"Yes, why? I mean there's two kinds of activities here, there's the exploration of Mars and then there's the life support for that exploration. And here you've been completely immersed in the life support, without paying the slightest attention to the reason we came in the first place!"

"Well, it's what I like to do," Nadia said uneasily.

"Fine, but try to keep some perspective on it! What the hell, you could have stayed back on Earth and been a plumber! You didn't have to come all this way to drive a goddamn bulldozer! Just how long are you going to go on grubbing away here, installing toilets, programming tractors?"

"All right, all right," Nadia said, thinking of Maya and all the rest. The square of vaults was almost finished, anyway. "I could use a vacation."

They took off in three big long-range rovers: Nadia and five of the geologists, Ann, Simon Frazier, George Berkovic, Phyllis Boyle, and Edvard Perrin. George and Edvard were friends of Phyllis's from their NASA days, and they supported her in advocating "applied geological studies," meaning prospecting for rare metals; Simon on the other hand was a quiet ally of Ann's, committed to pure research and a hands-off attitude. Nadia knew all this even though she had spent very little time alone with any of these people, except for Ann. But talk was talk; she could have named all the allegiances of everyone at base if she had to.

The expedition rovers were each composed of two four-wheeled modules, coupled by a flexible frame; they looked a bit like giant ants. They had been built by Rolls Royce and a multinational aerospace consortium, and had a beautiful sea green finish. The forward modules contained the living quarters and had tinted windows on all four sides; the aft modules contained the fuel tanks, and sported a number of black rotating solar panels. The eight wire mesh wheels were 2.5 meters high, and very broad.

As they headed north across Lunae Planum they marked their route with little green transponders, dropping one every few kilometers. They also cleared rocks from their path that might disable a robot-driven rover, using the snowplow attachment or the little crane at the front end of the first rover. So in effect they were building a road. But they seldom had to use the rockmoving equipment on Lunae; they drove northeast at nearly their full speed of thirty kilometers an hour, for several days straight. They were heading northeast, to avoid the canyon systems of Tempe and Mareotis, and this route took them down Lunae to the long slope of Chryse Planitia. Both these regions looked much like the land around their base camp, bumpy and strewn with small rocks; but because they were heading downhill they often had much longer views than
they were used to. It was a new pleasure to Nadia, to drive on and on and see new countryside continually pop over the horizon: hillocks, dips, enormous isolated boulders, the occasional low round mesa that was the outside of a crater.

When they had descended to the lowlands of the northern hemisphere, they turned and drove straight north across the immense Acidalia Planitia, and again ran straight for several days. Their wheel tracks stretched behind them like the first cut of a lawnmower through grass, and the transponders gleamed bright and incongruous among the rocks. Phyllis, Edvard and George talked about making a few side trips, to investigate some indications seen in satellite photos that there were unusual mineral outcroppings near Perepelkin Crater. Ann reminded them irritably of their mission. It made Nadia sad to see that Ann was nearly as distant and tense out here as she was at back at base; whenever the rovers were stopped she was outside walking around alone, and she was withdrawn when they sat together in Rover One to eat dinner. Occasionally Nadia tried to draw her out: "Ann, how did all these rocks get scattered around like this?"

"Meteors."

"But where are the craters?"

"Most are in the south."

"But how did the rocks get here, then?"

"They flew. That's why they're so small. It's only smaller rocks could be tossed so far."

"But I thought you told me that these northern plains were relatively new, while the heavy cratering was relatively old."

"That's right. The rocks you see here come from late meteor action. The total accumulation of loose rock from meteor strikes is much greater than what we can see, that's what gardened regolith is. And the regolith is a kilometer deep."

"It's hard to believe," Nadia said. "I mean, that's so many meteors."

Ann nodded. "It's billions of years. That's the difference between here and Earth, the age of the land goes from millions of years to billions. It's such a big difference it's hard to imagine. But seeing stuff like this can help."

Midway across Acidalia they began running into long, straight, steep-walled, flat-bottomed canyons. They looked, as George noted more than once, like the dry beds of the legendary canals. The geological name for them was fossae, and they came in clusters. Even the smallest of these canyons were
impassable to rovers, and when they came on one they had to turn and run along its rim, until its floors rose or its walls drew together, and they could continue north over flat plain again.

The horizon ahead was sometimes twenty kilometers off, sometimes three. Craters became rare, and the ones they passed were surrounded by low mounds that rayed out from the rims: splosh craters, where meteors had landed in permafrost that had turned to hot mud in the impact. Nadia's companions spent a day wandering eagerly over the splayed hills around one of these craters; the rounded slopes, Phyllis said, indicated ancient water as clearly as the grain in petrified wood indicated the original tree. By the way she spoke Nadia understood that this was another of her disagreements with Ann; Phyllis believed in the long wet past model, Ann in the short wet past. Or something like that. Science was many things, Nadia thought, including a weapon with which to hit other scientists.

Further north, around latitude 54°, they drove into the weird-looking land of thermokarst, hummocky terrain spotted by a great number of steep-sided oval pits, called alases. These alases were a hundred times bigger than their terran analogues, most of them two or three kilometers across, and about sixty meters deep. A sure sign of permafrost, the geologists all agreed; seasonal freezing and thawing of the soil caused it to slump in this pattern. Pits this big indicated that water content in the soil must have been high, Phyllis said. Unless it was yet another manifestation of martian times scales, Ann replied. Slightly icy soil, slumping every so slightly, for eons.

Irritably Phyllis suggested that they try collecting water from the ground, and irritably Ann agreed. They found a smooth slope between depressions, and stopped to install a permafrost water collector. Nadia took charge of the operation with a feeling of relief; the trip's lack of work had begun to get to her. It was a good day's job: she dug a ten-meter long trench with the lead rover's little backhoe; laid the lateral collector gallery, a perforated stainless steel pipe filled with gravel; checked the electric heating elements running in strips along the pipe and filters; then filled in the trench with the clay and rocks they had dug out earlier.

