

# INTO THE MIRANDA RIFT

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## I

This starts after we had already walked, crawled, and clawed our way fifty-three zig-zagging kilometers into the Great Miranda Rift, and had already penetrated seventeen kilometers below the mean surface. It starts because the mother of all Mirandaquakes just shut the door behind us and the chances of this being rescued are somewhat better than mine; I need to do more than just take notes for a future article. It starts because I have faith in human stubbornness, even in a hopeless endeavor; and I think the rescuers will come, eventually. I am Wojciech Bubka and this is my journal.

Miranda, satellite of Uranus, is a cosmic metaphor about those things in creation that come together without really fitting, like the second try at marriage, ethnic integration laws, or a poet trying to be a science reporter. It was blasted apart by something a billion years ago and the parts drifted back together, more or less. There are gaps. Rifts. Empty places for things to work their way in that are not supposed to be there; things that don't belong to something of whole cloth.

Like so many great discoveries, the existence of the rifts was obvious after the fact, but our geologist, Nikhil Ray, had to endure a decade of derision, several rejected papers, a divorce from a wife unwilling to share academic ridicule, and public humiliation in the pop science media—before the geology establishment finally conceded that what the seismological network on Miranda's surface had found had, indeed, confirmed his work.

Nikhil had simply observed that although Miranda appears to be made of the same stuff as everything else in the Uranian system, the other moons are just under twice as dense as water while Miranda is only one and a third times as dense. More ice and less rock below was one possibility. The other possibility, which Nikhil had patiently pointed out, was that there could be less of *everything*; a scattering of voids or bubbles beneath.

So, with the goat-to-hero logic we all love, when seismological results clearly showed that Miranda was laced with substantial amounts of nothing, Nikhil became a minor Solar System celebrity, with a permanent chair at Coriolis, and a beautiful, high-strung, young renaissance woman as a trophy wife.

But, by that time, I fear there were substantial empty places in Nikhil, too.

Like Miranda, this wasn't clear from his urbane and vital surface when we met. He was tall for a Bengali, a lack of sun had left his skin with only a tint of bronze, and he had a sharp face that hinted at an Arab or a Briton in his ancestry; likely both. He moved with a sort of quick, decisive energy that nicely balanced the tolerant good-fellow manners of an academic aristocrat in the imperial tradition. If he now distrusted people in general, if he kept them all at a pleasantly formal distance, if he harbored a secret contempt for his species, well, this had not been apparent to Catherine Ray, M.D., who had married him after his academic rehabilitation.

I think she later found the emptiness within him and part of her had recoiled, while the other, controlling, part found no objective reason to leave a relationship that let her flit around the top levels of Solar System academia. Perhaps that explained why she chose to go on a fortnight of exploration with someone she seemed to detest; oh, the stories she would tell. Perhaps that explained her cynicism. Perhaps not.

We entered the great rift three days of an age ago, at the border of the huge chevron formation: the rift where two dissimilar geologic structures meet, held together by Miranda's gentle gravity and little else. Below the

cratered, dust-choked surface, the great rift was a network of voids between pressure ridges; rough wood, slap-glued together by a lazy carpenter on a Saturday night. It could, Nikhil thinks, go through the entire moon. There were other joints, other rifts, other networks of empty places—but this was the big one.

Ah, yes, those substantial amounts of nothing. As a poet, I was fascinated by contradiction and I found a certain attraction to exploring vast areas of hidden emptiness under shells of any kind.

I fill voids, so to speak. I was an explicit rebel in a determinedly impressionist literary world of artful obscurity which fails to generate recognition or to make poets feel like they are doing anything more meaningful than the intellectual equivalent of masturbation—and pays them accordingly. The metaphor of Miranda intrigued me; an epic lay there beneath the dust and ice. Wonders to behold there must be in the biggest underground system of caverns in the known Universe. The articles, interviews, and talk shows played out in my mind. All I had to do was get there.

I had a good idea of how to do that. Her name was Miranda Lotati. Four years ago, the spelunking daughter of the guy in charge of "Solar System Astrographic's" project board had been a literature student of mine at Coriolis University. When I heard of the discovery of Nikhil's mysterious caverns, it was a trivial matter to renew the acquaintance, this time without the impediments of faculty ethics. By this time she had an impressive list of caves, mountains, and other strange places to her credit, courtesy of her father's money and connections, I had thought.

She had seemed a rough-edged, prickly woman in my class, and her essays were dry condensed dullness, never more than the required length, but which covered the points involved well enough that honesty had forced me to pass her.

