were back in the air; only one had crashed as a result of the virus, and it had been a small, old one dedicated to transporting Prospectors and their samples. He flew in the remaining Sunwing-D, which had been strengthened to handle stress better and had a more robust rocket system. Since he was the only additional mass on board, the amount of silane fuel was increased and the vehicle flew higher and faster than was otherwise



possible. The sunwing touched down at Aurorae an hour before sunset, fifteen hours after takeoff; a new speed record.

The next sol was Saturdaysol, February 1<sup>st</sup>, Marshall's tenth birthday. Will woke up two hours before sunrise because of jet lag and couldn't get back to sleep, so he microwaved a cup of coffee and settled onto the couch to relax, watch t.v., and wake up. Marshall rose at dawn, excited about his birthday, and sat on the couch leaning on his dad.

"I was so afraid you'd get stranded in Cassini and miss my birthday."

"No, the damage to the computers wasn't that severe. I was worried about all of you, especially when I heard environmental control was knocked out."

"I didn't worry about that too much; I figured the farm and the trees would keep the air in here breathable for a long time." Marshall paused. "But I guess it was a little scary."

"I'm glad you realize that. Yes, the biomes are pretty safe."

"I worry about nanna."

"And we haven't heard anything after three sols. I'm worried, too."

"Maybe she should fly here. We don't have to worry about winter here, except in Huron Biome. And we won't have terrorism and all that stuff."

Will smiled. "It's too bad it'd be so expensive for her to fly here."

"Dad? You know, I'm not so worried about not being able to get some of the latest toys, now. I think maybe we might be protected by space. I always figured I'd go back to Earth someday, maybe for college, but maybe I should stay here."

“Let’s wait and see. This is a pretty dangerous place to live, too. We’ve now had two people killed in vehicle crashes, either rangers or sunwings. If we had a fire inside one of these biomes, the dome could burst and a dozen people could die in one minute. Madhu’s cancer might have been caused by Martian dust. Joseph Stroger died because we weren’t expecting the flu. So don’t think you’re safer here.”

“I know, but I think I’m safer here from *people*! No one here has been murdered, mugged, robbed, or blown up!”

“True, and I hope that doesn’t happen here for a long, long time. But remember when you hear about those things on Earth that they affect very, very few people. If you choose where you live and what neighborhoods you visit at night, your chance of having trouble is pretty small. And as we get more and more people here, we’ll start to have some of those problems.”

“Do you and mom want to go back to Earth?”

Will looked at his son, trying to determine Marshall’s concern. “Maybe at some point when you finish high school, the four of us will talk about whether the whole family should go back or not. Or maybe you, or Lizzie, will decide you want to go back on your own. By then I think you’ll be able to fly there for school and come back here later.”

“Oh, I wouldn’t go back without you and mom!”

Will smiled. “We’ll see; that’s still eight years away. So, do you want to go outside for a hike after your birthday party, or maybe tomorrow afternoon? We could go to the top of Boat Rock. I’ve been wanting to take you up there.”

“Oh, that’d be fun! With Sammie and his dad?”

Will nodded. “Sure. Lizzie and mom could come along, too; Lizzie is old enough now.”

“Can I see the golf course? I keep hearing about it, but I want to walk on it.”

“That’s a good idea. It has a really good trail that twists and turns around the area east and north of the Outpost, with some very good views of it. The Golf Club just developed the sixth hole very nicely. Okay, maybe we can do that instead of Boat Rock.”

“No, I want to do Boat Rock tomorrow, but maybe we can hike the golf course next weekend!”

“Okay. There’s some good geology along the trail, too.” Will had to smile. He loved to do things with Marshall. At age ten, the boy could manage a space suit pretty well, though he had to have adult supervision when he went outside. They hadn’t let him outside more than three or four times a year. Maybe that would change.

He tapped his son on the shoulder. “Let’s go to the cafeteria and get breakfast for everyone.”

“Okay.”

Will and Marshall rose. The boy carried Will’s empty coffee cup to the cafeteria. They returned a few minutes later with breakfast; by then, Ethel and Lizzie were up and ready to eat. After breakfast, Ethel and Lizzie went into the girl’s bedroom and came out with a birthday cake for Marshall. Ten candles burned on top; they had finally abolished the ban on birthday candles. They all sang happy birthday to him, which pleased Marshall immensely. It was the first of two parties, the bigger one at lunchtime being for his friends and their parents. Will went into his bedroom and brought out the presents and Marshall eagerly pulled them from the gift bags. He got some toys and clothing his

parents had been hiding since Columbus 7 arrived. They were relieved he was pleased by their guesses, when he was eight, what he'd want when he was ten.

Marshall hurried off to show Sam his new toy robot. Ethel took the breakfast dishes back to the cafeteria while Will and Lizzie collected two baskets of laundry, stacked on top of each other, which Will hauled to the new laundry facility in Huron. He put them into the robotic washing system; they would come out washed, pressed, and folded about 5 p.m. Every item was bar coded and numbered and Will dictated instructions via his attaché indicating several that needed a little sewing, or extra starch, or bleach. It was a much better system than relying on Father Greg.

When he got home he was relieved to see an email from his mother.

*Will, I'm sorry it took so long to reach you. I'm fine, though the house has maybe \$50,000 of damage from burst pipes, and the insurance company will probably go bankrupt before it can pay me. I've spent the last three days at the Stamford Bahá'í Center, which we set up as an emergency shelter. I tried leaving you a voice mail on someone's satellite phone, but the Commission's voice mail system still isn't functioning. So let me know if you get this. My email is now up again.*

*"It's been terrible. We now have power three hours a day. The Center has an emergency generator, but there are serious shortages of gasoline. Groceries are running out. There's a dusk to dawn curfew everywhere. In New York City they've started shooting looters. We're safe in the Center, though, because someone who's a security guard brought his uniforms to the Center, and the young men staying here rotate who wears them! It makes us look official and guarded very well. That's worked, so far.*

*Paul got here from Wesleyan University yesterday. He was safe on campus, but he was worried about me. It was a harrowing trip, with police roadblocks to pass through and a lot of suspicious questions. The campus will be closed at least another two weeks. We have a few 'refugees' from New York; they plan to go back next week because by then there should be power six hours a day. I'm not sure when I'll go home. They say the state of emergency will last at least another week. Constant power may not be restored for another month.*

*Molly forwarded me all your messages to her. I'm relieved all of you are all right. Wish Marshall a happy birthday! Give him a kiss for me.*

*Looking forward to hearing from you.*

*Love,*

*Mom.*

## Marsians

March 1-3, 2050

The patio in Yalta Biome was filled for the welcoming dinner of the Gradivus mission. Earlier that sol, the *Hadriaca* and *Tharsis* had blazed through the Martian atmosphere several times to slow down, then had landed at Aurorae. Half of the several hundred kilograms of samples were on board the Interplanetary Transit Vehicle Ophir, ready to head for Earth; the other half had come to Aurorae for further research by Mars's scientists.

“Congratulations again, Neal,” said Will, as he stopped by the table where three of the astronauts were seated. “I know it is the third or fourth time I’ve said it—”

“No, fifth!”

“Well, whatever. But I can’t say it enough. There are only 150 of us on Mars, and we just pulled off a deep space mission. With six shuttles, we’re in the position to fly one or two asteroid missions per year! That’s more than Earth plans to launch for the near future. So, who’s committed to exploration?”

“We are!” agreed Neal. “We just need more people, Will.”

“I know, and we’re working on that. Columbus 8 was scheduled to fly sixty-four passengers and twelve tourists, but the computer virus and the huge drop in the stock market has caused half the tourists to pull out, and one now wants to settle here for at least a columbiad. So it appears we’ll be flying at least seventy settlers here. We plan to import more engineers who can manufacture things we need. We’ll also train more people in shuttle repair.”

“Good, that’ll help. We need hundreds, though.”

“In time. The interplanetary transportation system’s not mature enough, Neal, and building up the system will cost billions that we don’t have. We need to replace the interplanetary hubs with much larger vehicles and expand Embarcadero to provide more robust support and emergency assistance. Anyway, we’re expanding fifty percent again, and we’re importing settlers, not temporary workers. The gold exports are worth twice as much as expected because of economic uncertainty, so that helps, too.”

“That’s true. That will help a lot.”

Will hesitated. “It’ll help a lot for a while, but when gold prices jump, so does terrestrial production, and eventually that’ll depress the price. We could be rolling in dough for two years, then be really short.”

Neal nodded. Will shook hands with Zach. “I can’t thank everyone enough.”

“Thanks, Will.”

He reached out to Helmut. “Twenty-five years old and someone who has walked on Earth, moon, Phobos, Mars, Gradivus, and its moon.”

“I can’t believe it,” said Helmut, with a smile. They shook hands. “I feel like I’ve walked on Venus, too, since I stood on top of the debris pile in the impact crater.”

“That’s right. One of the highlights of the trip,” agreed Will. He waved goodbye to the table, then returned to his family to pick up dishes needing to be taken to the cleaning area. Then Will walked to the podium.

“Can I have everyone’s attention, please.” He paused for the conversation to die down. “We have a reason to celebrate tonight. We have sent six astronauts beyond Mars space to another world in our solar system, completed a thorough exploration,

reconnoitered its little moon, and brought them back here safely. We confirmed that Gradivus came from Vesta's southern impact basin, suffered several additional impacts, and in another month our labs here will have dated the various impacts. Gradivus's regolith contains fragments from all over the asteroid belt and possibly beyond. There are years of research to do on the samples recovered. The Venus samples should tell us when they were blasted off that world and they may contain hints about early life there; the wollastonite once was calcium carbonate deposited in an early Venus sea. The amazing thing to add is that we have the laboratory equipment here to do much of the basic study of these samples. We no longer have to export the samples to Earth."

The audience broke out into spontaneous applause at that point. Will was surprised, but they were proud of their accomplishments as well. An excitement hung in the air. It stimulated Will to remember parts of the speech he had been working on over the last month, one he had decided not to make. "We have much to be proud of," he continued. "Mars is a world based on peace, mutual trust, acceptance of differences—I won't say toleration because it goes beyond that—universal employment and prosperity, dialogue, and consensus. It is a community that develops the potential of all its members. It is a society that so far has been able to tap the talents of its members and help them express them maximally. It is a culture built upon the best of the cultures of Earth, with uniquely Martian additions that could only have been possible here. It is a world dedicated to exploring the unknown, now beyond this world as well. And finally, Mars is a leaven. As Earth appears increasingly to sink into partisanship, conflict, mistrust, a spiral of violence, economic extremes, and impoverishment, Mars can stand out as a beacon of hope and an example that a multicultural, international society really can work.



Friends, we must continue our efforts, redouble them, and know that we work toward a great future for Mars and for all of humanity.”

A cheer broke out, followed by applause. Will stepped down from the podium and returned to his table. “I think you’ve made us feel patriotic,” commented Ethel.

Dinner gradually broke up as families headed home to put children to bed and single people went back to work or gathered in small groups to relax. After putting the children to bed, Will and Ethel watched a bit of television; their favorite show was sufficiently popular on Mars that it received priority for the limited bandwidth the communications system allowed. After a month, they were still functioning at sixty percent of communications capacity, though a shuttle flight in a month would repair several communications satellites.

The next morning began an ordinary sol, with the usual heavy work load to complete. The family ate breakfast on the Patio in Yalta, where the big screen was carrying the BBC news live. It was a tense sol; the lead story was a United States bombing in Turanistan that had killed seven hundred civilians.

“Wait till you see the story,” said Skip to Will. “It’ll be repeated at the top of the hour. They hit the Grand Mosque during Friday prayer.”

“Skip, they say it was an accident!” exclaimed Roger, angrily. “Why would they do something like that on purpose? It makes no sense. They made an error entering the GPS coordinates.”

“Yeah, right. Roger, the Shaykh of this Mosque was a leading figure in the Lashkar and is still at large. His sermons inspired the computer virus that resulted in the deaths of about six thousand people and the beginning of the largest economic downturn

since the Great Depression! Accident, my foot. This is the most reactionary White House we've had in decades. They're getting even."

"They aren't dumb, Skip. Revenge will only beget more revenge, and they're sufficiently ethical to know that."

"Take your choice; they're either too dumb to program a bomb right or too dumb to realize the consequences of an intentional act of violence against innocent civilians."

"And we won't resolve that question here," replied Will. "Skip, how's the film?"

Skip didn't answer right away; he didn't want to change subjects. "They've started working on the special effects, but with the reduced communications, they can't send any clips to me that are more than about thirty seconds long. It's a pain."

"We should be close to one hundred percent in about a month, and you can get it then," replied Will. "Oh, here's the story."

They all turned to the screen. The details were as Skip and Roger had reported, except the death toll at the mosque had now been revised downward to six hundred as the last bodies had been pulled from the rubble; the mosque had been full and it was entirely enclosed because of Turanistan's cold climate. The toll was expected to rise as the injured died in hospitals, which were overwhelmed by the enormity of the disaster. President White was shown expressing regrets for the event, though he seemed wooden and unconvincing, and he mispronounced several Turanistani words. Several spokesmen for radical Muslim causes expressed the certainty that revenge terrorism would follow.

The report lasted a full five minutes. It was followed, much to Will's surprise, by his speech at last night's dinner. Yalta Biome had several cameras and anything that

happened there was regarded as public. “The guys in Houston running the Mars Channel must have liked what I said and rebroadcast it,” he said to Ethel.

“They didn’t ask you?” said Skip.

“No; anything I say here is regarded as public domain.”