Over the lower end of the gallery was a sump and pump, and an insulated transport line leading to a small holding tank. Batteries would power the heating elements, and solar panels charge the batteries. When the holding tank was full, if there was enough water to fill it, the pump would shut off and a solenoid valve would open, allowing the water in the transport line to drain back into the gallery, after which the heating elements would shut off as well.

"Almost done," Nadia declared late in the day, as she started to bolt the transport pipe onto the last magnesium post. Her hands were dangerously cold, and her maimed hand throbbed. "Maybe someone could start dinner," she said. "I'm almost done here." The transport pipe had to be packed in a...
thick cylinder of white polyurethane foam, then fitted into a larger protective pipe. Amazing how much insulation complicated a simple piece of plumbing.

Hex nut, washer, cotter pin, a firm tug on the wrench. Nadia walked along the line, checking the coupling bands at the joints. Everything firm. She lugged her tools over to Rover One, looked back at the result of the day’s work: a tank, a short pipe on posts, a box on the ground, a long low mound of disturbed soil running uphill, looking raw but otherwise not unusual in this land of lumps. “We’ll drink some fresh water on our way back,” she said.

They had driven north for over two thousand kilometers, and finally rolled down onto Vastitas Borealis, an ancient cratered lava plain that ringed the northern hemisphere between latitudes 60° and 70°. Ann and the other geologists spent a couple of hours every morning out on the bare dark rock of this plain, taking samples, after which they would drive north for the rest of the day, discussing what they had found. Ann seemed more absorbed in the work, happier. One evening Simon pointed out that Phobos was running just over the low hills to the south; the next day’s drive would put it under the horizon. It was a remarkable demonstration of just how low the little moon’s orbit was; they were only at latitude 69°! But Phobos was only some five thousand kilometers above the planet’s equator. Nadia waved goodbye to it with a smile; she would still be able to talk to Arkady using the newly arrived areosynchronous radio satellites.

Three days later the bare rock ended, running under waves of blackish sand. It was just like coming on the shore of a sea. They had reached the great northern dunes, which wrapped the world in a band between Vastitas and the polar cap; where they were going to cross, the band was about eight hundred kilometers wide. The sand was a charcoal color, tinged with purple and rose, a rich relief to the eye after all the red rubble of the south. The dunes trended north and south, in parallel crests that occasionally broke or merged. Driving over them was easy; the sand was hard-packed, and they only had to pick a big dune and run along its humpbacked western side.

After a few days of this, however, the dunes got bigger, and became what Ann called barchan dunes. These looked like huge frozen waves, with faces a hundred meters tall, and backs a kilometer wide; and the crescent that each wave made was several kilometers long. As with so many other martian landscape features, they were a hundred times larger than their terran analogs in the Sahara and Gobi. The expedition kept a level course over the backs of these great waves by contouring from one wave back to the next, their rovers like tiny boats, paddlewheeling over a sea that had frozen at the height of a titanic storm.
One day on this petrified sea, Rover Two stopped. A red light on the control panel indicated the problem was in the flexible frame between the modules; and in fact the rear module was tilted to the left, shoving the left side wheels into the sand. Nadia got into a suit and went back to have a look. She took the dust cover off the joint where the frame connected to the module chassis, and found that the bolts holding them together were all broken.

"This is going to take a while," Nadia said. "You guys might as well have another look around."

Soon the suited figures of Phyllis and George emerged, followed by Simon and Ann and Edvard. Phyllis and George took a transponder from Rover Three and set it out three meters to the right of their "road." Nadia went to work on the broken frame, handling things as little as possible; it was a cold afternoon, perhaps seventy below, and she could feel the diamond chill right down to the bone.

The ends of the bolts wouldn't come out of the side of the module, so she got out a drill and started drilling new holes. She began to hum "The Sheik of Araby." Ann and Edvard and Simon were discussing sand. It was so nice, Nadia thought, to see ground that wasn't red. To hear Ann absorbed in her work. To have some work to do herself.

They had almost reached the arctic circle, and it was Ls = 87, with the northern summer solstice only forty days away; so the days were getting long. Nadia and George worked through the evening while Phyllis heated supper, and then after the meal Nadia went back out to finish the job. The sun was red in a brown haze, small and round even though it was near setting; there wasn't enough atmosphere for oblation to enlarge and flatten it. Nadia finished, put her tools away, and had opened the outer lock door of Rover One, when Ann's voice spoke in her ear. "Oh Nadia, are you going in already?"

Nadia looked up. Ann was on the ridge of the dune to the west, waving down at her, a black silhouette against a blood-colored sky.

"That was the idea," Nadia said.

"Come on up here just a second. I want you to see this sunset, it's going to be a good one. Come on, it'll only take a minute, you'll be glad you did it. There are clouds to the west."

Nadia sighed and closed the outer lock door.

The east face of the dune was steep. Nadia carefully stepped in the prints Ann had made in her ascent. The sand there was packed and held firm most of the time. Near the crest it got steeper, and she leaned forward and dug in with her fingers. Then she was clambering onto the broad rounded crest, and could straighten up and have a look around.
Only the crests of the tallest dunes were still in sunlight; the world was a black surface, marred by short scimitar curves of steely gray. Horizon about five kilometers off. Ann was crouching, a scoop of sand in her palm.

"What's it made of?" Nadia asked.

"Dark solid mineral particles."

Nadia snorted. "I could have told you that."

"Not before we got here you couldn't. It might have been fines aggregated with salts. But it's bits of rock instead."

"Why so dark?"

"Volcanic. On Earth sand is mostly quartz, you see, because there's a lot of granite there. But Mars doesn't have much granite. These grains are probably volcanic silicates. Obsidian, flint, some garnet. Beautiful, isn't it?"

She held out a handful of sand for Nadia's inspection. Perfectly serious of course. Nadia peered through her faceplate at the black grit. "Beautiful," she said.