Now, armed with news of the moon Miranda's newly discovered caverns, I decided her name was clearly her destiny. I wasn't surprised when an inquiry had revealed no current relationship. So, I determined to create one and bend it toward my purposes. Somewhat to my surprise, it worked. Worked to the point where it wasn't entirely clear whether she was following my agenda, or I, hers.

Randi, as I got to know her, was something like a black hole; of what goes in, nothing comes out. Things somehow accrete to her orbit and bend to her will without any noticeable verbal effort on her part. She can spend a whole evening without saying anything more than "uh-huh." Did you like

the Bach? Nice place you have. Are you comfortable? Do you want more? Did you like it? Do you want to do it again tomorrow?

"Uh-huh."

"Say, if you go into Miranda someone should do more than take pictures, don't you think? I've thrown a few words around in my time, perchance I could lend my services to chronicle the expedition? What do you think?"

"Uh-huh."

My contract with her was unspoken, and was thus on her terms. There was no escape. But we are complementary. I became her salesman. I talked her father into funding Nikhil, and talked Nikhil into accepting support from one of his erstwhile enemies. Randi organized the people and things that started coming her way into an expedition.

Randi was inarticulate, not crazy. She went about her wild things in a highly disciplined way. When she used words, she made lists: "Batteries, CO<sub>2</sub> Recyclers, Picks, Robot, Ropes, Spare tightsuits, Tissue, Vacuum tents, Medical supplies, Waste bags, etc."

Such things came to her through grants, donations, her father's name, friends from previous expeditions, and luck. She worked very hard at getting these things together. Sometimes I felt I fit down there in "etc.," somewhere between the t and the c, and counted myself lucky. If she had only listed "back door," perhaps we would have had one.

As I wrote she was lying beside me in our vacuum tent, exhausted with worry. I was tired, too.

We wasted a day, sitting on our sausage-shaped equipment pallets, talking, and convincing ourselves to move on.

Nikhil explained our predicament: Randi's namesake quivers as it bobs up and down in its not quite perfect orbit, as inclined to be different as she. Stresses accumulate over ages, build up inside and release, careless of the consequences. We had discovered, he said, that Miranda is still shrinking through the gradual collapse of its caverns during such quakes. Also, because the gravity is so low, it might take years for a series of quakes and aftershocks to play itself out. The quake danger wouldn't subside until long after we escaped, or died.

We had to make sure the front door was closed. It was—slammed shut. The wide gallery we traversed to arrive at this cavern is now a seam, a disjoint. A scar and a change of color remain to demarcate the forcible fusion of two previously separate layers of clathrate.

Sam jammed all four arms into the wall, anchored them with piton fingers, pressed part of its composite belly right against the new seam, and pinged until it had an image of the obstructed passage. "The closure goes back at least a kilometer," it announced.

The fiber optic line we have been trailing for the last three days no longer reached the surface either. Sam removed the useless line from the comm set and held it against the business end of its laser radar. "The break's about fifteen kilometers from here," it reported.

"How do you know that?" I asked.

"Partial mirror." Randi explained on Sam's behalf. "Internal reflection."

Fifteen kilometers, I reflected. Not that we really could have dug through even one kilometer, but we'd done some pretending. Now the pretense ceased, and we faced reality.

I had little fear of sudden death, and in space exploration, the rare death is usually sudden. My attitude toward the risks of our expedition was that if I succeeded, the rewards would be great, and if I got killed, it wouldn't matter. I should have thought more about the possibility of enduring a long, drawn-out process of having life slowly and painfully drain away from me, buried in a clathrate tomb.

The group was silent for a long time. For my part, I was reviewing ways to painlessly end my life before the Universe did it for me without concern for my suffering.

Then Nikhil's voice filled the void. "Friends, we knew the risks. If it's any consolation, that was the biggest quake recorded since instruments were put on this moon. By a factor of ten. That kind of adjustment," he waved his arms at obvious evidences of faults in the cavern around us, "should have been over with a hundred million years ago. Wretched luck, I'm afraid."

"Perhaps it will open up again?" his wife asked, her light features creased with concern behind the invisible faceplate of her helmet.

Nikhil missed the irony in her voice and answered his wife's question with an irony of his own. "Perhaps it will. In another hundred million years." He actually smiled.

Randi spoke softly; "Twenty days. CO<sub>2</sub> catalyst runs out in twenty days. We have two weeks of food at regular rations, but we can stretch that to a month or more. We have about a month of water each, depending on how severely we ration it. We can always get more by chipping ice and running it through our waste reprocessors. But without the catalyst, we can't clean air."

"And we can't stop breathing," Cathy added.