“It’s a good speech, but quite a contrast to the previous news item,” noted Skip.

“I know,” replied Will, worriedly.

Soon everyone headed for work. Before Will was able to turn to his email, though, Enlai Tang and Vanessa Smith showed up at his office door. “Can we talk to you?” asked Enlai.

“Sure, come in. For how long? I have a teleconference in an hour.”

“Not that long. Five minutes.” Enlai and Vanessa sat at the table Will had in front of his desk, and he came around to join them. “We’re finishing up a paper for *Nature*,” said Enlai. “It’ll appear within the next month. We’ve been working very hard for the last seven months to study the five species of microorganisms recovered from the Hellas Ice Chimneys. The paper is coauthored by six people in the biology department at Stanford.”

“And?” asked Will.

“The Stanford people are experts in the genomes of thousands of species of bacteria,” replied Vanessa. They helped us to convert existing equipment here on Mars into a laboratory for studying the genetic material of the Hellas species. It turns out we’re dealing with species that are not known on Earth. The genetics, however, tell us that their nearest relatives are usually found in tropical marine muds, especially in coral reefs and the deep water near them.”

Will was surprised. “That’s bizarre. You’d think they would have come from deep-sea vents, or from bacteria common in NASA engineering facilities.”

“Meteorites don’t blast many pieces of the deep sea floor into space,” replied Enlai. “And these guys didn’t colonize the chimneys after being accidentally transported to Mars on a spacecraft a decade or two ago. A big impact blasted a lot of terrestrial ejecta into space and some found its way to Mars.”

“But when?” asked Will.

Vanessa smiled. She looked at Enlai, who smiled back. “That’s the question, isn’t it” he replied. “And we can determine the answer roughly by determining the quantity of genetic mutations and estimating the rate of mutation. That’s what the Stanford people have been helping us do over the last seven months. That’s why you haven’t seen me at all for most of that time; our equipment allows very accurate DNA sequencing, but it’s slow. We’ve sequenced eight short DNA segments and we plan to sequence eight more in the next four months. Our estimate is that the bacteria was blasted off the Earth and settled onto Mars between 50 and 90 million years ago.”

“The new Mars climatic model has several warmer periods in that interval,” noted Will.

“Yes,” agreed Enlai. “And by the way, the paper coining the new terminology has been accepted for publication in the *Journal of Climatology*: we’re using *estival*, from the Latin for summer, to refer to the times when Mars has a high axial tilt, the poles get lots of sun, and the atmosphere thickens; the added greenhouse effect indeed gives the entire planet a ‘summer.’ When Mars has a very low axial tilt and the poles get extremely cold and the atmosphere almost completely freezes out, we have a *hibernal* or ‘winter.’”

“And during an estival imported bacteria could spread atmospherically,” noted Will.

“Yes,” agreed Vanessa. “But there is a more interesting implication.”

Will frowned, then he opened his eyes wide as he considered the date.

“Chicxulub.”

“Yes,” agreed Enlai. “Cretaceous-Tertiary boundary. The impact that wiped out the dinosaurs was by far the largest impact the Earth has experienced in the last two hundred fifty million years. It made the rise of mammals and humans possible. It probably populated Mars as well.”

Will smiled, then they all laughed. “So Mars has had life for sixty-five million years! After that long of an interval, they might as well be considered Martians!”

“Exactly. Mars had life at the beginning and it has had life again for some time. They’re as good as native. They deserve protection.”

“So much for terraforming. No one planned to do that for a century, anyway. Maybe they could be moved to the tops of the volcanoes if we wanted the rest of this world. They’re anerobic, right?”

“Yes; they’re killed by oxygen,” said Vanessa. “We need to plan another trip back to the chimneys later this year to find out how many chimneys have colonies in them. We can also study extinct chimneys to determine when they were inhabited and if they still have spores. There may have been other species in the past, too; every time an estival is replaced by a hibernal, their habitat must shrink drastically and extinction may result. We have to examine the chimneys around Elysium again, also. Maybe there is evidence of past colonies that we didn’t recognize when we visited them.”

“Now we know what to look for,” said Will. “We will want to drill, eventually, to determine how much they’ve spread underground. But I suppose the Mars Council should declare the area a national park, next time it meets, so that it is off limits to settlement and resource exploitation.”

“We definitely won’t be setting up a hydrothermal power station there,” agreed Enlai, wryly. “You’ve got to let Louisa know. This will be public in about two weeks, once the peer reviews of the paper are completed and a publication date is set. It may start to leak earlier.”

“I’ll let her know. Send me a copy of the paper as soon as you feel it’s appropriate.”

“We’ll email a copy to you tomorrow, when it goes to *Nature*,” replied Vanessa. She and Enlai rose, so Will did as well. He thanked them and they left.

He turned back to his work, then received the Houston meeting. Work was beginning to get back to normal in the Commission headquarters, although the new computers had cost ten times as much as they would have a month earlier because of the severe shortage. The meeting reviewed the cargo and passenger manifests for Columbus 8; both were still being finalized, even though the first passengers would be on their way to Gateway Station between the Earth and moon in two months. During the meeting’s built-in pauses—three, for communications to shift back and forth between Earth and Mars—he did email.

At lunch Will went back to the patio, where he and the family always sat at their own table with two empty seats in case anyone wanted to join them briefly. But normally lunch was a family gathering for them; often they took their food home to prevent

interruptions. That sol, with the news from Turanistan, they watched the big screen while they ate.

The cycle of news had changed. The story of the bombing had additional information: the Air Force was denying intentional bombing and promising an investigation; a leak suggested the bombing had been intentional, as a signal to the Lashkar; the death toll had begun to rise again. But this time Will's comments were built into the story. Will sat up straight in his seat when the BBC announcer said that the President of the United States had been offended by the comments.

The picture cut away to President White walking across the tarmac when a reporter asked him about the comments from Mars. He stopped. "I think it's a shame the Governor of the Mars Operations would have anything to say about our foreign policy at all. It's completely inappropriate and a breach of his own ethics. The operation up there has lost touch with the people on Earth. They've become *Martians* rather than Americans. They like to think of themselves as guardians of harmony and nonviolence. In fact it's a tiny, isolated operation and they have their own problems, as is well known. We've shifted our priorities elsewhere." And then the President resumed walking to his limousine.

"Wow!" exclaimed Érico, who was seated at the next table.

Will sat there, shocked. "Bizarre," he replied. "Especially since the speech I gave happened hours before the bombing and had nothing to do with it!"

"They're sending a signal," said Roger. "Morgan's efforts have not gone well."

"I guess not." Will looked at Ethel. "I'll be hearing from Louisa about this."

“I can’t believe they did this to us! Your comments weren’t even meant for distribution!”

“Exactly.”

“How dare he attack our way of life this way,” echoed Ananda from another table.

“And what’s wrong with being a Martian?” added Érico. “I was never an American, regardless what White thinks. I’ve been here over twelve years and have no plans to return to Earth. I guess I am a Martian, now.”

“Or a *Marsian*,” corrected Carmen. They had occasionally used the term, pronounced *mar-zee-an*, to refer to human efforts on Mars, such as “Marsian culture,” to distinguish between them and “little green men.”

“So am I,” agreed Will. “Maybe it’s time we all said so, too. The President just said he wasn’t going to give us any money, after all!”

Ethel reached out and touched his arm. “Let’s not antagonize.”

“Actually, I don’t need to antagonize; just say that since my comments were made before the bombing, I don’t understand what the President’s problem is.” His voice mail beeped. He looked at his attaché; it was Louisa. He rose and walked out of the patio and to the yard, where he could talk in privacy. He played her message.

“Will, you should see the President’s comment about your speech. I’ve attached the clip to this message. As I understand it, the night shift here in Houston put a clip with your speech on our website and emailed the link to several dozen editors. You didn’t make it for release, right? I’m surprised you made the comments after the bombing; the timing must have looked pretty suspicious. Of course, the guys working last night were not the usual shift. Nothing is normal right now; half our people are still at home. Bye.”



Will set his attaché on the edge of a big pot that contained a tree, combed his hair, then faced it and recorded a reply. “Louisa, this is bizarre. I made my comments at dinner last night here in Aurorae. That would have been about 4 p.m. in Houston. I saw the news before going to bed four hours later and there was nothing about the bombing. Here’s a clip for you.” He paused to put himself in the right frame of mind. “You can ask me whether my comments had anything to do with the bombing this sol. No, my comments, made last night at 7 p.m. Aurorae time or about 4 p.m. Central Standard Time, were spontaneous and meant for us Marsians, who were celebrating the safe return of our Gradivus mission. They were not directed at any particular nation or news event. They certainly had nothing to do with the tragic bombing that occurred in Turanistan several hours after I gave my talk. I join with all other Marsians in extending our condolences to the families who have lost loved ones.”

He had emphasized the word “Marsians. He hit send, wondering whether Louisa would edit out the last sentence. He didn’t hear back from her for over an hour, which surprised him. The return email was from Doug Morgan’s office; Louisa sat behind his desk with him.

“Thanks for the clarification, Will,” Morgan began. “The President’s comments were aimed at me. The White House has been pushing me very hard to assist them in their effort to reassert control over the Mars Commission. They’re threatening to pull the LANTRs from Columbus 8 if we don’t cooperate. So far I have refused to help, but I have also been careful to leave the door open; I’m trying to stall until after Columbus 8 is underway. I think if I approach them very gently and point out that they have overreacted and could be embarrassed if we explain that your comment was recorded hours before the

attack, we may win some good will, especially if we don't release your new statement. On the other hand, if they don't budge, we'll release your statement, though I think we'll electronically tone down your emphasis on 'Martian'; that'll just anger them more."

"Please don't make any public statements right now," added Louisa. "They're trying to draw public attention away from the disaster in Turanistan. If we complain, we'll assist them. We have a publicity agenda; we'll stick to it. And Will, remember that I fly to Paris tonight for three months, so I'll be unreachable for the next twenty hours or so. My assistant will stay in Houston another week, then follow, so contact her and she'll reach me. I'll be staying in my apartment and working out of the Commission offices there, except for early April when I'm taking two weeks of vacation."

"Keep in touch, Will," added Doug. Then the videomail ended.

## Houston

Apr. 2050

The early afternoon sun slanted down Huron North's light well and shone on the grass covering the bottom. John Hunter and his wife, Vanessa Smith, sat in chairs in the shade of the wall with Greg Harris and his wife, Anna Racan. The two couples had apartments facing the grassy floor and often shared it together on Sunsol afternoons.

"I hope you can take care of our flowers," said Greg, indicating a row of zinnia pots. "Anna and I leave for Dawes right after Easter and we'll be gone at least three months."

"You're going away for three months?" asked John. "Greg, when have you ever gone away for that long before?"

"This is the first time. But Anna's needed at Dawes because a construction team will be arriving starting next week to start work on the second biome; she'll be the nurse and physical therapist."

"What about mass?" asked Vanessa.

"I've consecrated enough host and wine for the entire trip, and Eammon, as deacon, can distribute it. I'll give the sermon by video."

"As much as he says he wants to stop, he never does," added Anna. "In fact, we're planning to organize a mass and an interfaith service at Dawes, with the help of Kimberly and Ananda."

"But is that enough to justify your trip?" asked John.

“No. I’ll be doing religion on Sunsol. The rest of the week I’m there to set up chicken and tilapia production; Gaston has trained me how to do it. Neither Dawes nor Cassini have either; right now they incinerate or compost agricultural and cafeteria waste. Cassini may ship its waste up to Dawes, since right now there’s a lot of unused cargo capacity between the two outposts.”

“So, Dawes will become a chicken exporter,” said Vanessa, smiling. “A funny idea.”

Greg shrugged. “Cassini’s slated to get a third biome next year, and after Columbus arrives 8 both will grow thirty percent in population. The new Meridiani Trail built next year will provide a direct route from Aurorae to Dawes, making the round trip drive a bit faster.”

Vanessa looked at the zinnias. “John and I will be here, so there won’t be any problem.”

“When do you plan to visit the Hellas Chimneys again?” asked Anna. Vanessa and Enlai’s paper had appeared in the previous issue of *Nature* and now everyone on Mars knew about their research.

“Enlai’s going up in late June, just before the dust storm season. We may make another trip in early 2051 right after it ends; they want to send an expedition from there southward into the polar terrain.” She paused a moment. “But I’m not going because I’m pregnant.”

“Really, Congratulations!” said Anna. She leaned over and kissed her friend.

“So, you beat us!” added Greg.

“You’ll have your chance,” replied John. “It’s going to be interesting.”

“That’s why I’m wearing a radiation vest,” said Vanessa.

“I noticed, but that’s hardly a clue any more,” replied Anna. “Practically everyone has added attractive radiation vests to their outfits. It makes all of us look fat.”

“The new fashion,” added John.

“It’s so sweaty, though,” replied Vanessa, adjusting her blouse, which was covered by a vest filled with hydrogen-impregnated polyethylene pads five centimeters thick in front and in back.

“Of course, you’re always warm, now,” added John, putting his hand on her.

“This is not public information, yet,” Vanessa added. “It’s only been six weeks. We were surprised; we had planned to wait longer.”

“Don’t worry,” replied Anna. “God willing, we’ll be joining you next year.”

“Meanwhile, I’ll be at Aurorae for the next year,” said John. “I have some geochemistry to do, but there’s lots of industrial chemistry, and I may do construction as well; I enjoy it. And we’ll get a new flat after Columbus 8 arrives so we can accommodate a baby.”