They stood and watched the sun set. Their shadows went right out to the eastern horizon. The sky was a dark red, murky and opaque, only slightly lighter in the west over the sun. The clouds Ann had mentioned were bright yellow streaks, very high in the sky. Something in the sand caught at the light, and the dunes were distinctly purplish. The sun was a little gold button, and above it shone two evening stars: Venus, and the Earth.

"They've been getting closer every night lately," Ann said softly. "The conjunction should be really brilliant."

The sun touched the horizon, and the dune crests faded to shadow. The little button sun sank under the black line to the west. Now the sky was a maroon dome, the high clouds the pink of moss campion. Stars were popping out everywhere, and the maroon sky shifted to a vivid dark violet, an electric color that was picked up by the dune crests, so that it seemed crescents of liquid twilight lay across the black plain. Suddenly Nadia felt a breeze swirl through her nervous system, running up her spine and out into her skin; her cheeks tingled, and she could feel her spinal cord thrum. Beauty could make you shiver! It was a shock to feel such a physical response to beauty, a thrill like some kind of sex. And this beauty was so strange, so alien. Nadia had never seen it properly before, or never really felt it, she realized that now; she had been enjoying her life as if it were a Siberia made right, so that really she had been living in a huge analogy, understanding everything in terms of her past. But now she stood under a tall violet sky on the surface of a petrified black ocean, all new, all strange; it was absolutely impossible to compare it to
anything she had seen before; and all of a sudden the past sheered away in her head and she turned in circles like a little girl trying to make herself dizzy, without a thought in her head. Weight seeped inward from her skin, and she didn't feel hollow anymore; on the contrary she felt extremely solid, compact, balanced. A little thinking boulder, set spinning like a top.

###

They glissaded down the steep face of the dune on their boot heels. At the bottom Nadia gave Ann an impulsive hug: "Oh Ann, I don't know how to thank you for that." Even through the tinted faceplates she could see Ann grin. A rare sight.

###

After that things looked different to Nadia. Oh she knew it was in herself, that it was a matter of paying attention in a new way, of **looking**. But the landscape conspired in this sensation, feeding her new attentiveness; because the very next day they left the black dunes, and drove on to what her companions called layered or laminate terrain. This was the region of flat sand that in winter would lie under the CO2 skirt of the polar cap. Now in midsummer it lay revealed, a landscape made entirely of curvilinear patterns. They drove up broad flat washes of yellow sand that were bounded by long sinuous flat-topped plateaus; the sides of the plateaus were stepped and benched, laminated both finely and grossly, looking like wood that had been cut and polished to show a handsome grain. None of them had ever seen any land remotely like it, and they spent the mornings taking samples and borings, and hiking around in a loping martian ballet, talking a blue streak, Nadia as excited as any of them. Ann explained to her that each winter's frost caught a lamina on the surface. Then wind erosion had cut arroyos, and stripped away at their sides, and each strata was stripped back farther than the one below it, so that the arroyo walls consisted of hundreds of narrow terraces. "It's like the land is a contour map of itself," Simon said.

They drove during the days, and went out every evening, in purply dusks that lasted until just before midnight. They drilled borings, and came up with cores that were gritty and icy, laminated for as far down as they could drill. One evening Nadia was climbing with Ann up a series of parallel terraces, half-listening to her explain about the precession of aphelion and perihelion, when she looked back across the arroyo and saw that it was glowing like lemons and apricots in the evening light, and that above the arroyo were pale green lenticular clouds, mimicking perfectly the terrain's French curves. "Look!" she exclaimed.

Ann looked back and saw it, and was still. They watched the low banded clouds float overhead.
Finally a dinner call from the rovers brought them back. And walking down over the contoured terraces of sand, Nadia *knew* that she had changed—that, or else the planet was getting much more strange and beautiful as they traveled north. Or both.

###

They rolled over flat terraces of yellow sand, sand so fine and hard and clear of rocks that they could go at full speed, slowing down only to shift up or down from one bench to another. Occasionally the rounded slope between terraces gave them some trouble, and once or twice they even had to backtrack to find a way. But usually a route north could be found without difficulty.

On their fourth day in the laminate terrain, the plateau walls flanking their flat wash curved together, and they drove up the cleavage onto a higher plane; and there before them on the new horizon was a white hill, a great rounded thing, like a white Ayer's Rock. A white hill—it was ice! A hill of ice, a hundred meters high and a kilometer wide—and when they drove around it, they saw that it continued over the horizon to the north. It was the tip of a glacier, perhaps a tongue of the polar cap itself. In the other cars they were shouting, and in the noise and confusion Nadia could only hear Phyllis, crying "Water! Water!"

Water indeed. Though they had known it was going to be there, it was still startling in the extreme to run into a whole great white hill of it, in fact the tallest hill they had seen in the entire five thousand kilometers of their voyage. It took them all that first day to get used to it: they stopped the rovers, pointed, chattered, got out to have a look, took surface samples and borings, touched it, climbed up it a ways. Like the sand around it, the ice hill was horizontally laminated, with lines of dust about a centimeter apart. Between the lines the ice was pocked and granular; in this atmospheric pressure it sublimed at almost all temperatures, leaving pitted, rotten side walls to a depth of a few centimeters; under that it was solid, and hard.

"This is *lot* of water," they all said at one point or another. Water, on the surface of Mars...!

The next day the glacier hill formed their right horizon, a wall that ran on beside them for the whole day's drive. Then it really began to seem like a lot of water, especially as over the course of the day the wall got taller, rising to a height of about three hundred meters. A kind of white mountain ridge, in fact, walling off their flat-bottomed valley on its east side. And then, over the horizon to the northwest, there appeared another white hill, the top of another ridge poking over the horizon, the base remaining beneath it. Another glacier hill, walling them in to the west, some thirty kilometers away.
The borer cut into the ice, and passed back cylindrical drums 1.5 meters in diameter. When they turned the borer on it made a loud, low buzz, which was louder still if they put their helmets to the ice, or even touched it with their hands. After a while white ice drums thumped into a hopper, and then a small robot forklift carried them to a distillery, which would melt the ice and separate out its considerable load of dust, then refreeze the water into one-meter cubes more suitable for packing in the holds of the rovers. Robot freight rovers would then be perfectly capable of driving to the site, loading up and returning to base on their own; and base would then have a regular water supply, larger than they could ever use. Around three or four trillion cubic meters in the visible polar cap, Edvard calculated, though there were a lot of guesses in the calculation.