"Cathy," I asked, "I suppose it is traditional for poets to think this way, so I'll ask the question. Is there any way to, well, end this gracefully, if and when we have to?"

"Several," she replied with a shrug. "I can knock you out first, with anesthetic. Then kill you."

"How?" I ask.

"Does it matter?"

"To a poet, yes."

She nodded, and smiled. "Then, Wojciech, I shall put a piton through your heart, lest you rise again and in doing so devalue your manuscripts which by then will be selling for millions." Cathy's rare smiles have teeth in them.

"My dear," Nikhil said, our helmet transceivers faithfully reproducing the condescension in his tone, "your bedside manner is showing."

"My dear," Cathy murmured, "what would you know about anything to do with a bed?"

Snipe and countersnipe. Perhaps such repartee held their marriage together, like gluons hold a meson together until it annihilates itself.

Sam returned from the "front door." "We can't go back that way, and our rescuers can't come that way in twenty days with existing drilling equipment. I suggest we go somewhere else." A robot has the option of being logical at times like this.

"Quite right. If we wait here," Nikhil offered, "Miranda may remove the option of slow death, assisted or otherwise. Aftershocks are likely."

"Aftershocks, cave-in, suffocation," Randi listed the possibilities, "or other exits."

Nikhil shrugged and pointed to the opposite side of the cavern. "Shall we?"

"I'll follow you to hell, darling," Cathy answered.

Randi and I exchanged a glance which said; thank the lucky stars for *you*.

"Maps, such as they are," Randi began. "Rations, sleep schedule, leadership, and so on. Make decisions now, while we can think." At this she looked Nikhil straight in the eye, "While we care."

"Very well then," Nikhil responded with a shrug. "Sam is a bit uncreative when confronted with the unknown, Cathy and Wojciech have different areas of expertise, so perhaps Randi and I should take turns leading the pitches. I propose that we don't slight ourselves on the evening meal, but make do with minimal snacks at other times—"

"My darling idiot, we need protein energy for the work," Cathy interrupted. "We will have a good breakfast, even at the expense of dinner."

"Perhaps we could compromise on lunch," I offered.

"Travel distance, energy level, sustained alertness."

"On the other hand," I corrected, "moderation in all things. ..."

By the time we finally got going, we were approaching the start of the next sleep period, and Randi had effectively decided everything. We went single file behind the alternating pitch leaders. I towed one pallet. Cathy towed the other, and Sam brought up the rear.

There was a short passage from our cavern to the next one, more narrow than previous ones.

"I think ... I detect signs of wind erosion," Nikhil sent from the lead, wonder in his voice.

"Wind?" I said, surprised. What wind could there be on Miranda?

"The collisions which reformed the moon must have released plenty of gas for a short time. It had to get out somehow. Note the striations as you come through."

They were there, I noted as I came through, as if someone had sandblasted the passage walls. Miranda had breathed, once upon a time.

"I think," he continued, "that there may be an equilibrium between the gas in Miranda's caverns and the gas torus outside the ring system. Miranda's gravity is hardly adequate to compress that very much. But a system of caverns acting as a cold trap and a rough diffusion barrier . . . hmm, maybe."

"How much gas?" I wondered.

He shook his head. "Hard to tell that from up here, isn't it?"

We pushed half an hour past our agreed-to stop time to find a monolithic shelter that might prove safe from aftershocks. This passage was just wide enough to inflate our one meter sleeping tubes end to end. We ate dinner in the one Randi and I used. It was a spare, crowded, smelly, silent meal. Even Nikhil seemed depressed. I thought, as we replaced our helmets to pump down to let the Rays go back to their tent, that it was the last one we would eat together in such circumstances. The ins and outs of vacuum tents took up too much time and energy.

We repressurized and I savored the simple pleasure of watching Randi remove her tightsuit and bathe with a damp wipe in the end of the tent. She motioned for me to turn while she used the facility built into the end of our pallet, and so I unrolled my notescreen, slipped on its headband, and turned my attention to this journal, a process of clearly subvocalizing each word that I want on the screen.

Later she touched my arm indicating that I was next, kissed me lightly and went to bed between the elastic sheets, falling asleep instantly. My turn.

Day four was spent gliding through a series of large, nearly horizontal caverns. Miranda, it turns out, is still breathing. A ghost breath to be sure, undetectable except with such sensitive instruments as Sam contains. But there appears to be a pressure differential; gas still flows through these caverns out to the surface. Sam can find the next passage by monitoring the molecular flow. We pulled ourselves along with our hands, progressing like a weighted diver in an underwater cave; an analogy most accurate when one moves so slowly that lack of drag is unremarkable.