“The new flats will be larger and they’ll have a lot more private outside space,” said Anna. “I think they’re talking about ‘lawns’ about fifty percent bigger than this, and not shared with anyone else.”

“That’s correct,” replied John. “And balconies. We’re looking forward to more space, too.”

“So, will the baby be Lakota, Maori, American, or New Zealander,” asked Anne.

“Marsian,” replied John. “Maybe I should say ‘hyphenated Marsian’ part Lakota-Marsian, part Maori-Marsian, part other things as well.”

“Everyone is using the term Marsian now, since the President used it to criticize us and Will used it to defend us,” noted Greg.

“It still makes me think of ‘little green men’ not of me!” added Anna.

“They’re ‘Martians.’ We need to call ourselves something,” replied John. “I no longer worry about that. We’re Marsians. There aren’t many of us, but we have a distinctive culture, a distinctive dialect, distinctive sports and arts, distinctive architecture, distinctive clothing fashions—” He pointed to Vanessa’s outfit with its radiation vest. “A distinctive social structure with collective meals. . . it will continue to change and evolve, but after fourteen years it’s already pretty distinct.”

“It is,” agreed Greg. “But what worries me is the negative edge. ‘We’re Marsians; they aren’t.’ President White’s repeated criticisms and his efforts to take over the Commission have given Marsianness an angry side.”

“We’re angry at him, sure, but not just for that,” responded Vanessa. “The Congressional hearings have uncovered clear evidence the attack on the mosque was deliberate and there’s impeachment in the air.”

“Again,” said John, shaking his head. “We can do without the U.S. The gold can now cover half our costs. We could probably get grants from the Chinese and others who want to thwart the United States to cover the rest.”

“That would be a mess,” said Greg. “I’ve been thinking that we need a positive Martian event—or would it be a Marsian event?—right now to balance the situation. A big dinner and arts evening, for example.”

“One thing we still don’t have is a holiday,” agreed John. “That’s something we could use.”

“The equinox is coming up in late May,” noted Vanessa. “It’d make a good holiday. For Aurorae and Dawes, it’s midsummer because the sun’s overhead. For Cassini, it’s the vernal equinox.”

“That’s a great idea!” exclaimed Greg. He stood up to pace around, he was so excited. “We have two equinoxes per annum; about one per Earth year. We could make it a holiday like American Thanksgiving, with big meals, using distinctively Marsian cuisine. And we have to have art! Seven weeks: there’s time to prepare!”

“But how can we invent a holiday?” asked John.

“Holidays are not that hard to invent. The Governor declares a sol off and the Mars Council passes a resolution declaring a public holiday. The public does the rest. The Borough Councils could appoint Equinox Committees, too.”

“That would work,” agreed John. “And you and Anna could plan the celebration at Dawes while Vanessa and I assist with Aurorae.”

“And we can find someone to spearhead the effort in Cassini,” said Greg. His eyes twinkled with excitement. “This is doable.”

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It was two sols before Greg could talk to Will about his idea. Meanwhile, he did further research. When he arrived at Will’s office for his appointment on April 2, the boss was busy on the videophone.

“Sorry for the delay,” Will said, when he finally beckoned Greg in. “Lots of last minute changes to the cargo manifest and even to the passenger manifest.”

“I hear. Anna heard just this sol that her cousin’s coming.”

Yes, he's the new addition. Another tourist pulled out because he's suddenly broke. The Dow Jones is down fifty percent and unemployment's rising fast as Europeans and Japanese shift their investments out of the U.S. to other economies."

"Making it all worse."

"Exactly, and the U.S. economy is dragging down everyone else's. Governments are contacting the Commission and reneging on all or part of their annual subsidy, but the price of gold goes up and we have more gold income. It's a constant balancing act."

"And a headache. How are the negotiations going with the White House?"

Will shrugged. "I'm not involved. I gather it's very slow and there's not much progress. Meanwhile, they're putting pressure on us. NASA has asked for double the payment for support services next year. The contractor that builds the Mars shuttle engines has asked for a big advance payment. The support contractor for the mobilhabs and conestogas has said it cannot continue without tripling the fee."

"But some of that isn't from the White House, right? Some of it must be economic necessity."

"Correct. The economic crisis is unlike anything since the Great Depression over a century ago. The drumbeats of war make economic uncertainty even worse, and the aging of populations in Europe and Japan have very little surplus for space exploration anyway. We have to make some difficult choices because we don't have enough money for everything. I've been urging Morgan to pool resources with the moon, since their economic crisis is worse than ours—tourism has collapsed—and they have some common equipment. But he has been concentrating on tough bargaining because working with the Lunar Commission would alienate NASA further. We'll have to go without



some support services. We have more experience with our ground vehicles than anyone on Earth.” He sighed. “Let’s not dwell on the negative. What can I do for you?”

“I have a positive idea for you. We need a positive ‘national’ or Marsian holiday. Anna and I were talking to John and Vanessa the other sol and we hit on the idea of celebrating the equinoxes. They occur about once per terrestrial year. On Earth, the spring equinox is an old agricultural celebration in many societies. The equinoxes are important to us because they drive our internal climates; when the sun is overhead the equatorial biomes have summer. Celebrating them would help us keep in touch with the planet’s seasonal cycles. I’ve talked to Madhu; she could have an artistic evening ready for the next one, which falls on May 22. We thought the best celebration would be to have the sol off, followed by a big dinner and an arts evening.”

“That’s a great idea. But celebrating some holidays by the terrestrial calendar—like New Years and Easter—and celebrating others by the Marsian calendar will get complicated at times.”

“Nothing we can’t handle.”

“True. The Muslims have the same problem already with their religious holidays. We’ve tried to make the landing of Columbus 1 into ‘Mars Day’ but it hasn’t taken off, maybe because we were never sure which calendar to follow in celebrating it. Right now we could use an outlet for Marsian feeling.”

“We had exactly the same thoughts.”

Will nodded. “Okay, let’s do it. I suggest you ask the Mars Council for a proclamation. I’ll talk to my heads of staff about the holiday; they’re jealous of the time

they have right now because we're badly behind schedule. But a sol won't do any harm, and considering how hard everyone has been working, it might do some good."

"Excellent." Greg rose. "Anna and I leave for Dawes in two weeks, but we can get the ball rolling here, then get it started there as well. I'll talk to the Mars Council about a proclamation and the Borough Council about appointing a planning committee."

"Good idea. Thanks, Greg."

Father Greg nodded, waved, and headed out of the office. Will turned back to his work. There was another email from Sebastian Langlais asking Will whether he could prevail on the Mars Commission for any additional business; Shackleton faced a fifty percent cut in personnel over the next six months otherwise. Will replied quickly that he had been trying, but was encountering a lot of resistance. When he hit "send" nothing happened for thirty seconds, then the message "communications with Earth interrupted" appeared on his screen.

He called Mars control. "Rostam, how long has the link with Earth been down?"

"About two minutes. It went down unexpectedly. The problem appears to be in Houston. Communications are still coming up via Paris, Beijing, Tokyo, and Moscow. Email and media are already being rerouted down there via the other ground stations and we're rerouting things up here as well."

"Their computer systems have not been robust, since the virus."

"But this has never happened before. Previous instabilities lasted thirty seconds or less. I'm sure they'll inform us of the problem once service is restored."

"Okay. I just emailed the moon, but it didn't go."

"Send it again, the Paris transfer point is functioning."

“Okay. Thanks.” Will hung up and sent the message to Sebastian again. That time it went. He turned to Louisa’s latest email from Paris, where she was settled for the spring. It proposed public relations themes for the summer.

Before he finished his videophone was beeping urgently. It was Silvio DiPonte. “Will, the big screen here in Yalta has the BBC news on it. They’ve interrupted their regular program for a news bulletin about Houston. Something’s happened there.”

“What?”

“No one knows. The city has fallen silent; all communications are down. The crisis has dragged down the electrical grid as far away as Dallas and New Orleans, too.”

Will groaned. “Thanks, I’ll warn Rostam. I wonder if it’s another virus.” Will exchanged a few more words with Silvio, then closed the circuit. He turned on the BBC news on his attaché

There was nothing new, but he found it impossible to do anything; he felt a sense of dread, almost anxiety. In the last few months there had been way too much uncertainty; staring at the screen, he realized he had been under a lot of stress. No doubt it was affecting his blood pressure and cholesterol, not to mention he had been shorter with the kids, lately. And he worried about the dozens of people in Houston with whom he interacted daily; what might be happening to them? He looked at his chronometer program; it was 4 p.m. in Texas. Rush hour.

While he was contemplating the possible impact of the troubles on his own life, the BBC had a news break. “The Pentagon has just announced that the North American Air Defense Command’s early warning satellites have detected a nuclear explosion about twenty kilometers northeast of Houston, Texas. The explosion appears to have been in

the 20 to 50 kiloton range, which means it was equivalent to twenty to fifty thousand tons of TNT. It is assumed that the sudden loss of communication with Houston, and the collapse of much of the electrical grid in Texas, is attributable to the explosion.

“Our experts tell us that such an explosion would produce a flash bright enough to blind people within a few kilometers. It would cause spontaneous ignition of fires. The shock wave would be capable of destroying buildings out a dozen or more kilometers, depending on the nature of the construction. There would also be radiation effects.

“The blast would also emit a powerful electromagnetic pulse. A person with one foot on a train track would be shocked. All electronics would be burned out; cell phones, computers, automobile engines, even household appliances with chips in them would have been rendered useless. We have no information yet about the quantity of injury to people and property that has resulted. It is likely that we will not find out for some time, because even electronics that were turned off would have been burned out.”

The reporter turned to the co-anchor and they filled time by calmly discussing the news. Will stared at the screen, shocked by their demeanor as much as by the news. The Hiroshima and Nagasaki bombs were equal to 21 kilotons of TNT; this one was as large or larger. The Mars Commission was located southeast of Houston, probably thirty or more kilometers from the explosion. The altitude was an important variable; if the bomb exploded high, the flash and EMP would reach the Commission, blinding persons outside, lighting many structures on fire, and destroying electronics; if it exploded low or on the ground, the horizon would shield the Commission from the flash and EMP, but there would be fallout and possibly a large shock wave that would blow over many

structures, convert windows into a hail of bullets, and expose millions to radiation far worse than the Martian surface.

In addition to a thousand Mars Commission workers and their families, there were cousins, close friends, and even a few spouses of Marsians living in the area. Greater Houston had millions of people; probably hundreds of thousands of them already were dead or soon would be.

Will's videophone beeped. It was Rostam Khan. "Will, have you heard the latest?"

"I have the BBC on. It's a major tragedy."

"I know, but I wanted to be sure you knew."

"Thank you. Was Houston monitoring anything for us, this sol?"

"They were providing a second set of eyes on preparations for the launch of the *Pavonis* and *Arsia*. They were monitoring Aster 1 and 2 so we had more time for other tasks. They were watching all our biomes, but that work was mostly being done in Seville and Paris, so that's ongoing. And of course they were providing a constant set of second eyes for all our Prospectors and all our expeditions."

"Of course. Our work on the new 75-meter class biome is being monitored in Moscow, though."

"And there's the vast amount of support work they were doing, paying the bills, issuing research grants to geologists and biologists, handling human resources matters, engineering updates to everything from fuel cells to low-flow toilets, keeping track of our inventories, investing our retirement monies, finalizing Columbus 8, etc."

“I know. All that’s blown away for months at least. Thanks, Rostam. I’ll draft a statement for the Mars operation right away.” Will closed the connection. But before he could draft anything, he closed his eyes to deal with the emotion, which was building in him. He took control of himself and said a short Bahá’í prayer for the remover of difficulties. Then he drafted a list of points while keeping one eye on the television image flickering on his attaché. He was ready.

“Attention all Mars personnel. Just minutes ago we lost all communications with Houston, including email, telephone, and media. Since then we have heard on the British Broadcasting Corporation’s all news channel that a nuclear device has exploded twenty kilometers northeast of the city of Houston. We assume that the flash, blast, and electromagnetic impulse have knocked out all services at the Mars Commission headquarters. However, there is no confirmation of a nuclear explosion from sources other than the Pentagon and no information is currently flowing from Houston itself.

“We can infer that a tragedy of great but still unknown extent has unfolded in Houston. It is essential that crucial personnel in environmental management, shuttle support, and deep space exploration remain at their posts. Personnel in Prospector support must be shifted to the above functions to replace support no longer coming from Houston. We recommend that other personnel remain at their posts if possible. There will be a special brief meeting after dinner in the patio, and I urge the interfaith committee to plan a service for 7:30 p.m.

“Dear Friends, this will be a difficult experience for all of us. Friends and relatives are in danger. But we will get through this tragedy just as we have weathered

many other storms, and the spirit of Mars will be manifested to all as a result. You are all in my thoughts.”

Then he sent the message. He immediately looked at the clock; 4:15 p.m. in Houston as well as at Shackleton Station. Sebastian Langlais, High Commissioner of the Moon Commission and commander of all lunar operations, had flown from Houston to Shackleton last month, from which he ran the Lunar Commission about half the year. Will called up his old friend’s videomail number.

“Sebastian, this is Will. We just heard about Houston about fifteen minutes ago. I feel terrible; your people are a hundred times more tied to the place than we are. Can you please confirm the situation, preferably by transmitting to us a telescopic image of the city. My calendar shows the moon is at first quarter; that means Houston will be visible another five or six hours. We’re opening communications with Paris, but it’s almost midnight there and they won’t have staff for eight hours.