They spent several days testing the miner, and deploying an array of solar panels to power it. In the long evenings after dinner Ann would climb the ice wall, ostensibly to take more borings, although Nadia knew she just wanted away from Phyllis and Edvard and George. And naturally she wanted to climb all the way to the top, to get on the polar cap and look around, and take borings of the most recent layers of ice; and so one day when the miner had passed all the test routines, she and Nadia and Simon got up at dawn—just after two AM—and went out into the supercold morning air and climbed, their shadows like big spiders climbing before them. The slope of the ice was about thirty degrees, steepening and then letting off time after time as they ascended the rough benches in the hill's layered side.

It was seven AM when the slope laid back and they walked onto the surface of the polar cap. To the north was a plain of ice that extended as far as they could see, to a high horizon some thirty kilometers away. Looking back to the south they could see a great distance over the geometric swirls of the layered terrain; it was the longest view Nadia had ever had on Mars.

The ice of the plateau was layered much like the laminated sand below them, with wide bands of dirty pink contouring across cleaner stuff. The other wall of Chasma Borealis lay off to the east, looking almost vertical from their point of view, long, tall, massive: "So much water!" Nadia said again. "It's more than we'll ever need."

"That depends," Ann said absently, screwing the frame of the little borer into the ice. Her darkened faceplate turned up at Nadia: "If the terraformers have their way, this will all go like dew on a hot morning. Into the air to make pretty clouds."

"Would that be so bad?" Nadia asked.

Ann stared at her. Through the tinted faceplate her eyes looked like ballbearings.
That night at dinner she said, "We really ought to make a run up to the pole."

Phyllis shook her head. "We don't have the food or air."

"Call for a drop."

Edvard shook his head. "The polar cap is cut by valleys almost as deep as Borealis!"

"Not so," Ann said. "You could drive straight to it. The swirl valleys look dramatic from space, but that's because of the difference in albedo between the water and the CO2. The actual slopes are never more than six degrees off the horizontal. It's just more layered terrain, really."

George said, "But what about getting onto the cap in the first place?"

"We drive around to one of the tongues of ice that drop to the sand. They're like ramps up to the central massif, and once there, we drive right to the pole!"

"There's no reason to go," Phyllis said. "It'll just be more of what we see here. And it means more exposure to radiation."

"And," George added, "we could use what food and air we do have to check out some of the sites we passed on the way up here."

So that was their point. Ann scowled. "I'm the head of the geological survey," she said sharply. Which may have been true, but she was a horrible politician, especially compared to Phyllis, who had any number of friends in Houston and Washington.

"But there's no geological reason to go to the pole," Phyllis said now with a smile. "It'll be the same ice as here. You just want to go."

"Well?" Ann said. "Say I do! There are still scientific questions to be answered up there. Is the ice the same composition, how much dust—everywhere we go up here we collect valuable data."

"But we're up here to get water. We're not up here to fool around."

"It's not fooling around!" Ann snapped. "We obtain water to allow us to explore, we don't explore just to obtain water! You've got it backwards! I can't believe how many people in this colony do that!"

Nadia said, "Let's see what they say at base. They might want us to help with something there, or they might not be able to send a drop, you never know."
Ann groaned. "We'll end up asking permission from the UN, I swear."

She was right. Frank and Maya didn't like the idea, John was interested but noncommittal. Arkady supported it when he heard of it, and declared he would send a supply drop from Phobos if necessary, which given its orbit was impractical at best. But at that point Maya called mission control in Houston and Baikonur, and the argument rippled outward. Hastings opposed the plan; but Baikonur, and a lot of the scientific community, liked it.

Finally Ann got on the phone, her voice very curt and arrogant, though she looked scared: "I'm the geological head here, and I say it needs to be done. There won't be any better opportunity to get onsite data on the original condition of the polar cap. It's a delicate system, and any change in the atmosphere is going to impact it heavily. And you're got plans to do that, right? Sax, are you still working on those windmill heaters?"

Sax had not been part of the discussion, and he had to be called to the phone. "Sure," he said when the question was repeated. He and Hiroko had come up with the idea of manufacturing small windmills, to be dropped from dirigibles all over the planet. The constant westerlies would spin the windmills, and the spin would be converted to heat in coils in the base of the mills, and this heat would simply be released into the atmosphere. Sax had already designed a robotic factory to manufacture the windmills; he hoped to make them by the thousands. Vlad pointed out that that the heat gained would come at the price of winds slowed down; you couldn't get something for nothing. Sax immediately argued that that would be a side benefit, given the severity of the global dust storms the wind sometimes caused. "A little heat for a little wind is a great trade-off."

"So, a million windmills," Ann said now. "And that's just the start. You talked about spreading black dust on the polar caps, didn't you Sax?"

"It would thicken the atmosphere faster than practically any other action we could take."

"So if you get your way," Ann said, "the caps are doomed. They'll evaporate and then we're going to say, 'I wonder what they were like?' And we won't know."

"Do you have enough supplies, enough time?" John asked.

"We'll drop you supplies," Arkady said again.

"There's four more months of summer," Ann said.

"You just want to go to the pole!" Frank said, echoing Phyllis.
"So?" Ann replied. "You may have come here to play office politics, but I plan to see a bit of this place."

Nadia grimaced; that ended that line of conversation, and Frank would be angry. Which was never a good idea. Ann, Ann. . . .