As we glided along I forgot my doom, and looked at the marbled ice around me with wonder. Randi glided in front of me and I could mentally remove her dusty coveralls and imagine her hard, lithe, body moving in its skin-hugging shipsuit. I could imagine her muscles bunch and relax in her weight-lifter's arms, imagine the firm definition of her neck and forearms. A poet herself, I thought, who could barely talk, but who had written an epic in the language of her body and its movement.

Sam notified us that it was time for another sounding and a lead change. In the next kilometer, the passage narrowed, and we found ourselves forcing our bodies through cracks that were hardly large enough to fit our bones through.

My body was becoming bruised from such tight contortions, but I

wasn't afraid my tightsuit would tear; the fabric is slick and nearly invulnerable. On our first day, Randi scared the hell out of me by taking a hard-frozen, knife-edged sliver of rock and trying to commit hari-kiri with it, stabbing herself with so much force that the rock broke. She laughed at my reaction and told me that I needed to have confidence in my equipment.

She still has the bruise, dark among the lighter, older blemishes on her hard-used body. I kiss it when we make love and she says "Uh-huh. Told you so." Randi climbed Gilbert Montes in the Mercurian antarctic with her father and brother carrying a full vacuum kit when she was thirteen. She suffered a stress fracture in her ulna and didn't tell anyone until after they reached the summit.

The crack widened and, to our relief, gave onto another cavern, and that to another narrow passage. Randi took the lead, Nikhil followed, then me, then Cathy, then Sam.

Sam made me think of a cubist crab, or maybe a small, handleless lawn mower, on insect legs instead of wheels. Articulate and witty with a full range of simulated emotion and canned humor dialog stored in its memory, Sam was our expert on what had been. But it had difficulty interpreting things it hadn't seen before, or imagining what it had never seen, and so it usually followed us.

By day's end we had covered twenty-eight kilometers and were another eighteen kilometers closer to the center. That appeared to be where the road went, though Nikhil said we were more likely to be on a chord passing fifty kilometers or so above the center, where it seems that two major blocks came together a billion years ago.

This, I told myself, is a fool's journey, with no real chance of success. But how much better, how much more human, to fight destiny than to wait and die.

We ate as couples that night, each in our own tents.

## II

On day five, we became stuck.

Randi woke me that morning exploring my body, fitting various parts of herself around me as the elastic sheets kept us pressed together.

Somehow, an intimate dream I'd been having had segued into reality, and I felt only a momentary surprise at her intrusion.

"You have some new bruises," I told her after I opened my eyes. Hers remained closed.

"Morning," she murmured and wrapped herself around me again. Time slowed as I spun into her implacable, devouring wholeness.

But of course time would not stop. Our helmets beeped simultaneously with Sam's wake-up call, fortunately too late to prevent another part of me from becoming part of Randi. Sam reminded us, that, given our fantasy of escaping from Miranda's caverns, we had some time to make up.

Randi popped out of the sheets and spun around airborne in a graceful athletic move, and slowly fell to her own cot in front of me, exuberantly naked, stretching like a sensual cat, staring right into my enslaved eyes.

"Female display instinct—harmless, healthy, feels good."

Harmless? I grinned and reminded her: "But it's time to spelunk."

"Roger that," she laughed, grabbed her tightsuit from the ball of clothes in the end of the tent, and started rolling it on. They go on like a pair of pantyhose, except that they are slick on the inside and adjust easily to your form. To her form. I followed suit, and we quickly depressurized and packed.

It took Sam an hour to find the cavern inlet vent, and it was just a crack, barely big enough for us to squeeze into. We spent an hour convincing ourselves there was no other opportunity, then we wriggled forward through this crack like so many ants, kits and our coveralls pushed ahead of us, bodies fitting any way we could make them fit.

I doubt we made a hundred yards an hour. Our situation felt hopeless at this rate, but Sam assured us of more caverns ahead.

Perhaps it would have been better if Nikhil had been on lead. Larger than Randi and less inclined to disregard discomfort, he would have gone slower and chipped more clathrate, which, as it turned out, would have been faster.

Anyway, as I inched myself forward, my mind preoccupied with the enigma of Randi, Miranda groaned—at least that's what it sounded like in my helmet, pressed hard against the narrow roof of the crack our passage has become. I felt something. Did the pressure against my ribs increase? I fought panic, concentrating on the people around me and their lights shining past the few open cracks between the passage and their bodies.

"I can't move." That was Cathy. "And I'm getting cold."