“Also, Sebastian, the moon stations, the Mars outposts, and Columbus 8 all need second sets of eyes that we can’t get from Houston any more. I assume the Lunar Commission is out of service as well. Let’s open some direct communications channels. You can monitor Aurorae and we can monitor Shackleton. You can help out with Gateway and Columbus 8 as well. It may take a few sols to get the systems talking to each other well, but I doubt we’ll get ground support any sooner. Let me know what you think. Bye.”

He hit send and thought about the situation on the moon. The personnel there rotated back to Earth half the year, because lunar gravity was too low for long-term human health and raising children, and because transportation was reasonably quick and

regular. Most had their families in the Houston area. The nuke was also a serious crisis for Columbus 8, which was taking shape at Gateway. Will looked up the voice mail number of Seiji Takada, who was also serving as Commander of Gateway; Gateway was only intermittently inhabited, and when Columbus cargo and passenger missions were about to depart, it was essentially taken over by the Mars Commission. The rest of the time the Lunar Commission ran it.

“Seiji, let me know how things are going there and whether you need backup,” he said. “We can provide some of the support Houston gave you. Bye.”

Will sent the message, then sent one to Louisa, then picked up his attaché and walked to Mars Control, located one floor below his office. Ruhullah was there and had already redeployed Prospector operators to provide environmental management backup. He was talking to Emily Scoville, Commander at Cassini, just as Will arrived, about mutual monitoring of systems. It had become a standard practice to have two groups of people monitoring systems, with the backup team auditing the other’s performance periodically. Will called in a few others to help as well and began drawing up the second and third shift schedules. Then Sebastian’s reply arrived.

“Will, thanks for the call. We’ve already yanked two six-meter telescopes from their research schedule and have them pointed at Houston at fairly high resolution. Unfortunately, there’s a line of thunder storms just north of the city and it’s marching southward, so we’re going to lose the view in two or three hours. The picture’s being broadcast on various media outlets, but we’ll add a live feed to Mars. There’s a large circular area of darkish discoloration about fifteen or twenty kilometers around and it’s



rapidly becoming obscured by clouds; the latter appear to be smoke from fires. There's a massive fire developing, and without communications it will be hard to fight.

“As for reciprocal monitoring, we'd be glad to do it. We have LeMonnier Station providing a backup to Shackleton and vice versa, but the sort of detached monitoring Houston provides is hard to duplicate. We've recalled all surface expeditions; it's much easier for us to do that than you, since they've all been deployed via hopper. They're mostly staffed by Columbus 8 geologists in training, so we will be training them in environmental control systems monitoring instead. We're delaying a flight to Gateway until we have a better sense of the situation. We can provide ground support for Gateway. Many of us won't be working tomorrow because of the worry. My wife's down there.

“But we'll start transmitting the backup data to you right away. Feel free to do the same. And keep in touch; let us know what you learn from Paris. Bye.”

On the heels of that message was a video from Seiji Takada. “Will, we're fine and awaiting contact with Houston. We've contacted Johnson Spaceflight Center, but there's no response from them, either. We have three quarters of the cargo here with two more ion freighters scheduled to arrive in the next two weeks. One has our last interplanetary hab. One Mars shuttle is sitting on the moon, scheduled to fly here next month. We have sixteen Columbus 8 crew on the moon for training, six here, and twelve on the way, and twelve scheduled to arrive every two weeks to prepare the cargo flight and set up Columbus 8 for departure. We need monitoring if mission control doesn't come back up soon, but our folks at Shackleton can assist with that, and once the twelve arrive in three days we can press them into service. Bye.”

Will acknowledged the response and urged Seiji to set up personnel to provide monitoring, then called Rostam and Ruhullah over and replayed the two messages. They assigned four personnel to monitor the lunar systems and two to monitor Columbus 8. Rostam redirected to Shackleton the usual Mars control data transmission that was sent to Houston. Then Louisa responded.

“Will, I can’t get through to anyone in Houston. I’ve called Pierre Messier, head of the Commission’s Paris office. We’ll both be in his office in fifteen minutes. He plans to call in as many people as possible, in spite of the hour. I’ve also called David Alaoui and he’s looking into whether the Mercury-Venus Commission can provide some limited ground support for us, but they’re concerned about LeMonnier Station in particular, since it’s a European Union station. Fortunately it has always been supported from Darmstadt and Toulouse, and those facilities can probably help Shackleton and maybe us.

“Keep in mind that if Doug Morgan is killed or incapacitated, or even if he is unreachable for a long period of time, as Assistant Commissioner you would become the acting Commissioner. No one ever anticipated the possibility that the Mars Commission would be run from Mars, but that may be necessary if we can’t hear at all from Houston for a lengthy period of time. Until we hear from Doug, we’ll take orders from you. Bye.”

Will hadn’t thought of that. He hit reply. “Louisa, you are quite right. Until we hear from Houston, the Paris Office must assume the role of terrestrial coordination and I’ll advise through it. If I am Acting Commissioner, that makes Pierre Acting Assistant Commissioner. Pavel Rudenkov in Moscow is completely reliable; he’d be next in line, and their facilities are smaller than Paris’s. The Tokyo and Brasilia offices are even smaller. The Seville and Milan facilities provide direct support to specific aspects of the

operation and that will continue. Seville can probably expand their monitoring of the biomes, since they already provide biological and ecological management advice. Please find out how soon they can expand their support for the Shackleton biomes. You know what services Houston provides; Paris does some of them for our European personnel and will have to scale up in this emergency.

“Sebastian Langlais and I have set up backup monitoring of each other’s facilities and vehicles. The moon can help a lot for now, and we can help them, but we’ll need more in-depth assistance from you.

“We also need to think about the media implications. I’ll work on a statement about the tragedy to release in a few hours. Please send me talking points, and work on the media contacts from there. Bye.”

So many things to deal with: one moment it made his head spin and the next moment it energized him to wade in and salvage the situation as best he could. He quickly drafted a statement for internal purposes: “I am sure I speak on behalf of all personnel in the Mars Commission, on Earth as well as on Mars, when I say that our thoughts and concerns are focused on our colleagues in Houston, who appear to be facing a very grave situation. While they overcome their own personal tests and rebuild our Houston operation, they can be sure that we will stay the course and continue our vital work of exploring and settling the Red Planet.” He signed it “Assistant Commissioner” and sent it out to all Commission employees on both planets. Then Silvio called. “Will, the Patio’s filling up. People feel the need to gather and talk through the situation.”

“Thanks, I’ll be right down.” He closed the circuit and headed to Yalta.

A third of the Outpost was there, listening intently to a new announcement from the BBC. The screen had been split; a small image in the lower right showed greater Houston from the six-meter telescope at Shackleton.

“What are they saying?” Will asked.

“It’s the Pentagon again,” replied Skip. “A large cargo transport plane left Turanistan for central Texas about twelve hours ago carrying heavy equipment back to the States. It had been diverted southward by the line of thunderstorms across Texas and was flying through the northeastern Houston suburbs at the time of the explosion. The speculation is that somehow a terrorist group managed to smuggle one of the missing North Korean nukes on board, possibly built into one of the humvees or armored personnel carriers it was transporting.”

“If that’s true, this terrorist act against Houston is accidental?” asked Will, dumbfounded.

Skip nodded angrily. “Of course, if the U.S. hadn’t stirred up all this trouble in Turanistan in the first place, there wouldn’t be this incident, or the computer virus! The evidence that Khaliestan was involved in the French nuclear terrorist incident is stronger than the role of Turanistan, but Khaliestan’s an ally and has vast oil wealth, so they are ignored and a poor, isolated Central Asian nation gets targeted instead!”

“That’s not a fair or reasonable interpretation of the situation at all,” responded Brian, quietly but with anger in his voice.

“Let’s not argue right now,” replied Will immediately, feeling rising tension in the room.

“What are we going to do?” asked John Hunter.

“We’re going to get our work done, explore this world, and expand our settlement base,” replied Will. “We did without Houston for a week back in February and we managed fine under much more difficult circumstances. I’ve already contacted the Paris Office of the Commission about increasing their backup, and Shackleton has already made a mutual agreement with Aurorae to back up and audit each other’s environmental management procedures. The moon has surplus staff; our Columbus 8 personnel. They can be trained and have the right equipment.”

“Will Columbus 8 still come?” asked Silvio.

“I suspect a third of our seventy new people were in Houston, and some will be injured. Maybe we’ll have to replace some of them. But we’ll get some sort of flight underway if we have to run the launch from here. We’ve got two months.”

“Shackleton could handle the launch,” noted Neal.

“Exactly, for a reasonable fee,” replied Will. “It’s premature to worry. This isn’t the end of the world, nor is it the end of Mars exploration. We’re here and we’re staying.”

That seemed to encourage the others. Will looked around the crowd. He spotted Helmut, who looked pale and shaken. “Any news about your mom?”

“No, or from my brother Kristoff, who works at the Mars Commission.”

“I’m sorry,” said Will. He felt a lump rise in his throat. “They’ll be in my prayers.”

Helmut nodded. “Thanks.”

There was an announcement on the tv screen, so everyone else turned back to it. President White walked into the White House press room. He looked shaken, angry, and determined. “My fellow Americans,” he began. “Today will go down in history for one

of the most tragic and cruel events perpetuated by men against other men. A group of terrorists appear to have smuggled a nuclear device into the territory of the United States of America and have detonated it in the air over the northeastern side of Houston. The possibility that the bomb was flown in from Turanistan inside a United States military transport is being carefully examined. Once the sponsors of this dastardly act have been identified, you can be absolutely assured that the United States will capture and bring them to justice or kill them in the attempt. If any government linkage to this act can be demonstrated, a reciprocal response at the appropriate level can be expected.

“While the Pentagon is hard at work to secure our safety and protect our freedom, emergency teams are streaming into Houston from all directions. Their preliminary reports indicate horrific destruction of the city, with extensive fires burning out of control and thousands of persons suffering from terrible burns, temporary or permanent blindness, and injuries from collapsing buildings. I have declared the entire region a disaster area and have authorized mobilization of the National Guard in Texas and all surrounding states. You can be sure that we will rebuild Houston.

“There are a number of important national and international facilities in Houston, among them the control centers for NASA and various space commissions. I have signed an order taking over emergency control of all these operations and directing the United States military to provide them immediate support. This act of cowardice on Earth will not cause loss of life in space.

“Finally, Beatriz and I are praying for the victims and will do everything we can to help them. We will not rest until this injustice has been righted. God bless the United States of America.”

The President walked out of the press room without taking questions. The audience on Mars looked shocked. “Have we just been taken over?” asked Yevgeny.

“I don’t know,” replied Will. “We haven’t been so informed. But the President’s effort, besides being unnecessary, is not in conformity with the Mars Commission Treaty, which does not offer any circumstances when control over the Commission can be vested in one nation, even temporarily.”

“So it’s illegal?” asked Anna.

“Most definitely!” replied Silvio, before Will could speak. “No question about it.”

“I defer to Silvio’s judgment,” replied Will.

“If Morgan’s out of commission, who’s in charge?” asked Brian.

“I am, as Assistant Commissioner,” replied Will.

He remained in the patio another ten minutes, watching television with everyone and chatting. No one asked additional questions; he apparently had assured them for the time being. He promised to return and walked back to the control room in Riviera Biome.

Data had begun to flow between Shackleton and Aurorae. LeMonnier Station in Mare Serenitatis was auditing Cassini and Dawes; their data exchange had begun as well. Dozens of email messages had started to flow back and forth about various details, since the procedures on the moon and Mars were not identical. Shackleton spaceport had started auditing the oversight of the Mars shuttles at Aurorae and was providing ground support for Gateway Station, located at the lagrange point where the gravity of the Earth and moon balanced each other. Aurorae had started receiving data from Columbus and the cargo flight as well, auditing Shackleton’s efforts.

“We’ll need at least six people on duty continuously,” said Ruhullah. “Eight would be better; ten optimal.”

“I know,” replied Will. “Press into service everyone you can. There were one hundred auditors with powerful computers watching everything in Houston, and no one can replace that.”

“Over the years, new computers and software could have automated a lot of it anyway,” said Érico. “Frankly, the Commission should have reduced the ‘mission control’ facility more. With the time delay, we have to run everything here. Their backup and auditing really doesn’t catch that much, and by the time they catch a problem and inform us, we’ve usually spotted it anyway.”

“I know, but the auditing feature keeps everyone on their toes. If our people are switching back and forth between our systems and Shackleton’s, they won’t get bored. I think Shackleton may need us more than we need them because they were never autonomous. They didn’t have to be.”

“This is a good plan,” agreed Ruhullah. “And the moon personnel are the only ones who can back us up. No one else has the computers and software.”

“Let’s cross our fingers we don’t have an accident of some sort right now,” added Will. His attaché beeped; he lifted it from his belt. “Oh-oh, a videomail from some General. Érico, Ruhullah, let’s look at this together.” He pointed to an empty meeting room. The three of them walked in and closed the door. Will put his attaché on the table in front of them and pushed “play.”

“Commander Elliot, this is General Bart St. Pierre, United States Air Force, NORAD headquarters, Cheyenne Mountain.” The General spoke quickly, matter of



factly, calmly. He was in his fifties, with short, prematurely white hair, a wiry face, and a perfectly pressed uniform. “Pursuant to the President’s orders, we are assuming overall responsibility for oversight and guidance of your operations. We have a team ready assist you immediately and over the next twenty-four hours the personnel and computers available should increase considerably. We will need a database of computer protocols immediately, followed by operational support specifications. A file is attached to this message with a software filter to install on the lead computer there. I’m copying Major Chester Silk at Canaveral, who will be our point man for this operation. Please acknowledge immediately with an estimate when data will begin to flow.”