The next day the terran offices weighed in with the opinion that the polar cap ought to be sampled in its aboriginal condition. No objections from base; though Frank did not get back on the line. Simon and Nadia cheered: "North to the Pole!"

Phyllis just shook her head. "I don't see the point. George and Edvard and I will stay down here as a back-up, and make sure the ice miner is working right."

###

So Ann and Nadia and Simon took rover Three and drove back down Chasma Borealis and around to the west, where one of the glaciers curling away from the cap thinned to a perfect rampway. The mesh of the rovers' big wheels caught like a snowmobile's driving chain, running well over all the various surfaces of the cap, over patches of exposed granular dust, low hills of hard ice, fields of blinding white CO2 frost, and the usual lace of sublimed water ice. Shallow valleys swirled outward in a clockwise pattern from the pole; some of these were very broad. Crossing these they would drive down a bumpy slope that curved away to right and left over both horizons, all of it covered by bright dry ice; this could last for twenty kilometers, until the whole visible world was bright white. Then before them a rising slope of the more familiar dirty red water ice would appear, striated by contour lines. As they crossed the bottom of the trough the world would be divided in two, white behind, dirty pink ahead. Driving up the south-facing slopes, they found the water ice more rotten than elsewhere, but as Ann pointed out, every winter a meter of dry ice sat on the permanent cap to crush the previous summer's rotten filligree, so the potholes were filled on an annual schedule, and the rover's big wheels crunched cleanly along.

Beyond the swirl valleys they found themselves on a smooth white plain, extending to the horizon in every direction. Behind the polarized and tinted glass of the rover's windows the whiteness was unmarred and pure. Once they passed a low ring hill, the mark of some relatively recent meteor impact, filled in by subsequent ice deposition. They stopped to take borings, of course. Nadia had to restrict Ann and Simon to four borings a day, to save time and keep the rovers' trunks from being overloaded. And it wasn't just borings; often they would pass black isolated rocks, resting on the ice like Magritte sculptures: meteorites. They collected the smallest of these, and took samples from the larger ones; and once passed one that was as big as the rover. They were nickel-iron for the most part, or stony chondrites. Chipping away at one of
picked up her maimed hand and peered at the scar, until it made her uncomfortable and she tried to pull it back. He drew it up, gave the newly exposed knuckle at the base of the ring finger a kiss. "You've got strong hands, Ms. Nine Fingers."

"I did before this," she said, making a fist and holding it up.

"Someday Vlad will grow you a new finger," he said, and took the fist and opened it, then held the hand as they continued to walk. "This reminds me of the arboretum in Sebastopol," he said.

"Mmm," Nadia said, not really listening, intent on the warm heft of his hand in hers, in the tight intermingling of their fingers. He had strong hands too. She was fifty-one years old, a round little Russian woman with gray hair, a construction worker with missing fingers. So nice to feel the warmth of another body; it had been too long, and her hand soaked up the feeling like a sponge, until the poor thing tingled, full and warm. It must feel odd to him, she thought, then gave up on it. "I'm glad you're here," she said.

# # #

Having Arkady at Underhill made it like the hour before a thunderstorm. He made people think about what they were doing; habits that they had fallen into without thought came under scrutiny, and under this new pressure some became defensive, others aggressive. All the standing arguments got a bit more intense. Naturally this included the terraforming debate.

Now this debate was in no sense a single event but was rather an ongoing process, a topic that kept coming up, a matter of casual exchanges between individuals, out working, eating meals, falling asleep. Any number of things could bring it up: the sight of the white frost plume over Chernobyl; the arrival of a robot-driven rover, laden with water ice from the polar station; clouds in the dawn sky. Seeing these or many other phenomena someone would say "That'll add some BTUs to the system," or "Isn't that a good greenhouse gas," and perhaps a discussion of the technical aspects of the problem would follow. Sometimes the subject would come back up in the evenings back in Underhill, leading from the technical to the philosophical; and sometimes this led to long and heated arguments.

The debate was not, of course, confined to Mars. Position papers were being churned out by policy centers in Houston, Baikonur, Moscow, Washington, and the UN Office for Martian Affairs in New York, as well as in government bureaus, newspaper editorial offices, corporate board rooms, university campuses, and bars and homes all over the world. In the arguments on Earth, many people began to use the colonists' opinions as a kind of shorthand for the various positions, so that watching the terran news the colonists themselves would see people saying that they backed the Clayborne
position, or were in favor of the Russell program. This reminder of their enormous fame on Earth, their existence as characters in an ongoing TV drama, was always peculiar and unsettling; after the flurry of TV specials and interviews following touchdown, they had tended to forget the ongoing video transmissions, absorbed in the daily reality of their lives. But the video cameras were still shooting tape to send back home; and there were a lot of people on Earth who were fans of the show.

So nearly everyone had an opinion. Polls showed that most supported the Russell Program, an informal name for Sax's plans to terraform the planet by all means possible, as fast as they could. But the minority who backed Ann's hands-off attitude tended to be more vehement in their belief, insisting that it had immediate applications to the Antarctic policy, and indeed to all terran environmental policy. Meanwhile different poll questions made it clear that many people were fascinated by Hiroko and the farming project, while others called themselves Bogdanovists; Arkady had been sending back lots of video from Phobos, and Phobos was good video, a real spectacle of architecture and engineering. New terran hotels and commercial complexes were already imitating some of its features, there was an architectural movement called Bogdanovism, as well as other movements interested in him that were more concentrated on social and economic reforms in the world order.