Our tightsuits were top of the line "Explorers," twenty layers of smart fiber weave sandwiched with an elastic macromolecular binder. Despite their thinness the suits are great insulators, and Miranda's surrounding vacuum is even better.

Usually, conductive losses to the cryogenic ice around us are restricted to the portions of hand or boot that happen to be in contact with the surface and getting *rid* of our body heat is the main concern. Thus, the smart fiber layers of our suits are usually charcoal to jet black. But if almost a square meter of you is pressed hard against a cryogenic solid, even the best million atom layer the Astrographic Society can buy meets its match, and the problem is worse, locally.

The old expression, "colder than a witches tit" might give you some idea of Cathy's predicament.

"I can't do much," I answered, "I'm almost stuck myself. Hang in there."

"Sam," Cathy gasped, her voice a battleground of panic and self control, "wedge yourself edge up in the crack. Keep it from narrowing any more."

"That's not going to work, Cathy," it replied. "I would be fractured and destroyed without affecting anything."

"Remember your laws!" Cathy shrieked. "You have to obey me. Now do it, before this crushes my ribs! Nikhil, make the robot obey me!"

"Cathy, dear," Nikhil asks, "I sympathize with your discomfort, but could you hold off for a bit? Let us think about this."

"I'll be frozen solid in minutes and you want to think. Damn it, Nikhil, it hurts. Expend the robot and save me. I'm your doctor."

"Cathy," Sam says, "We will try to save you, but we have gone only a hundred kilometers since the quake, and there may be a thousand to go. If we encounter such difficulties every hundred kilometers, there may be on the order of ten of them yet to come. And you only have one robot to expend, as you put it. Sacrificing me now places the others in an obviously increased risk. Nothing is moving now, so thinking does not entail any immediate increased risk."

*"Damn your logic. I'm getting frostbite. Get me out of here!"*

Embarrassed silence slammed down after this outburst, no one even breathing for what seemed like a minute. Then Cathy started sobbing in short panicky gasps, which at least let the rest of us know she was still alive.

Randi broke the silence. "Can the rest of you move forward?"

"Yes," Nikhil answers, "a little."

"Same here," I add.

"Sam," Randi ordered. "Telop bug. Rope."

"I have these things."

"Uh-huh. Have your telop bug bring the rope up to me, around Cathy. When I've got it, put a clamp on it just behind Cathy's feet."

"Yes, Randi," Sam acknowledged its orders. "But why?" It also requested more information.

"So Cathy's feet can . . . grab—uh—get a foothold on it." Randi's voice showed her frustrations with speech, but no panic. "Can you model that? Make an image? See what will happen?"

"I can model Cathy standing on a clamp on the rope, then rotate horizontal like she is, then put the passage around her. . . . I've got it!" Sam exclaimed. "The telop's on its way."

"Please hurry," Cathy sobs, sounding somewhat more in control now.

I felt the little crablike telop scuttling along through the cracks between my flesh and the rock. The line started to snake by me, a millimeter Fullerene fiber bundle that could support a dinosaur in Earth gravity, a line of ants marching on my skin. I shivered just as the suit temperature warning flashed red in my visor display. The telop's feet clicked on my helmet as it went by. I waited for what seemed hours that way.

"Grab the line." Randi commanded and we obeyed. "Feet set, Cathy?"

"I can't . . . can't feel the clamp."

"OK. I'll take up some of the, the slack . . . OK now, Cathy?"

"It's there. Oh, God I hope this works."

"Right," Randi answered. "Everyone. Grab. Heave."

I set my toe claws and gave it my best effort forward. Nothing seemed to move much.

"Damn!" Randi grunted.

"Use the robot, I'm freezing," Cathy sobbed.

"Dear," Nikhil muttered, "she *is* using the robot. She's just not *being* one."

I started to get cold myself. My toes were dug in, but I couldn't bend my

knees, so everything was with the calves. If I could just get my upper legs into it, I thought. If I just had a place to stand. Of course, that was it.

"Randi," I asked, "If Cathy grabbed the rope with her hands, stood on Sam and used all of her legs? Wouldn't that make a difference?"

Her response was instantaneous. "Uh-huh. Sam, can you, uh, move up under Cathy's feet and, uh, anchor yourself."

"Do you mean under, or behind so that she can push her feet against me?"

"I meant behind, Sam. Uh," Randi struggled with words again, "uh, rotate model so feet are down to see what I see, er, imagine."

"Yes ... I can model that. Yes, I can do that, but Cathy's knees cannot bend much."

"Roger, Sam. A little might be enough. OK, Cathy, understand?"

"Y-Yes, Randi." Seconds of scraping, silence, then "OK I've got my feet on Sam."