Will looked at the others. Érico was angry. “This is just an excuse to take over the Commission. There’s no way a bunch of Air Force techies can provide meaningful assistance to us. They’d have to install our software on their machines—which we will have to send them—and they’d have to learn the procedures long-distance.”

“It will take us more time to train them than we have right now,” added Ruhullah.

“I agree, and this is illegal as well. Silvio just said so. I’m sure he’ll issue a restraining order if we ask. But for now, I had better be nice and stall them.” Will turned back to his attaché. He hit reply, blind copied Sebastian, and began to record.

“Thank you for contacting us, General St. Pierre. We heard the President’s remarks a half hour ago and are immensely grateful for the effort he is coordinating to assist the people of Houston, many of whom are friends, loved ones, and colleagues. I can report that up here all is well. The Mars Commission has a longstanding emergency plan that covers the current contingency. We immediately initiated mutual auditing of each other’s environmental management systems among the three outposts on Mars, and

that system was quickly extended to include the stations on the moon. The lunar facilities are ideally suited to back us up and vice versa because of similar crew training, equipment, and procedures. We have already started to train each other's personnel in the details of the systems.

“For this reason, we see no reason to accept the President's kind offer at this time. But we are simultaneously examining it very closely and examining our own capacities up here to deal with any potential difficulties. Our judge has expressed the opinion that it would be contrary to the provisions of the Mars Commission Treaty for us to turn over the control of the Commission to a national government, but he is doing further research into the issue. Our environmental management personnel are considering what situations might need your assistance and we hope to have a report for you and Major Silk in a few hours. We are also pursuing all avenues for contacting Dr. Douglas Morgan, the High Commissioner, in whose hands any final decision still rests. We will get back to you as soon as possible with the results.”

Will added a blind copy to Silvio DePonte and Louisa Turner, then sent the message. He looked at the other two. “Those are our priorities. I want a preliminary report about ways personnel at Canaveral might be able to help us in two hours *without* granting them control. We have to make the preservation of life a priority. I want Silvio to issue a detailed legal opinion; the General will have to engage his lawyers, and that buys us time. I want an effort to contact Morgan, however futile; I doubt more than one percent of the population of the metropolitan area has been killed, so Doug is probably alive. That legitimately buys time as well.”

“What about our. . . independence?” asked Érico, struggling for the right word.

“We will be dependent on Earth for decades. We need to keep the United States on our side as much as reasonably possible. But unless there is an authoritative legal judgment giving the U.S. control over the Commission, they won’t get it.”

“Will, we don’t have anyone to spare to write a report about ways they might help,” exclaimed Ruhullah.

“Then I’ll put it together,” replied Will. He nodded to Ruhullah and Érico, who headed out of the room and back to their tasks. He turned to the Outpost’s Emergency Plan, an enormous document sitting on their internal website, with which he was reasonably familiar. He began to jot down notes.

Then a videomail arrived from Sebastian. Unable to resist the temptation, Will activated it. He was startled to see it was a copy of the live conversation that had occurred between Sebastian and General St. Pierre. “Good evening, Commander Langlais,” began the general. “No doubt you have heard the President’s orders that we assume overall responsibility for oversight and guidance of all lunar operations. We have a team ready to begin assisting you immediately and anticipate that our capacity to provide ground control should expand with great rapidity. We will need a database—”

“I beg your pardon, General? I apologize if I have to correct you, but I am not Commander Langlais; I am High Commissioner Langlais.”

“Sir, the Lunar Commission is now under the emergency control of the President of the United States, so you are the Commander—”

“General, the terms of the Lunar Commission Treaty are quite clear. The United States does not have the authority—”

“Sir, this is a wartime situation and your headquarters has been attacked, so—.”

“General, what sort of support do you really think you can provide? Do you have anyone who understands the workings of a D-40 Biome? How about an Artemis interorbital passenger shuttle? A Korolev lifter? A lunar conestoga? An SCN-100 reactor?”

“You need auditing and backup, and we can provide people able to be trained faster than anyone else on Earth, Commander.”

“I’m sure that’s true, but I already have auditing and backup from Mars, and they know our equipment. Almost everyone up there has worked here, and some of my folks have worked there.”

“Commander, I have my orders from the President of the United States. We need a database of your computer protocols immediately, followed by operational support specifications. I will send you a file to install a secure communications link with the lead computer in Shackleton—”

“General, the President of the United States cannot claim emergency jurisdiction over the Lunar Commission anymore than he can over Buckingham Palace, and you know it.”

“If you do not cooperate, you will be relieved of your command.”

“And if you persist in making demands, we will take the United States government to court. I am taping this entire conversation.”

“Commander Langlais, I suggest you talk this matter over rationally and calmly with your subordinates. I need to hear from you within an hour. That, sir, is the last word I have on the matter. Goodbye.” And the General closed the video link.

Will immediately hit reply. “Sebastian, thanks for forwarding this to me. I have already forwarded to you St. Pierre’s videomail to me. This helps enormously to plan my response to his next move. Let’s work closely. I’ll forward this to Louisa Turner, who is in Paris right now, and ask her to call you about using the media to respond to this campaign. Your press people won’t be available, but Louisa can help us both. Bye.” Then Will hit forward. “Louisa, we can’t use this without Sebastian’s permission, obviously. You need to think of a media strategy that will apply to both Commissions, because we have to work together to survive this and the Lunar Commission’s media people are out of the picture. Please talk to Sebastian, and copy me of course. Bye.”

Columbus 8. Will wondered whether the General had called Takada. So he grabbed the exchange he had had with the General and forwarded the videomail to the Commander at Gateway. “Seiji, the United States government is making an illegal move to take control over the Mars Commission. Until we hear from Douglas Morgan about this, don’t make any agreements or commitments and refer all communications to me as Assistant Commissioner, and therefore as *Acting* Commissioner. If you need rapid response, talk to Pierre Messier in Paris; he’s working closely with me. Failing that, call Sebastian Langlais at Shackleton; we’re coordinating with him as well. Bye.”

Then he went back to reviewing the emergency plan, though it was almost impossible to concentrate. Too many things were happening at once, and no doubt St. Pierre’s reply to him was winging through space. Twenty minutes later, his videomail icon lit up with a new message.

“Commander Elliott, my orders are very simple and clear, and I don’t have time to argue with you. Your President has assumed control of the Mars Commission. You

must cooperate or you will be relieved of command and could face charges of obstruction or possibly treason. We need the database of computer protocols, the operational support specifications, and establishment of a secure communications line, and we need them *immediately*. Please acknowledge. Good bye.”

Will hit reply. “Thank you General, but I am a busy man as well. We are preparing a report for you, nailing down the legal opinion, and pursuing contact with Commissioner Morgan. I’m afraid your jurisdiction extends neither over Mars, nor over our Paris operation to which terrestrial coordination has temporarily passed. We welcome and look forward to any specific support you can provide us from among the items in the report we are preparing. We are also immensely grateful to the Pentagon and the President for their efforts to assist the suffering residents of Houston. Goodbye.”

## Demonstration

Late Apr. 2050

Will and Sebastian heard nothing more from General St. Pierre for the next twelve hours. Will sent a report, as promised, to the General about Mars's emergency support needs; it was rather short and was primarily engineering-oriented, since there was virtually nothing the Pentagon could reasonably expect to provide on short notice.

Dawn streaked the sky over Houston at about midnight, Aurorae time, and 1 p.m. in Paris. Television screens across the Earth, on the moon, and on Mars sprang alive with images from the hovering news helicopters of the television stations in Dallas, Austin, San Antonio, and New Orleans; images of streets littered with abandoned and burned out cars, neighborhoods reduced to cinders, smoking downtown skyscrapers with their northeastern windows blown out, plane after plane of relief supplies and personnel landing at the area's airports, and lines of old, computer-free cars, their paint peeling and sometimes their windows blown out, driving anywhere to escape the city of death. A half hour later Will's attaché lit up with the recording of a videophone call relayed by Pierre Messier.

"Dr. Messier, you don't know me. I'm Henry Arroyo, chief of public safety at the Mars and Lunar Commission facilities in Houston." He was a relatively young man with a thin moustache, who spoke with a trace of Latino accent.

"My God, how are you calling me!" exclaimed Messier. "We've been trying to reach the Commission for hours!"

“Nothing’s working here; no telephones, computers, radios, televisions, not even the cars, except a few old ones without computers. But five minutes ago a carload of young men from the Mars Exploration Society chapter in Dallas drove up. They brought three satellite telephones and as much food and water as they could fit in their car. They had to come into the city from the south because of all the destruction up north, so it took them all night to get here.

“They said I should call you. The Mars and Lunar Commission buildings are both on fire, but we have been able to contain them. There was a huge thunderstorm about 7 p.m. last night and that helped, but the fires are still smoldering and overnight the water pressure dropped to almost nothing, so we have improvised with some hoses, a gasoline-powered generator, and we’re draining the reflecting pool in front of the building. We still have about 300 employees here from both operations, mostly single folks who preferred to stay here rather than walk home. We’ve set up an emergency shelter in the auditorium.”

“What about Douglas Morgan?” asked Messier.

“He left for home and was about half way there when the bomb went off. His secretary was still in the office and she walked the route; he lives about two miles from here. She found him and brought him back here in a borrowed child’s wagon. The nurses treated him as best they could; he’s almost blind, though that may be temporary, and has burns over fifteen percent of his body from the flash. He was in intense pain, so about midnight I got someone to drive him and two other burn victims to the nearest hospital. He’s there now, but the hospital may not be able to do much because it is overwhelmed with burn victims. A few employees come back here after going to the hospital because



they correctly guessed our nurses had more time and better access to medications. I am sure the National Guard will remove people to other cities as fast as possible.”

“Has anyone come and demanded jurisdiction over the Commission facilities?”

Arroyo paused, surprised. “No, no one has come here at all. There’s incredible chaos.”

“I can imagine. What’s going on over at the Johnson Spaceflight Center?”

“It’s the same. I drove over myself about 4 a.m., and their head of public safety sent someone over here about 1 a.m. to find out if we had any needs. What’s the situation on the moon and Mars? That’s what everyone here wants to know.”

“Everything is fine. The moon is auditing and providing backup to Mars and vice versa. There have been no problems. But everyone’s terribly worried about their friends, loved ones, and colleagues in Houston.”

“Now that we have three satellite telephones, we plan to let people call and assure their families they are alright.”

“Good. Mr. Arroyo, thanks for calling. I’ll call you back when I have anything new to report. We’ll forward this entire conversation to Will Elliott on Mars; he’s the acting Commissioner.”

“Good. We need help down here, but I think it’ll arrive soon. We have things as much under control as we can. Three hours ago a brother of a staffer who is a physician arrived. He has been a great help. The Mars Exploration Society headquarters in Colorado has sent two trucks of food that should arrive this afternoon. They plan to drive as many people back to Denver as possible.”

“Then keep up the good work. We’ll see what we can do to help. Good bye.”

“Goodbye.” Then Arroyo’s face disappeared.

Will hit reply. “Pierre, thanks for forwarding a copy of that call. Have someone check our finances. We need to give a significant bonus to all Houston employees. Also, Mr. Arroyo said the Mars Exploration Society was evacuating people to Denver. That’s the last place we want them; it’s too close to NORAD headquarters in Cheyenne Mountain. They might try to force our people to work for them. We should evacuate our people to Mexico if we can arrange it, or let them disperse across the country to relatives. Bye.”

He sent the message and almost immediately got a message from Louisa. “Will, I just saw Arroyo’s report from Houston. The Commission needs leadership and Doug won’t be fit for months, so you should declare yourself the Acting Commissioner. We’ll back you immediately.”

Will hit reply. “Louisa, let’s convene a meeting of all senior staff we can reach on both planets and do this formally and properly. I don’t think I should just declare myself Acting Commissioner. Let’s have a formal procedure, right away. Mr. Arroyo can tell us whether any senior people in Houston are reachable. Can you and Pierre call around Earth? I can get my people to join the meeting even if it is late here.”

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It was two hours before they could put together a video conference call. Krister Soderblom, the Commission’s director of governmental relations, joined the call from the Arabian Gulf; Ginger Petropoulos, head of Mars land sales, participated by satellite phone from Houston. To reduce the chance of the United States government eavesdropping, they routed the call to Mars via Venus and ESA’s network of satellites.

The meeting lasted only two rounds. They agreed Will had to start serving as interim Commissioner immediately; that all Houston employees should receive a \$20,000 bonus to help them recover from the disaster (which, with inflation, was modest); and that the national representatives serving on the Board of Trustees should be invited to Paris immediately to resolve the issue of the Commissionership of the agency. Pierre started by calling the European Space Agency, which naturally was opposed to the American takeover.

After the meeting ended, Will taped a message to all employees that, until Douglas Morgan's health recovered sufficiently, and in conformity with the wishes of the heads of staff of the various departments of the Commission, he was assuming the role of acting High Commissioner. Louisa issued a press release with the recording attached. Before Will went home at 3:30 a.m. and flung himself into his bed for a three hour nap, he heard the tape playing on BBC.

At Houston, the word of the satellite phones was spreading and employees or relatives of employees were stopping by to let people know they were okay. At 4 a.m., Helmut was awakened by a call. He had been asleep on top of his bed with his clothes on; he jumped up and activated his attaché.