But terraforming was near the center of all these debates, and the colonists' disagreements about it were played out on the largest possible public stage. Some of them reacted by avoiding the cameras and requests for interviews; "It's just what I came to get away from," Hiroko's assistant Iwao said, and quite a few agreed with him. Most of the rest didn't care one way or the other; a few seemed actually to like it. Phyllis's weekly program, for instance, was carried by both Christian cable stations and business analysis programs all over the world. But no matter how they dealt with it, looking at the polls and listening to the talk made it obvious that most people on Earth and on Mars assumed that terraforming would take place. It was not a question of whether but of when, and how much. Among the colonists themselves this was nearly the universal view. Very few sided with Ann: Simon of course; perhaps Ursula and Sasha; perhaps Hiroko; in his way John, and now in her way Nadia. There were more of these "reds" back on Earth, but they necessarily held the position as a theory, an aesthetic judgement. The strongest point to their arguments, and thus the one that Ann emphasized most often in her communiques back to Earth, was the possibility of indigenous life. "If there is Martian life here," Ann would say, "the radical alteration of the climate might kill it off. We cannot intrude on the situation while the status of life on Mars is unknown; it's unscientific, and worse, it's immoral."

Many agreed with that, including a lot of the terran scientific community, which influenced the UNOMA committee charged with overseeing the colony. But every time Sax heard the argument he blinked rapidly. "There's no sign of life on the surface, past or present," he would say mildly. "If it does exist it has
to be underground, near volcanic vents I suppose. But even if there is life down there, we could search for ten thousand years and never find it, nor eliminate the possibility it isn't down there somewhere else, somewhere we haven't looked. So waiting until we know for sure that there is no life—" which was a fairly common position among moderates— "effectively means waiting forever. For a remote possibility which terraforming wouldn't immediately endanger anyway."

"Of course it would," Ann would retort. "Maybe not immediately, but eventually the permafrost would melt, there would be movement through the hydrosphere, and contamination of all of it by warmer water and terran lifeforms, bacteria, viruses, algae. It might take a while, but it would surely happen. And we can't risk that."

Sax would shrug. "First, it's postulated life, very low probability. Second, it wouldn't be endangered for centuries. We could presumably locate it and protect it in that time."

"But we may no be able to find it."

"So we stop for low-probability life we can never actually find?"

Ann shrugged. "We have to, unless you want to argue that it's okay to destroy life on other planets, as long as we can't find it. And don't forget; indigenous life on Mars would be the biggest story of all time, it would have implications for the galactic frequency of life that are impossible to exaggerate. Looking for life is one of the main reasons we're here!"

"Well," Sax would say, "in the meantime, life that we are quite sure exists is being exposed to an extraordinarily high amount of radiation. If we don't do something to lessen it, we may not be able to stay here. We need a thicker atmosphere to cut down on radiation."

This was not a reply to Ann's point but the substitution of another one, and it was an argument that was very influential. Millions on Earth wanted to come to Mars, to the "new frontier," where life was an adventure again; waiting lists for emigration both real and fake were massively oversubscribed. But no one wanted to live in a bath of mutagenic radiation; and the practical desire to make the planet safe for humans was stronger in most people than the desire to preserve the lifeless landscape already there, or to protect a postulated indigenous life that many scientists assured them did not exist.

So it did seem, even among those urging caution, that terraforming was going to happen. A subcommittee of UNOMA had been convened to study the issue, and on Earth it was now in the nature of a given, an unavoidable part of progress, a natural part of the order of things. A manifest destiny.
On Mars, however, the issue was both more open and more pressing, not so much a matter of philosophy as of daily life, of frigid poisonous air and the radiation being taken; and among those in favor of terraforming, a significant group was clustering around Sax—a group that not only wanted to do it, but to do it as fast as possible. What this meant in practice no one was sure; estimates of the time it would take to get to a "human-viable surface" ranged from a century to ten thousand years, with extreme opinions on either end, from thirty years (Phyllis) to a hundred thousand years (Iwao). Phyllis would say, "God gave us this planet to make in our image, to create a new Eden." Simon would say, "If the permafrost melts we'd be living on a collapsing landscape, and a lot of us would be killed." Arguments wandered over a wide range of issues: salt levels, peroxide levels, radiation levels, the look of the land, possibly lethal mutations of genetically engineered microorganisms, and so on.

"We can try to model it," Sax said, "but the truth is we'll never be able to model it adequately. It's too big, and there's too many factors, many of them unknown. But what we will learn from it will be useful in controlling Earth's climate, in avoiding global warming or a future ice age. It's an experiment, a big one, and it will always be an ongoing experiment, with nothing guaranteed or known for sure. But that's what science is."

People would nod at this.

Arkady as always was thinking of the political point of view. "We can never be self-sufficient unless we do terraforming," he pointed out. "We need to terraform in order to make it ours, so that we will have the material basis for independence."

People would roll their eyes at this. But it meant that Sax and Arkady were allies of a sort, and that was a powerful combination. And so the arguments would go around, again and again and again, endlessly.

And now Underhill was nearly complete, a functioning and in most ways a self-sufficient village. Now it was possible to act further; now they had to decide what to do next. And most of them wanted to terraform. Any number of projects had been proposed to begin the process, with advocates for each, usually those who would be responsible for doing it. This was an important part of terraforming's attraction; every discipline could contribute to the enterprise in one way or another, so it had broad-based support. The alchemists talked about physical and mechanical means to add heat to the system; the climatologists debated influencing the weather; the biosphere team talked about ecological systems theories to be tested. The bioengineers were already working on new microorganisms; they were shifting, clipping and recombining genes from algae, methanogens, cyanobacteria, and lichens, trying to come up with organisms that would survive on the present martian surface, or under it. One day they invited Arkady to take a look at what they were doing, and Nadia went along with him.
They had some of their prototype GEMs in Mars jars, the largest of which was one of the old habitats in the trailer park. They had opened it up, shoveled regolith onto the floor, and sealed it again. They worked inside it by teleoperation, and viewed the results from the next trailer over, where instrument gauges took readings, and video screens showed what the various dishes were producing. Arkady looked at every screen closely, but there wasn't that much to see: their old quarters, covered with plastic cubicles filled with red dirt; robot arms extending from their bases against the walls. There were visible growths on part of the soil, a bluish furze.