"Then let's try. Pull on three. One, two, three."

We all slid forward a bit this time, but not much. Still it was much more progress than we'd made in the last half hour.

"Try again." I feel her take up the slack. "One, two, three."

That time it felt like a cork coming out of the bottle.

Over the next hour, we struggled forward on our bellies for maybe another 110 meters. Then Randi chipped away a final obstruction and gasped.

Haggard and exhausted as I am, my command of the language is inadequate to my feelings as I emerged from the narrow passage, a horizontal chimney actually, onto the sloping, gravelly ledge of the first great cavern. Involuntarily, I groaned; the transition from claustrophobia to agoraphobia was just too abrupt. Suddenly, there was this immense space with walls that faded into a stygian blackness that swallowed the rays of our lights without so much as a glimmer in return.

My helmet display flashed red numbers which told me how far I would fall, some six hundred meters; how long I would fall, just over two minutes, and how fast I would hit, almost ten meters per second; a velocity that would be terminal for reasons not involving air resistance. Think of an Olympic hundred meter champion running full tilt into a brick wall. I backed away from the edge too quickly and lost my footing in Miranda's centigee gravity.

In slow frustration, I bounced; I couldn't get my clawed boots down to the surface, nor reach anything with my hands. Stay calm, I told myself, I could push myself back toward the cavern wall on the next bounce. I waited until I started to float down again and tried to reach the ledge floor with my arm, but my bounce had carried me out as well as down.

A look at the edge showed me that my trajectory would take me over it before I could touch it. There was nothing I could do to save myself—my reaction pistol was in a pallet. Visions of Wile E. Coyote scrambling in air trying to get back to the edge of a cliff went through my mind, and I involuntarily tried to swim through the vacuum—not fair, at least the coyote had air to work with.

The helmet numbers went red again as I floated over the edge. Too desperate now to be embarrassed, I found my voice and a sort of guttural groan emerged. I took another breath, but before I could croak again, Cathy grabbed my arm and clipped a line to my belt. She gave my hand a silent squeeze as, anchored firmly to a piton, I pressed my back against the wall of the cavern to get as far as I could from the edge of the ledge. I shook. Too much, too much.

I canceled any judgment I'd made about Cathy. Judge us by how far, not how, we went.

Sam told us the cavern was twenty-seven kilometers long and slanted severely downhill. Our ledge topped a six-hundred-meter precipice that actually curved back under us. We gingerly made our camp on the ledge, gratefully retreated to our piton-secured tents, and ate a double ration silently, unable to keep our minds off the vast inner space which lay just beyond the thin walls of our artificial sanity.

Sleep will be welcome.

Day six. The inner blackness of sleep had absorbed my thoughts the way the cavern absorbed our strobes, and I woke aware of no dreams. After a warm, blousy, semiconscious minute, the cold reality of my predicament came back to me and I shivered. It had taken a full day to complete the last ten kilometers, including five hours of exhausted unconsciousness beneath the elastic sheets. We would have to make much better time than that.

That morning, Randi managed to look frightened and determined at the same time. No display behavior this morning—we dressed efficiently, packed our pallet and turned on the recompressors minutes after waking.

Breakfast was ration crackers through our helmet locks.

I stowed the tent in the pallet and turned to find Randi standing silent at the edge. She held the Fullerene line dispenser in one hand, the line end in the other, snapped the line tight between them, and nodded. We had, I remembered, fifty kilometers of Fullerene line.

"Randi, you're not considering ..."

She turned and smiled at me the way a spider smiles to a fly. Oh, yes she was.

"Preposterous!" was all Nikhil could say when Randi explained what she had in mind. Cathy, docile and embarrassed after yesterday's trauma, made only a small, incoherent, frightened giggle.

And so we prepared to perform one of the longest bungee jumps in history in an effort to wipe out the entire length of the passage in, as it were, one fell swoop. Nikhil drilled a hole through a piece of the cavern wall that looked sufficiently monolithic and anchored the line dispenser to that. Sam, who was equipped with its own propulsion, would belay until we were safe, then follow us.

Randi stretched a short line segment between two pitons and showed us how to use it to brace ourselves against the wall in Miranda's less-than-a-milligee gravity. We held our fly-like position easily and coiled our legs like springs.

"Reaction pistols?" Randi asked.

"Check." Nikhil responded.

"Feet secure?"

Three "Checks" answered.

"Line secure."

Sam said "Check."

Randi cleared her throat. "On three now. One, two, *three*."