His father looked exhausted and grief-struck. "Helmut, I just got a 1-minute call from Kristoff; the two Commission buildings have three satellite phones. He walked home last night to see what had happened to mom. The house was burning; the entire neighborhood was being consumed. He found mother on the ground outside. She. . . had expired from burns and loss of blood from the shrapnel. I'm very sorry to be telling you this so abruptly, but Kristoff couldn't give any details because the call was so short. He

wasn't able to save any photographs, clothing, anything at all. I asked him to go back and bury her and he said he'd try, but I'm not sure he can do it. They have busses coming in from Brownsville to evacuate everyone in southern Houston southward and he planned to get on one of them, then call me when he was safe. He was inside his office when the bomb went off and its windows were south facing. He saw a bright flash and thought it was very bright lightning because thunderstorms were expected later that day, then the power went out. Everyone went into the hallway to talk about the power failure, then the shock wave came through and broke his window, but no one inside was cut by glass because they had gone into the hallway.

“Anyway, call me when you get this. I'm sorry we aren't together for this terrible event. So. . . call me when you can. Bye.”

Helmut stared at the screen in shock for a minute, then tears filled his eyes. He had feared and dreaded the news; he had been paralyzed all day by the possibility. *At least his brother was alive, he thought. At least Kristoff was alive.*

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Exhausted and aching, Will rose at 6:30 a.m., took a shower, and shaved. He checked his mail. An urgent message from his mom awaited.

“Will, two F.B.I. agents stopped by the house a little while ago,” she began. “They asked a lot of questions about your contact with Iranians. They wanted to know how well we knew Taraz; that really angered me and I'm afraid I blew up at them, telling them that he was one of the sweetest, most caring sons in law one could imagine, and if they were so concerned about the country, they should pursue serious problems! I'm afraid that didn't go over very well, but I knew they wouldn't arrest an old lady,

especially a Bahá'í who has a Bahá'í family and an Iranian Bahá'í son in law who has no political positions at all. Then they asked me about Ruhullah—that's the name of your second in command, right?—whether he was a Bahá'í, what I knew about him, etc. I told them of course he was Muslim, and a man of great energy and integrity—that's my impression at least—and they jotted it all down. Then they left. I thought I'd let you know. Something fishy is going on.

“This bombing has made everyone paranoid. Everything's closed. I don't know why the nuke means the mall down the street has to be closed, but apparently it does. There were several attacks overnight on mosques around the U.S. and one on a Hindu temple; figure that out. CNN, however, just showed the Islamic Center of Houston and it's a burned out shell from the nuclear bomb, not because of mobs. The Muslim community has erected an American flag over the ruins. A lot of Muslims were injured.”

She sighed. “It feels like the apocalypse here. There's anger, confusion, and a sense of helplessness. People want to attack something, but there's nothing to attack. We had already conquered the country from which the bomb was flown. Everyone's listening to every word the President says. They wave their flags and love it.

“Be careful about your situation, son. People here want the United States to hold onto everything it has and get everything it can get. A takeover of the moon and Mars *feels* good. It's a popular response to the bomb, though it's hardly sufficient. And the President can't afford to blow anything right now; he has to look strong and tough.

“Anyway, be careful. Send me a quick message so I can see you. Bye.”

Will watched the picture fade. Ethel came up behind him and put her hands on his shoulder. He looked up at her with tears in his eyes. "They're playing rough, but don't let that get you," she said. She leaned down and kissed him.

"Thanks, I won't."

"Say a prayer and answer her. We'll get through this."

Will nodded and closed his eyes a moment to center himself with a short prayer. Then he hit reply. "Hi mom, and thanks for the message. I can't tell you how precious it is to hear your voice and see your face right now. In a few months when the time delay is minimal, we've got to spend a sol together by video. I just wish you could come here or I could go there, but that's impossible.

"Thanks letting me know about the visit. Sounds like they're trying to coerce me. Everyone says the effort to take over the Commission is a violation of international treaties and therefore is illegal, and I am sworn to uphold the law. Furthermore, by law I'm now acting Commissioner. So pray for me; this may be an interesting time. We may have to make our case to the American people. Bye."

He didn't dare say much; his mother's phone could be tapped. Then he headed for the patio to grab some breakfast.

"Hey Will!" exclaimed Roger, from a table near the buffet table. Roger rose and beckoned Will to a corner where they could talk in private. "Listen. I got a call about half an hour ago from a General St. Pierre, U.S. Air Force. His message was that the President had asked me to take on a very important responsibility for the country and for the Mars Commission: the position of Commander of Mars Operations, starting immediately."

Will was surprised. "And what happened?"

“I laughed at him. Then I hit ‘record’ and laughed again so he’d hear it, told him he had no idea what he was asking, that no one would accept and obey an illegally appointed Commander, and hit send. Since then I have been getting madder and madder and have wanted to reply again and give him a piece of my mind, but Madhu has wisely counseled silence.”

“Don’t get them mad at you,” agreed Will.

“I can’t understand what is happening down there. I was not too upset when White was inaugurated. I’m conservative; he’s more conservative than I am, but he was making many statements of conciliation and sounded moderate. The stock market was convinced and recovered. But then there was the computer virus attack, his attack against Turanistan made him wildly popular, and he was able to push through Congress a bunch of appointments that I could never have believed would happen. After all, he didn’t appoint conservative folks from the previous Republican administration; he brought in a bunch of people with no Washington experience, who really did want to run the country based on the Book of Revelation! I really fear a major disaster for America.”

“And for the world.”

Roger nodded. “For humanity. Anyway, Skip is actually planning a rally and demonstration against the attempted takeover for lunchtime. I probably shouldn’t tell you; he doesn’t want you to know. I think he doesn’t want the effort to reflect badly on you. But I’m going to help him.”

“I see.” Will looked at the floor to think. Then he looked up. “Thanks.”

He walked back to the Control Area wondering what to do. Mars had never had a demonstration before; he wondered how it would look inside a little biome, whether a lot

of shouting would be loud or not, and whether he should stop it or look surprised. He couldn't mention it to anyone on Earth; there was no way of knowing whether his conversation would be tapped.

“Will, thank God you're here,” exclaimed Ruhullah as soon as he stepped into the Control Room. “I just arrived, too. Zach has a strange reading in the waste management system; he caught it quite quickly. We're dispatching a team to check the pressure release valves.”

“Is something stuck?”

Ruhullah nodded. “Yes, but the backup valve's working. And we just had an attempt to hack into our system; Kim caught it and blocked it. She's trying to trace the source. We're wondering whether it was the military.”

“Could be, but we have this every month or so.”

“I know. And my sister just called from Stuttgart; an F.B.I. agent based in Germany visited and asked a bunch of questions about me.”

“They just visited my mom in Connecticut and asked about you, too.”

“Really?”

Will nodded. “Something's going to happen, I think. No terrorists in your family, I hope?”

“Of course not! But I have a very conservative cousin who's the Imam-jom'eh—the big imam—of the central mosque in Yazd, and he's very, very conservative. He's always warning me about you Bahá'ís.”

“Of course; we're very dangerous.”



They both laughed at the absurdity. When they finished laughing, they turned to see someone enter the control area. It was Helmut Langlais, looking pale and tired.

“Helmut, what happened?” asked Will, immediately fearing the worst.

“I heard from dad about four hours ago that my mom was killed in Houston. My brother’s alive, though, and is being evacuated to Brownsville.”

“Oh, I’m so sorry, Helmut.” Will walked over to him and gave him a hug. The young man melted in his arms a moment, relieved to find some comfort. Then he pulled away a bit. “I came here to work. I want to help my father. I want to help monitor Shackleton.”

“Did you get enough sleep?” asked Ruhullah.

“I hope so; I got a few hours.”

“Okay, go tell Rostam across the hall. That’s all he got, too,” said Ruhullah.

“Thanks.” Helmut walked across the hall.

Will looked at Ruhullah. “I’m so sorry. I knew Angela; she was a great hostess and cook, very witty, and a marvelous partner for Sebastian. He must be devastated. I’ll have to videomail a condolence to him right away.”

“We’ll have a lot of these situations,” added Ruhullah.

They walked over to Kim Irion’s station to ask her about the hack attack. It had not been very sophisticated. A technician soon had the valve fixed. Will went to his office to videomail Sebastian, then reviewed a collection of newspaper clippings Louisa’s assistant had put together. In the middle he got an urgent email from Earth. It was from the Internal Revenue Service, demanding that he come to the Dallas, Texas office on June 15, 2050, with the last seven years’ tax records, so they could audit him.

He stared, then laughed. His taxes were professionally prepared by a friend in Connecticut who was very thorough and who was also an attorney. This was harassment, pure and simple. He hit forward and sent it to his friend, who would no doubt represent him and send him a big bill for the work.

The whole rest of the morning he was rattled. He did his work, but he was distracted. His friend's email confirming his fear that the audit looked like harassment did not help. He told Ethel about it in the buffet line at lunch.

"This is a really sad sol for humanity, for Mars, for America," she said. "How much of our money is in American-based assets?"

"Hard to say because the value has dropped a lot lately. Maybe a third, with a third in European stock, mostly Muller Mining, and a third in Martian land."

"A third; that's five or six million bucks." She shrugged. "Let them have it, or give it to charity."

He was surprised. "That doesn't sound like the advice of your Presbyterian grandmother."

"No, she was a real penny pincher. But she never had as much money as we have. It's an absurd amount. We need to defend it, then give a bunch of it away."

"We can give it to the Colonization Society."

The thought made him feel better. He loaded up his plate and came out to sit on the Patio just as Skip and Roger went up to the platform. In the craziness of the morning, Will had forgotten about the demonstration!

"Ladies and gentlemen, good sol, and may we have your attention please," exclaimed Skip Carson. "As all of you know, yestersol the government of the United

States announced that it had taken over the Mars Commission. All I have to do is look at our faces to see how you feel about the idea. It's absurd!"

He shouted the last word and waited for the audience to respond. They hesitated and looked at Will. Skip was surprised; Will said nothing, uncertain how he should react.

Roger stepped to the mike with Skip. "No one can accuse me of being unsympathetic to the philosophy of the current administration. But I am deeply offended by the effort to take over the Commission. Everyone here agrees that it is an illegal act. It appears to be a simple act of expediency: the Administration has been negotiating to take a larger role in Mars exploration for several months and has taken advantage of our moment of weakness to make its move. We don't need their help, as the report sent to them made clear. If they want to help us, they should start by pouring more resources into Houston and helping our friends and loved ones rebuild!"

That got some scattered, tentative applause. Roger looked at Will, as if searching for help. Will didn't dare say anything.

"We want to send a very clear, unambiguous message to Washington: leave the Commission alone!" continued Skip. "We're doing fine, thank you. If you want to help, there are many ways to do so. You can send more people here, subsidize our work more, or develop technology we will need. Otherwise, our robots will be built elsewhere; our rockets elsewhere; our vehicles elsewhere; our reactors elsewhere. If you want to be on the technological cutting edge, stay involved in the Commission, support its work, and support humanity's most exciting exploration effort of all time!"

That got applause and a few cheers. Skip smiled, pleased he had gotten a reaction from the crowd. Roger took over again. "The world has grown dark. Northern Houston

has been incinerated. Nation is attacking nation. This is a time when we must pull together as one and demonstrate the tolerance, the compassion, the mutual trust and support, the intimate collaboration that is possible. Mars is a model of international cooperation and trust. That's what the Commission stands for. That's the value we must affirm this sol."

That got applause as well. Roger had never expressed himself so eloquently about their common values before.

"Friends, there has been one attempt to find a replacement for Acting Commissioner Elliott," said Skip. "One person here received a call this sol asking him to take over. That person rejected the offer."

The crowd looked around, clearly upset, and Will nodded at those who looked at him.

"I would never have accepted such a request, even if it was phrased as an order from the President of the United States," exclaimed Roger. "This campaign is illegal. Marsians must stand up and make their position clear: we will not tolerate an attack on law and written treaties like this!" He looked at the crowd and they applauded him.

Brian Stark rose. "Roger, are you saying you got such a call?"

"Yes, early this morning."

"Then Skip is wrong—I love to say that, as you know—because I got a call from an Air Force General as well, just two hours ago. So two of us have been called, not one. He offered the position of Commander of Mars Operations to me. I refused it and said no one would obey me. And since then, I have been getting angry about the call."

"I got a call also," exclaimed Neal Stroger. "It was just fifteen minutes ago, too."

“Damn them!” exclaimed Érico.

“Idiots!” added someone else.

“They can ask me! I’ll be glad to run things!” quipped Zach, and everyone laughed at the idea of a Fundamentalist President appointing a gay American as Commander of Mars.

“There are a few other developments that are worth mentioning,” added Will, quietly. “In the last twenty-four hours, at least two Mars staffers have had the F.B.I. visit their terrestrial relatives to ask questions, and at least one staffer has received an audit notice from the IRS.”

“Really?” said Skip. “I am ashamed of being an American!”

“So am I!” echoed Brian. “I love my country, but this attack on us simply does not make any sense. We didn’t nuke Houston. Our relatives and friends are victims of this attack. I want to see the U.S. help us, not divert us into politics.”

“Then let’s all sing,” replied Roger. “Where’s our flag? Bring it up.”