"That's our champion so far," Vlad said. "But still only slightly areophytic." They were selecting for a number of extreme characteristics, including resistance to cold and dehydration and UV radiation, tolerance for salts, little need for oxygen, a habitat of rock or soil. No single terran organism had all these traits, and those that had them individually were usually very slow growers; but the engineers had started what Vlad called a mix and match program, and recently they had come up with a variant of the cyanophyte that was sometimes called bluegreen algae. "It is not precisely thriving, but it does not die so fast, let us put it that way." They had named it cyanophyte primares, its common name becoming Underhill algae. They wanted to make a field trial with it, and had prepared a proposal to send down to UNOMA.

Arkady left the trailer park excited by the visit, Nadia could see; and that night he said to the dinner group, "We should make the decision on our own, and if we decide in favor, act."

Maya and Frank were outraged by this, and clearly most of the rest were uncomfortable as well. Maya insisted on a change of subject, and awkwardly the dinner conversation shifted. And the next morning Maya and Frank came to Nadia, to talk about Arkady. The two leaders had already tried to reason with him, late the night before. "He laughs in our face!" Maya exclaimed. "It's useless to try to reason with him!"

"What he proposes could be very dangerous," Frank said. "If we explicitly disregard a directive from the UN, they could conceivably come here and round us up and ship us home, and replace us with people who will pay attention to the law. I mean, biological contamination of this environment is simply illegal at this point, and we don't have the right to ignore that. It's international treaty. It's how humanity in general wants to treat this planet at this time."

"Can't you talk to him?" Maya asked.

"I can talk to him," Nadia said. "But I can't say that it will do any good."

"Please, Nadia. Just try. We've got enough problems as it is."

"I'll try, sure."
So that afternoon she talked to Arkady. They were out on Chernobyl Road, walking back toward Underhill. She brought it up, and suggested that patience was in order. "It will only be a matter of time before the UN comes around to your view anyway."

He stopped and lifted her maimed hand. "How long do you think we have?" he said. He pointed at the setting sun. "How long do you suggest we wait? For our grandchildren? Our great-grandchildren? Our great-great-grandchildren, blind as cave fish?"

"Come on," Nadia said, pulling her hand free. "Cave fish."

Arkady laughed. "Still, it's a serious question. We don't have forever, and it would be nice to see things start to change."

"Even so, why not wait a year?"

"A terran year or a martian year?"

"A martian year. Get readings on all the seasons, give the UN time to come around."

"We don't need the readings, they've been taken now for years."

"Have you talked to Ann about that?"

"No. Well, sort of. But she doesn't agree."

"A lot of people don't agree. I mean maybe they will eventually, but you have to convince them. You can't just run roughshod over opposing opinions, otherwise you're just as bad as the people back home that you're always criticizing."

Arkady sighed. "Yeah yeah."

"Well, aren't you?"

"You damned liberals."

"I don't know what that means."

"It means you're too soft-hearted to ever actually do anything."

But they were now within sight of the low mound of Underhill, looking like a fresh squarish crater, its ejecta scattered around it. Nadia pointed at it. "I did that. You damned radicals—" she jabbed him in the ribs with her elbow, hard — "you hate liberalism because it works."

He snorted.

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"It does! It works in increments, over time, after hard labor, without fireworks or easy dramatics or people getting hurt. Without your sexy revolutions and all the pain and hatred they bring. It only works."

"Ah, Nadia." He put his arm over her shoulders, and they started walking again toward base. "Earth is a perfectly liberal world. But half of it is starving, and always has been, and always will be. Very liberally."

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Still, Nadia seemed to have affected him; he quit calling for a unilateral decision to release the new GEMs onto the surface, and he confined the agitprop to his beautification program, spending much of his time in the Quarter, trying to make colored bricks and glass. Nadia joined him for a swim before breakfast on most days, and they along with John and Maya took over a lane in the shallow pool that filled all of one of the vaulted chambers, and swam a brisk workout of one or two thousand meters. John led the sprint sets, Maya led the distance sets, Nadia followed in everything, hampered by her bad hand, and they churned through the extra-splashy water like a line of dolphins, staring through their goggles down at the sky-blue concrete of the pool bottom. "The butterfly was made for this gee," John would say, grinning at the way they could practically fly out of the water. Breakfasts afterwards were pleasant if brief, and the rest of the days were the usual round of work; Nadia seldom saw Arkady again till evenings at dinner, or afterward.

Then Sax and Spencer and Rya finished setting up the robot factory for making Sax's windmill heaters, and they applied to UNOMA for permission to distribute a thousand of them around the equatorial regions, to test their warming effect. All of them together were only expected to add about twice the heat to the atmosphere that Chernobyl did, and there were even questions as to whether they would be able to distinguish the added heat from background seasonal fluctuations; but as Sax said, they wouldn't know until they tried. And there was no doubt that the heaters would add some heat to the surface, detectable or not.

And so the terraforming argument flared again. And suddenly Ann flew into violent action, taping long messages that she sent to the members of UNOMA's executive committee, and to the national offices for Martian affairs for all the countries that were currently on the committee; and finally to the UN General Assembly. These appearances were given enormous amounts of attention, from the most serious policy-making levels all the way down to the tabloid press and TV, media that regarded it as the newest episode of the red soap opera. Ann had taped and sent her messages in private, so the colonists learned of them by seeing excerpts on terran TV, and watching the reaction to them in the days that followed: debates in government, a rally in Washington that drew twenty thousand; endless amounts of editorial space, and commentary in the scientific nets. It was a bit shocking to see the strength of
These responses, and some of them felt Ann had gone behind their backs. Phyllis for one was outraged.

"Besides, it doesn't make sense," Sax said, blinking rapidly. "Chernobyl is already releasing almost as much heat into the atmosphere as these windmills, and she never complained about that."

"Yes she did," Nadia said. "She just lost the vote."

Hearings were held at UNOMA, and while they were going on a group of the materials scientists confronted Ann after dinner. A lot of the rest of them were there to witness this confrontation; Underhill's main dining hall filled four chambers, whose dividing walls had been removed and replaced by load-bearing pillars; it was a big room, filled with chairs and potted plants and the descendants of the Ares' birds, and most recently lit by windows installed high across the northern wall, through which they saw the ground level crops of the atrium. A big space; and at least half the colonists were in it eating when the meeting took place.