We jumped out and down, in the general direction of Miranda's center. After a brief moment of irrational fear, we collected ourselves and contemplated the wonders of relativity as we sat in free fall while the "roof" of the cavern flashed by. It was a strange experience; if I shut my eyes, I felt just like I would feel floating outside a space station. But I opened my eyes and my light revealed the jagged wall of the cavern whipping by a few dozen meters away. It was, I noted, getting closer.

Judiciously taking up the slack in our common line, Nikhil, who was an

expert at this, used the reaction pistol to increase our velocity and steer us slightly away from the roof. A forest of ice intrusions, curved like elephant tusks by eons of shifting milligravity, passed by us too close for my comfort as the minuscule gravity and the gentle tugs of the reaction pistol brought us back to the center of the cavern.

We drifted. Weight came as a shock: our feet were yanked behind us and blood rushed to our heads as the slack vanished and the line started to stretch. Randi, despite spinning upside down, kept her radar pointed "down." We must have spent twenty seconds like that, with the pull on our feet getting stronger with every meter farther down. Then, with surprising quickness the cavern wall stopped rushing past us. Randi said "Now!" and released the line, leaving us floating dead in space only a kilometer or so from the cavern floor.

I expended a strobe flash to get a big picture of the cavern wall floating next to us. It looks like we are in an amethyst geode; jumbles of sharp crystals everywhere and a violet hue.

"Magnificent." Cathy said with a forced edge in her voice. Trying to make contact with us, to start to put things back on a more normal footing after yesterday, I thought.

"Time to keep our eyes down, I should think," Nikhil reminded her, and the rest of us. "Wouldn't want to screw up again, would we?"

There was no rejoinder from Cathy so I glanced over at her. Her visor was turned toward the crystal forest and apparently frozen in space. A puff from my reaction pistol brought me over to her and my hand on her arm got her attention. She nodded. The crystals were huge, and I wondered at that, too.

I checked my helmet display—its inertial reference function told me I was fifty kilometers below the surface and the acceleration due to Miranda's feeble gravity was down to seven centimeters per second squared, so when we touched down to the rugged terrain a kilometer below in just under three minutes . . . we'd hit it at 11 meters per second. I thought again of that Olympic hundred-meter dash champion running full tilt into a brick wall.

"Randi, I think we're too high." I tried to keep my voice even. This was the sort of thing we left to Sam, but he wasn't with us just now.

As if in answer, she shot a lined piton into the wall next to us, which was starting to drift by at an alarming rate.

"Swing into the wall feet first, stop, fall again," she said.

"Feet toward the wall!" Nikhil echoed as the tension started to take hold, giving us a misleading sense of down. The line gradually pulled taut and started to swing us toward the wall. Then it let go, leaving us on an oblique trajectory headed right toward the forest of crystals. Piton guns are neat, but no substitute for a hammer.

"No problems," Nikhil says. "We dumped a couple of meters per second. I'll try this time."

He shot as Randi reeled her line in.

Eventually we swung into the wall. Cathy seemed rigid and terrified, but bent her legs properly and shielded her face with her arms as the huge crystals rushed to meet us.

They shattered into dust at our touch, hardly even crunching as our boots went through them to the wall.

"What the . . ." I blurted, having expected something more firm.

"Deposition, not extrusion?" Randi offered, the questioning end of her response clearly intended for Nikhil.

"Quite so. Low gravity hoarfrost. Hardly anything to them, was there?"

"You, you knew, didn't you?" Cathy accused, her breath ragged.

"Suspected," Nikhil answered without a trace of feeling in his voice, "but I braced just like the rest of you. Not really certain then, was I?"

"Hello everyone, see you at the bottom," Sam's voice called out, breaking the tension. Three of us strobed and spotted the robot free falling past us.

The wall on which we landed curved gently to the lower end of the cavern, so we covered the remaining distance in hundred-meter leaps, shattering crystals with each giant step, taking some sort of vandalistic delight in the necessity of destroying so much beauty. We caught up to Sam laughing.

"This way," it pointed with one of its limbs at a solid wall, "there is another big cavern, going more or less our way. It seems to be sloped about one for one instead of near vertical."

Our helmet displays reproduced its seismologically derived model which was full of noise and faded in the distance, but clearly showed the slant down.

After a couple of false leads we found a large-enough crack leading into the new gallery. Cathy shuddered as she squeezed herself in.

That cavern was a mere three kilometers deep—we could see the other end.

We shot a piton gun down there, and cheered when it held; using the line to keep us centered, we were able to cross the cavern in ten minutes.

Cathy dislodged a largish boulder as she landed, and it made brittle, tinkling, ice noises as it rolled through some frost crystals.

"Hey!" I said when the significance of that got through to me. "I heard that!"