Brian Stark himself jumped up to grab the Mars flag, which decorated an obscure corner of the patio. He brought it on stage and Skip and Roger took a hold of it with him. Will immediately stood—it was an unconscious act of respect—and the entire crowd followed. And they began to sing:

*This land is your land, this land is my land,*

*From Tharsis Montes to the Hellas Basin,*

*From the cratered highlands to the Mariner valleys,*

*This land was made for you and me.*

*As we were ranging across his deserts*

*Along his channels, o'er gleaming ice caps,*

*We felt a love for his ruddy vistas*

*This land was made for you and me*

They sang it again, Skip beckoned Will up on the stage, and soon everyone was urging him to go up. He walked up and the three men embraced him one by one. Then they sang the song again:

*This land is your land, this land is my land,*

*From Tharsis Montes to the Hellas Basin,*

*From the cratered highlands to the Mariner valleys,*

*This land was made for you and me.*

*As we were walking along the cliff edge*

*We saw above us, the twin moon shining*

*We saw below us the Aurorae Valley*

*This land was made for you and me*

The entrance to the bottom of the construction pit was rough and rock-covered. Will followed Alexandra down and spent most of his time looking around. It was sixty-three meters across on the bottom, and because it was excavated into a hillside, the southern wall was twenty meters high, while the northern side consisted of a berm of piled regolith ten meters high. The floor had a north-facing slope, just like the outside landscape; it would be their first biome that was not flat-bottomed. The southern wall was steep, its boulders and gravel held in place by injected water that had quickly frozen into ice.

“That’s the spot where the wall caved in?” Will asked, pointing to an icy-covered circular alcove on the northeastern side.

Alexandra nodded. “We’re lucky nothing was damaged.”

“If it had happened during the day, someone could have been crushed.”

“It was a couple tonnes of stuff. The slope is stable; we immediately hosed it down, then removed the debris.”

“What do the folks in Moscow say?” They stopped in front of the landslide alcove and looked up. A trench had been carved in the slope by the falling rock, which was also white from freshly applied water.

“Pavel’s sending a final analysis this afternoon, but the preliminary is that we’re clear to start sinking the biome footings. We’re conducting another round of seismic analysis to get a better sense of where the injected water pooled and why it didn’t freeze

that section better. We'll probably have to change procedures; use more steam injection points, hose down the final surface, and possibly anchor debris nets over the surface."

"The latter could be incorporated into the duricrete to serve as reinforcement."

"We'll have to look into that. This is the largest pit we've ever dug. The techniques for forty and fifty meter biomes have to be changed for sixty meter biomes."

"Even more so when we start on seventy-five and one hundred meter biomes. Pretty soon we'll extend biomes past this steep section of the slope and the bigger biomes won't require such deep pits. Let's stay out of the pit except for inspections and equipment removal until Pavel gives us a clearance. Then we'll resume."

They turned and headed back out. "Of course, in another year Pavel's construction support team will be half as big. When something like this happens, we'll be more on our own."

"I know, but that's the financial reality. If the national representatives ever meet, maybe they'll appoint a new Commissioner, and I won't have to worry about budgets. And maybe they'll give more money. But right now I have the unenviable position of having to finalize a preliminary budget for an organization that still lacks a headquarters, half of whose employees are still dealing with no electricity and partially or completely damaged houses, with burned spouses and kids, who may be living with relatives all over the U.S. for the next six months, an organization with no financial support from the United States, with gold income whose value changes every sol, and whose national pledges change in value every sol. Maybe in six months the value of the dollar, euro, ruble, and gold will stabilize and we'll know what we really have. Meanwhile, we have to make plans for cuts."



“I know, and I’m sorry, and grateful you can take the stress.”

“Thank you. By the way, the U.S. is still holding two passenger transfer vehicles in low Earth orbit, so we can’t get twenty-four people to Gateway. Of course, we’re still not completely sure who some of those people will be, but at least we now have a reliable backup list. Yestersol we filed a motion to add additional damages; we’ll need to buy more fuel to get the last cargo shipment to Gateway.”

“Won’t that delay the judgment?”

“Apparently not. We should hear in a few hours.”

“If we win, do you think the U.S. will agree to attend a meeting of Commission Trustees?”

“Maybe.”

“And you still don’t want to be Commissioner?”

“God no! Everyone up here thinks I should be the new Commissioner, but remember that our work is still the tip of the iceberg. The Commissioner needs to be on Earth, especially for fund raising and diplomacy. Those are his main tasks, really. And for the next decade or so, the Commission will have the bulk of its employees on Earth, not on Mars, because it’s cheaper to do as many of our vital tasks on Earth as possible.”

“True, Will, but you’re cutting our support staff, remember! And that makes it much harder.”

“I know, but this may be temporary.”

“But gold just hit \$8,000 per ounce.”

“Yes, but Alexandra, the dollar has fallen in value to a third of a euro; gold is about \$1,000 per ounce when measured in strong year-2000 dollars. Practically every

gold mine on Earth that ever has been operated is being reopened. Gold production on Earth may triple. As long as there is economic uncertainty—and there’s a lot of that right now—demand for gold will stay high. But once stability returns the price of gold will crash, a lot of mines will go bankrupt, and we’ll have a huge financial crisis.”

“I know, but we can’t afford to save for that, Will, so let’s spend it.”

“I’m trying to make a long term plan.” He shrugged, then pointed at the circular pit they had just left. “So, we’ll have Colorado ready in time for Columbus 8, right? You have four months.”

“I know, and I know we’re late. Yes, Colorado will be fully pressurized, and the foundations of the various housing units will be ready for the people and bubbles arriving on Columbus 8. We should have the soil and gardens set up in the yard as well. But the bubbles that arrive won’t be fully ready for habitation for four more months.”

“Accommodating all those people will be interesting, especially since we will have some tourists and they will need comfortable lodgings. We’ll do it. Thanks for the tour, Alexandra. It sounds like this accident won’t set us back much.”

“Not compared to a computer virus and nuclear terrorism! We’re losing two sols of work, tops.”

“Good. Do you and Yevgeny have any plans for Equinox?”

She shrugged, which was barely noticeable in the spacesuit. “No, we’ll go to the big dinner, attend the premiere of Skip’s film and the arts evening, and then spend the sol next to the swimming pool.”

“Like everyone else. Have a good sol.” He waved goodbye and she reciprocated. Will walked uphill to head back to the airlocks, but he stopped momentarily to survey the

work they were doing. A line of biomes was marching westward across the Aurorae Valley; first, a pair of forty-meter biomes, Yalta and Catalina; then another forty-meter pair, Riviera and Shikoku; then a fifty-meter pair, Huron and the almost completed Shenandoah; now a sixty-meter, Colorado, which would be matched with another B-60, Dakota. The next pair would also be sixty meters, then they'd probably build a seventy-five meter pair. One hundred meters was their eventual goal.

He turned and headed for the airlock, thinking about Alexandra's questions. He had not been altogether honest; he would like to be Commissioner. But he knew the United States would never allow it because he had defied them. He also knew that politicking and partisanship was getting worse on the Mars Commission's Board of Trustees—the representatives of the national governments—and it would be almost impossible for someone on Mars to keep track of the intrigues. He was saddened, frustrated, and sometimes angered as a result. But it was likely that his hand as Governor of Mars—if he was retained—would be strengthened by his interim Commissionership.

He passed through the airlock, put his suit back in his locker—they now had a very nice locker room between Joseph Hall and the new Arrival Hall and Main Garage—and headed for his office. On the way he had to detour around two robotic cleaners, one in a hallway, sweeping and washing the concrete floor, and the other in Joseph, vacuuming the carpeted floor. The former had a bin full of small plastic garbage bags; the apartments now had robotic garbage pickup.

Will entered Yalta and was startled to hear people cheering and applauding. They were looking at the big screen, which had CNN news on it, live. They saw his surprised

look. “The United States Federal Court has released our passenger transfer vehicles!” exclaimed Lisa Kok. She had run out from the kitchen wearing her chef’s hat and apron.

“Really? What about the rest of the case?”

“The attempt to take over the Mars Commission has been ruled illegal!” exclaimed Skip. “Sanity has finally triumphed.”

“Thank God,” said Will. “That means the Lunar Commission is clear as well.”

“I hope they drop the audit of your finances,” said Lisa.

“Probably; all they have found is that the U.S. government owes me a larger refund. I just hope they drop the demand that I fly back to Earth to appear in tax court personally. Even with the sworn statement of our public safety people and our court that I will be extradited if found guilty, they’re still insisting that I appear.”

“It’s harassment,” said Skip.

“Politics,” replied Will. “This is good news. It probably means the Board of Trustees will finally meet.”

“Almost two months after Morgan had to resign,” added Skip, shaking his head. “You’ve done a good job.”

“Thank you.” He looked at the screen and they listened to the court statement, which was being repeated. “No one will get any work done the rest of this sol, so I guess I should declare the afternoon a holiday. Tomorrow’s Equinox anyway. Some people are even exchanging presents; they might need the time for shopping.”

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May 22, 2050—or the first of Sagittarius in the Martian year 47, if one used the local calendar that they had informally adopted—dawned bright, clear, and cold at Aurorae

Outpost, as always. Will, Ethel, Marshal, and Lizzie went to the patio for breakfast—a sparse meal, since the cooks were busy preparing midafternoon dinner—then came home for presents.

“Now remember, we aren’t making this as big as birthdays,” said Will, as they entered the flat. “It won’t be as big as Ayyám-i-Há either. But everyone wants to do something special to make Equinox a Marsian holiday, regardless of religion or culture.”

“Okay, okay,” said Marshall. “You guys didn’t order anything for us from Earth for it, anyway.”

“But we haven’t ordered Equinox presents for the next two years, either,” noted Ethel.

“That means clothes,” said Lizzie, rolling her eyes. It was about all they made on Mars that could be given as gifts, and all the used toys were for younger kids than they.

“That’s okay,” replied Will. “What would you guys like to do to celebrate Equinox as a family? I asked you yestersol and the sol before and never got an answer.”

“Let’s just exchange presents, then go to the pool until dinnertime,” replied Marshall.

“You know what I’d like?” asked Ethel. “Maybe next year we can do it. I’d like to have a special family breakfast together. Not just the usual food; something special. Maybe we can order something from the kitchen.”

“Some people have ordered special breakfasts and lunches,” said Will. “Lisa was complaining to me about it. Next year I hope the kitchen offers special meals people can take home. The big communal meal is very nice, but a smaller family meal would make this special, too.”

“I’d like to decorate deedee,” said Lizzie, pointing to their diminutive potted tropical tree in the living room, which they had named a few months back. “We’re putting our presents under it already; can’t we put some ornaments on it, too?”

“I like the decorations on the Patio,” added Marshall. “It makes the holiday festive.”

“Next year, let’s plan on decorating the entire living room,” suggested Ethel, with a smile. “And especially deedee. That gives us plenty of time to make the ornaments.”

“Good,” replied Lizzie.

“Dad, can we open the presents?” asked Marshall. “Cause Sammie and I want to go to the pool.”

“Okay.” Will looked at his watch. “We’ve got thirty minutes before the sun officially crosses the equator. Do you want to go to the celebration? Everyone’s bringing noisemakers.”

“Yes, then the pool!”

“Okay.” Will turned to the tree. He sat on the floor and began to hand out presents, which were in decorative, reusable plastic boxes or bags. “Marshall from mom and dad. Lizzie from mom and dad.” He handed them to the recipients.

Marshall pulled open the box and out came a vest. “Light blue. Cool. Thanks, dad.” He held it up to look at it; it was “Martian style,” a double layer of cotton and polyester with large pockets around the front and back filled with standard five-centimeter thick hydrogen-impregnated polyethylene radiation shields. The kids loved to slip all sorts of toys, writing utensils, and other junk into the pockets as well. The vest extended down past their waist. He tried it on.

Lizzie's box had a dress. She stood and modeled it. "I hope you like it," said Ethel, tentatively.

Lizzie nodded. "Yes; I like flower patterns."

"I thought so."

"Thanks." She kissed her mother and father. Then she pointed to a big bag.

"That's yours, dad."

"Oh?" Will was puzzled by the large bag, so he picked it up and reached in. Out came a hat. But it was no ordinary hat; it resembled a fedora slightly and even looked like it might be made of felt, but the top was higher and the brim wider and thicker. Will hefted it; he could tell it was filled with hydrogen-impregnated plastics as well. He put it on and looked in the mirror. "Thank you." Then he frowned. "I wonder whether I look slightly ridiculous."

"I think so!" exclaimed Marshall.

"Silvio says they aren't selling," replied Ethel. "People have to get used to them, that's all. It's fashionable enough once we see them around."

"And they provide radiation protection," said Will, nodding. "Okay, I'll do my patriotic duty."

"It does look a bit silly," commented Marshall.

"People used to wear hats all the time on Earth," replied Ethel. "Maybe hats will make a comeback."

"At least here," said Will. "There are good reasons to wear them, after all." He reached down and grabbed the last bag. "For you." He handed it to his wife.

“Thank you.” She smiled and reached in. Her eyes opened with delight when she pulled out a thin shawl of wool in a plaid pattern. “Oh, how nice. Yalta and Riviera are always so chilly in the evenings. This will cover my arms and legs very nicely. You got this from Earth, though; it’s too nice to have been made here!”

“Yes, it’s an extra present I ordered for you,” said Will. “But look inside. I had Madhu sew some radiation pockets, so you can put in some pads if you want.”

“Oh, how nice,” she said. She smiled. “They’re the rage. You’re sweet, as always.” She kissed him. She draped it around her shoulders and they all admired it.