"Why didn't you discuss this with us?" Spencer asked her.

Ann's glare forced Spencer to look away. "Why should I discuss it with you?" she said, turning her gaze on Sax. "It's clear what you all think about this, we've gone over it many times before, and nothing I've said makes any difference to you. Here you sit in your little holes running your little experiments, making things like kids with a chemistry set in a basement, while the whole time an entire world sits outside your door. A world where the landforms are a hundred times larger than their equivalents on Earth, and a thousand times older, with evidence concerning the beginning of the solar system scattered all over, as well as the whole history of a planet, scarcely changed in the last billion years. And you're going to wreck it all. And without ever honestly admitting what you're doing, either. Because we could live here and study the planet without changing it—we could do that with very little harm or even inconvenience to ourselves. All this talk of radiation is bullshit and you know it. There's simply not a high enough level of it to justify this mass alteration of the environment. You want to do that because you think you can. You want to try it out and see—as if this were some big playground sandbox for you to build castles in. A big Mars jar! You find your justifications where you can, but it's bad faith, and it's not science."

Her face had gone bright red during this tirade; Nadia had never seen her anywhere near as angry as this. The usual matter-of-fact facade that she placed over her bitter anger had shattered, and she was almost speechless with fury, she was shuddering. The whole room had gone deadly quiet. "It's not science, I say! It's just playing around. And for that game you're going to wreck the historical record, destroy the polar caps, and the outflow channels,
and the canyon bottoms—destroy a beautiful pure landscape, and for nothing at all."

The room was as still as a tableau, they were like stone statues of themselves. The ventilators hummed. People began to eye one another warily. Simon took a step toward Ann, his hand outstretched; she stopped him dead with a glance, he might as well have stepped outside in his underwear and frozen stiff. His face reddened, and he cracked his posture and sat back down.

Sax Russell rose to his feet. He looked the same as ever, perhaps a bit more flushed than usual, but mild, small, blinking owlishly, his voice calm and dry, as if lecturing on some textbook point of thermodynamics, or enumerating the periodic table.

"The beauty of Mars exists in the human mind," he said in that dry factual tone, and everyone stared at him amazed. "Without the human presence it is just a concatenation of atoms, no different than any other random speck of matter in the universe. It's we who understand it, and we who give it meaning. All our centuries of looking up at the night sky and watching it wander through the stars. All those nights of watching it through the telescopes, looking at a tiny disk trying to see canals in the albedo changes. All those dumb sci-fi novels with their monsters and maidens and dying civilizations. And all the scientists who studied the data, or got us here. That's what makes Mars beautiful. Not the basalt and the oxides."

He paused to look around at them all. Nadia gulped; it was strange in the extreme to hear these words come out of the mouth of Sax Russell, in the same dry tone that he would use to analyze a graph. Too strange!

"Now that we are here," he went on, "it isn't enough to just hide under ten meters of soil and study the rock. That's science, yes, and needed science too. But science is more than that. Science is part of a larger human enterprise, and that enterprise includes going to the stars, adapting to other planets, adapting them to us. Science is creation. The lack of life here, and the lack of any finding in fifty years of the SETI program, indicates that life is rare, and intelligent life even rarer. And yet the whole meaning of the universe, its beauty, is contained in the consciousness of intelligent life. We are the consciousness of the universe, and our job is to spread that around, to go look at things, to live everywhere we can. It's too dangerous to keep the consciousness of the universe on only one planet, it could be wiped out. And so now we're on two, three if you count the moon. And we can change this one to make it safer to live on. Changing it won't destroy it. Reading its past might get harder, but the beauty of it won't go away. If there are lakes, or forests, or glaciers, how does that diminish Mars's beauty? I don't think it does. I think it only enhances it. It adds life, the most beautiful system of all. But nothing life can do will bring Tharsis down, or fill Marineris. Mars will always remain Mars,
different from Earth, colder and wilder. But it can be Mars and ours at the same
time. And it will be. There is this about the human mind; if it can be done, it will
be done. We can transform Mars and build it like you would build a cathedral,
as a monument to humanity and the universe both. We can do it, so we will do
it. So—" he held up a palm, as if satisfied that the analysis had been supported
by the data in the graph—as if he had examined the periodic table, and found
that it still held true— "we might as well start."

He looked at Ann, and all eyes followed her. Ann's mouth was tight, her
shoulders slumped. She knew she was beaten.

She shrugged, as if she were shrugging a hooded cape back over her
head and body, a heavy carapace that weighed her down, and covered her
entirely from them. In the flat dead tone that she usually employed when she
was upset, she said, "I think you value consciousness too high, and rock too
little. We are not lords of the universe. We're one small part of it. We may be
its consciousness, but being the consciousness of the universe does not mean
turning it all into a mirror image of us. It means rather fitting into it as it is, and
worshipping it with our attention." She met Sax's mild gaze, and one final flare
of her anger jetted out: "You've never even seen Mars."

And she left the room.

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Janet had had her camera specs on, and videotaped this exchange. Phyllis sent a copy back to Earth. A week later the UNAMO committee on
environmental alterations approved the dissemination of the heater windmills.

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The plan was to drop them from dirigibles. Arkady immediately claimed
the right to pilot one, as a sort of reward for his work on Phobos. Maya and
Frank were not unhappy at the thought of Arkady disappearing from Underhill
for another month or two, so they immediately assigned him one of the craft.
He would drift east in the prevailing winds, descending to place windmills in
channel beds and on the outer flanks of craters, both places where winds
tended to be strong. Nadia first heard of the expedition when Arkady skipped
through the chambers to her and told her about it.

"Sounds nice," she said.

"Want to come along?" he asked.

"Why yes," she said. Her ghost finger was tingling.