Within a few minutes they were ready to go to the Patio, where a crowd was assembling with noisemakers. Ruhullah was on stage, ready to lead everyone in a countdown. The sun, still barely in the northern hemisphere, was almost exactly over the equator and heading south. The large screen had a countdown flashing on it. They all counted down the last ten second aloud, then began to bang pots and pans or blow horns while shouting “Equinox!” Then everyone looked at each other and laughed, embarrassed because they had never had a custom like that before. The crowd slowly thinned as people headed elsewhere.

Will and Ethel led the kids home to change into swimming suits, and they returned to Yalta to swim. The pool was full of kids and there was a volleyball game for adults nearby as well; dozens of spectators chatted as they sat in chairs pulled over from the Patio and lined up under the two buildings’ wide overhangs. The kitchen put out ice cream and cookies and the biome took on a festival atmosphere.

Will sneaked away for half an hour to check his messages. The Bio-Archive administration in New Mexico had sent a dozen documents, including a proposal for a



California redwood ecology in a two-hundred meter biome with a one-hundred meter ceiling. That was encouraging; throughout the court case, Bio-archive had not communicated with Mars at all. It seemed to signal that relations with the United States government were returning to a sort of normalcy. A message from Sebastian about resumed communications with NASA and its offices provided further evidence of a change, though Sebastian added a very sad personal note: the death of his wife—Helmut's mother—in Houston had been confirmed. Will sent both a message of condolence.

Much to his surprise, a message also arrived from the Internal Revenue Service as well, stating that their audit had showed that he had overpaid his taxes by \$3,735 over the last seven years and that they would send him a check. Will had insisted that his tax preparer not include a thousand dollars of deductions every year on the grounds that since he wasn't on Earth to look everything over, he preferred to overpay by a small amount. But during the audit his tax preparer had insisted that the deductions be included.

Whistling and feeling happier than he had in months, Will returned to Yalta to tell Ethel they were cleared. The whole family returned home in a good mood.

After the kids changed clothes, they all went back to Yalta for a light lunch; the big dinner was at 5 p.m. Then they headed to Joseph Hall, where the garage, cleared of vehicles, had been temporarily converted into a movie theatre for the premier of Skip Carson's movie, *The Survivor*. He had incorporated modest special effects into the opening scene when a vehicle that looked like a Mars shuttle crashed on a planet that looked like Mars with the first crew to visit that world. For the next two hours, the lone survivor crawled out of the wreckage and salvaged what equipment he could in order to

fight for survival. At the end, they all gave Skip Carson and Brian Stark a standing ovation for an excellent, dramatic film about the inner resources that humans possessed.

By the time the questions and answers ended, it was time for the big dinner. Everyone returned to the Patio for the best food Mars could offer. Every major dinner the kitchen hosted was a bit grander than the last, and this one saw the premier of several new dishes, such as blackened tilapia, crab cakes—with artificial crab—and rose water flavored ice cream.

As everyone finished their desserts and filled their cups with coffee and tea, Will rose and walked up to the stage. “May I have everyone’s attention for a moment,” he began, and waited a moment for the crowd to quiet. “I don’t want to interrupt the festivities, so I’ll be brief. I want to thank everyone for making this sol a special Marsian holiday. We have combined many good customs from our native cultures on Earth to make a set of Marsian customs. Twice an annum, we now have our own gift-exchanging holiday to complement the sols we celebrate in our homes based on religious and national traditions. We will celebrate the moment the sun crosses the equator, which is found in most cultures on Earth. Many families had a special lunch at home, a custom that I think will grow every year. We have our big collective meal together. And we have cultural events: the film premiere this afternoon and the cultural evening later tonight, which will include two original poems, an original song, and a short, original play.

“To these customs I want to add a few words from the Governor. This sol is a very special, historic sol. Not only is it our first celebration of Equinox, but it also marks the final recognition of the Mars Commission as an independent, international, intergovernmental body. Yestersol the U.S. Federal courts gave us a victory. We are all

grateful; we are not bitter or suspicious, rather we want to get on with the task of exploring and settling this world, an enterprise to which every nation can and must contribute.”

Will was interrupted by a wave of applause. It had been a long struggle and the Marsians were relieved that they had won.

“In spite of the very difficult times on Earth, the future of all humanity is bright, and Mars will help lead the way. This sol we received a proposal to build, six years hence, a California Sequoia biome. The biome would be two hundred meters across and one hundred high, for that is the height needed to accommodate redwoods. The sol is coming when we will see giant redwoods on Mars. We will live to see them ten meters high; our children, twenty; our grandchildren, thirty. Eventually, perhaps a thousand years hence, a biome will contain redwood trees one hundred meters high, their uppermost boughs brushing against the top of the dome. Perhaps these great trees will become one of this world’s symbols, for they will represent perseverance, patience, survival against all odds, and hope.

“This is our future. The last six months have seen the birth of a new consciousness here. It is the dawn of ‘Marsianness,’ a word we never before would have uttered or considered seriously. Yet here we are: Marsians. It is a transplanted identity, by and large, but in our children it finds its natives. Marsianness is tied to a land isolated far from the mainstream of humanity. It is slowly becoming a culture, a dialect, and a nationality of its own. It will not see independence soon, not in our lifetime, but it already has semi-autonomous political institutions. And its future is glorious; it will become the standard bearer of civilization, just as Greece, Rome, and western Europe, Iran, India,

China, Russia, and the Americas have before it. It already represents a beacon of hope, a proof that a just and united future is possible for all humanity, and a promise that a stable, prosperous, and peaceful society is possible.

“So twice per annum, on the spring and autumnal equinox sols, let us celebrate our accomplishments, give thanks we are on Mars, and reflect about the brightness of our future. We have much to be proud of. Thank you.” And Will Elliott walked back to his seat to thunderous applause, for they were all thankful for the present and hopeful for the future.

## **Columbus 7:**

Cargo leaves Gateway: 27 Mar 2048

Feb. 1, 2048: Marshall's eighth birthday

Columbus 7 Leaves Gateway: 12 Apr. 2048

Autumnal Equinox: 2048.4854 (c. June 25)

Opposition: 27 June 2033

Dust storm season begins: 11 Aug. 2048

Columbus 6 reaches Earth: 27 July 2048

Columbus 7 Arrives Mars: 12 Oct. 2048

Lands Mars: 18 Oct. 2048 (after maintenance visits to Phobos and Deimos)

Cargo reaches Mars: 27 Nov. 2048

Syrtris 1 leaves for Earth via inner ss: 1 Dec. 2033

Dust storm season ends: Dec. 31, 2048

Annual election: May 10, 2049

Conjunction: 5 August 2049

Syrtris 1 reaches Earth: 31 Dec. 2049

Cargo leaves Mars for Earth: 5 Mar. 2050

Cargo leaves Earth for Mars: May 11, 2050

Autumnal equinox: May 28, 2050

Columbus 8 leaves Earth for Mars, 14 June 2050

Opposition: 14 Aug. 2050

Cargo reaches Earth from Mars: 20 Nov. 2050

Columbus 8 reaches Mars: 4 Nov. 2050 (140 days)

Cargo reaches Mars from Earth, January 26, 2051

Columbus 8 leaves Mars 15 Mar. 2051 to Venus 20 Oct. 2051, stay until late Mar/early April 2052, arrive Earth late June 2052 (with Magellan return crew)

New Mission Names: Columbus = normal use of Mars/Earth opposition; LANTR engines: named after stars, as are their flights. Other missions: named after the flagship vehicle.

## Plot Summary

1. Arrival 2

Will and Marshall welcome Helmut Langlais and Skip Carson to Aurorae Outpost, show them around, and get to know them. Then Will returns to his office and meets Brian Stark, who was sent by the U.S. Navy on a secret mission to see whether Mars is a good site for a uranium enrichment facility.  
Date: 18 October 2048
2. Dinner 22

At dinner, Greg Harris meets an ex-nun who is now a physical therapist and John Hunter meets a Maori exobiologist. Will welcomes everyone.  
Date: 20 October 2048
3. Developments 34

Will talks to commander of Columbus 7 about his return flight to Earth. At an informal gathering of staff, they discuss exploration of near-Mars asteroids. Rosa Stroger complains to Will about Stark. The three of them go out in a ranger to see “the Tower” and Will makes Stark explain his mission to Stroger.  
Date: 3 November 2048
4. Quake 51

An Aurorae-Houston Heads of Staff meeting approves three Columbus 8 flights and three asteroid missions from Mars. Afterward, Will talks to Irina and she notes she is pregnant with her fifth child. She feels bad; he reassures her. Then a 3.9 earthquake hits Aurorae and everything leaks air a little bit.  
DATE: 3 December 2048
5. Aster-1 68

The Aster-1 probe is launched toward an asteroid. Rudenkov proposes larger annexes that can be used on the surface for housing as well. Carson talks politics and tries to get Will to take a position. Anna tells Greg she’s going to Dawes for a few months so they can think about their relationship.  
Date: early March 2049
6. Election 79

Aster-1 fires its engine and prepares for a landing on 2019 XA. Helmut learns he needs an operation in Aurorae for damage to his knee cartilage. Borough meetings are held on the eve of the elections.  
Date: late May 2049
7. Meridiani 93

Helmut, Érico, Anna, and Skip take a Sunwing-4 flight from Dawes to Aurorae and it crashes.  
Date: late May 2049 (three days after the election)

8. Landfall 116  
Recovery from the crash. The emergency teams are sucking up staffing; Lisa Kok complains she can't maintain food production and bioarchive research. Will goes to the hospital to meet with everyone. Carson wants to start *Survival: Mars*. The day Aster-1 lands on 2019XA, Van de Velde dies.  
Date: early June 2049
9. Proposals 129  
Will meets with the geologists and agrees to a lottery for one position on the Gradivus expedition. Talks to Helmut about his plans. Sees Carson's facility. Anna and Greg meet with Suzanne van de Velde and she proposes an immigration grant in her husband's honor.  
Date: early July 2049
10. Hellas 150  
Helmut gets to go to Hellas. Greg proposes to Anna and she accepts. Scandal in the Presidential campaign. John and Vanessa spend time together in Hellas. Stark gets mad about the solar power units; Will asks him about Pentagon plans to buy Martian uranium for weapons systems.  
Date: early Aug. through Sept. 2049
11. Ice Chimney 167  
Skip Carson's happy with Stark, who proves to be quite an actor. The ice chimneys are reached and one has life in it; but it's terrestrial, not Martian. Launch of Aster-2 to Eureka. More about Aster-1. Sudden change in the mission to Gradivus; Helmut gets selected.  
Sept. 2049
12. Launch 182  
Greg and Anna set wedding date; John and Vanessa decide to marry; Suzanne incorporates the immigrant society. Carson movie is progressing. Presidential election is a shocker and the stock market dips. Launch.  
Date: late Oct/early Nov. 2049
13. New Year 199  
Will and Thierry debate the Christian manger scene and the role of religion in public life; Will and Lisa discuss the murky waters of Riviera pool; White elected president after many delays of delay; Will philosophizes about it privately with a few friends. White makes a very conciliatory speech; but Will decides to shift personal investments anyway.  
Date: late December/early Jan 2050
14. Virus 213  
Will talks to Skip about politics, then flies to Dawes to get a tour. Will tells Ethel David says because of deteriorating relations between US and Europe, the Mercury mission is likely to be suspended because it needs American nukes, or shifted to Chinese nukes. On



his way to Cassini a computer virus is unleashed that destroys most computers in North America.

DATE: Late Jan 2050

15. Gradivus

235

White invades Turanistan. Marshall's tenth birthday. President attacks Commission and Mars as too foreign. Gradivus mission lands in spite of damage. Helmut finds a fragment of Venus on the asteroid's surface.

DATE: Jan 25- Feb. 1, 2050

16. Martians

261

Gradivus mission returns safely. Reports about the chimney bacteria come back: they are ancient Earth colonizers. Will gives a speech about the Mars example and the US President ridicules it as "Martian." US gradually recovers from the computer virus, but the stock market is down forty percent and the GDP is predicted to shrink ten percent that year. Turanistan is conquered completely by the US but criticism of the act rises when the US accidentally bombs a mosque.

Date: March 1-3, 2050

17. Houston

274

Houston gets nuked when the passenger plane is diverted there from Dallas. Columbus 7 ready to depart. Columbus 8 is in advanced planning stages. Communications collapse; Commission headquarters destroyed; Morgan blinded. NASA demands that Will accept NASA authority over Mars and he refuses carefully.

Date: Apr. 2050

18 Demonstration

303

Roger, Brian, and Neal are offered command and refuse. Will's mom is visited by the FBI; Will's being audited by the IRS; Ruhullah's sister is visited by the FBI, too. The Martians demonstrate in Yalta against the US government.

Date: Late Apr. 2050

19. Equinox

318

Alexandra gives Will a tour of the Colorado Biome's pit, which had a minor cave in. They discuss the lawsuit, the development of biomes, and the equinox.

Date: May 28, 2050

Ideas not used in novel: NASA refuses to allow Columbus 8 to proceed and pulls the LANTR engines. Will is so busy he gives Ruhullah management responsibility over Aurorae, then asks the borough meeting to do the same. President attacks him as influenced by Islam. He defends Ruhullah as an Iranian-Martian and calls himself a Martian. The position is popular on Mars as well. David Alaoui or one of the other early Mars mission members is elected the new Commissioner of Mars. Columbus 8 proceeds on chemical propulsion instead.

Volume 7 started about July 8-10, 2003; dropped July 30 for Survival Mars; revived Aug. 27 when the latter was finished. Delayed by a thorough rereading and editing of all six previous volumes. Completed December 10/11, 2003. Revised Dec. 15-21, 2008