"We have an atmosphere, mostly methane and nitrogen. It's about ten millibars and nearly a hundred Kelvins," Sam answered my implied question. Top-of-the-line robot, Sam.

It occurred to me then that, should we all die, Sam might still make it out. Almost certainly would make it out. So someone will read this journal.

The next cavern went down as well and after that was another. We kept going well past our planned stopping time, almost in a daze. Our hammers made echoes now, eerie high-pitched echoes that rattled around in the caverns like a steelie marble dropped on a metal plate.

We made camp only 170 kilometers above Miranda's center, eighty-five below the surface. Nikhil told us that if the rift continued like this, along a chord line bypassing the center itself, we were more than one-third of the way through, well ahead of schedule.

Randi came over to me as I hammered in the piton for a tent line and put a hand on my arm.

"Psyche tension; Cathy and Nikhil, danger there."

"Yeah. Not much to do about it, is there?"

"Maybe there is. Sleep with Cathy tonight. Get them away from each other. Respite."

I looked at Randi, she was serious. They say tidal forces that near a black hole can be fatal.

"Boys in one tent, girls in the other?"

"No. I can't give Cathy what she needs."

"What makes you think I can?"

"Care about her. Make her feel like a person."

Honestly, I was not that much happier with Cathy's behavior than Nikhil's. Though I thought I understood what she was going through and

made intellectual allowances, I guess I saw her as being more of an external situation than a person to care about. What Randi was asking wouldn't come easy. Then, too, there was the other side of this strange currency.

"And you? With Nikhil?"

"Skipped a week of classes at Stanford once. Went to a Nevada brothel. Curious. Wanted to know if I could do that, if I needed to, to live. Lasted four days. Good lay, no personality." She tapped the pocket of my coveralls where my personal electronics lived, recording everything for my article. "You can use that if we get out. Secrets are a headache." She shrugged. "Dad can handle it."

"Randi. . ." I realized that, somehow, it fit. Randi seems to be in a perpetual rebellion against comfort and normalcy, always pushing limits, taking risks, seeking to prove she could experience and endure anything. But unlike some mousy data tech who composes sex thrillers on the side, Randi has no verbal outlet. To express herself, she has to live it.

"Randi, I can see that something has to be done for Nikhil and Cathy, but this seems extreme."

"Just once. Hope." She smiled and nestled herself against me. "Just be nice. Don't worry about yourself. Let her lead. Maybe just hugs and kisses, or listening. But whatever, give. Just one night, OK? So they don't kill themselves. And us."

It took me a minute or so to digest this idea. Another thought occurred to me. Randi and I were single—not even a standard cohab file—but Nikhil and Cathy. . . . "Just how are you going to suggest this to them?" I asked.

Randi shook her head and looked terrified. "Not me!"

I don't think I'm going to be able to finish the journal entry tonight.

### III

Day seven. Last night was an anticlimax. Nikhil thought the switch was jolly good fun, in fact he seemed relieved. But Cathy . . . once her nervousness had run its course, she simply melted into my arms like a child and sobbed. I lay there holding her as she talked.

Born to a wealthy Martian merchant family, she'd been an intellectual

rebel, and had locked horns with the authoritarian pastoral movement there which eventually gave rise to the New Reformation. When she was fifteen, she got kicked out of school for bragging about sleeping with a boy. She hadn't, but: "I resented anyone telling me I couldn't so much that I told everyone that we did."

Her parents, caught between their customers and their daughter, got out of the situation by shipping her off to the IPA space academy at Venus LI. She met Nikhil there as an instructor in an introductory paleontology class.

She got her MD at twenty-two and plunged into archeoimmunology research. A conference on fossil disease traces linked her up with Nikhil again, who had been ducking the controversy about Miranda's internal structure by using p-bar scans to critique claims of panspermia evidence in Triton sample cores. His outcast status was an attraction for her. They dated.

When he became an instant celebrity, she threw caution to the wind and accepted his proposal. But, she found, Nikhil kept sensual things hidden deep, and there was a cold, artificial hollowness where his sense of fun should be. Cathy said they had their first erudite word fight over her monokini on their honeymoon, and they had been "Virginia Woolfing" it ever since.

"Damn dried-up stuffed-shirted bastard's good at it," she muttered as she wrapped herself around me that night. "It stinks in here, you know?" Then she fell asleep with tears in her eyes. She was desirable, cuddly, and beyond the stretch of my conscience.

That morning, when our eyes met and searched each other, I wondered if she had any expectations, and if, in the spirit of friendship, I should offer myself. But I decided not to risk being wrong, and she did nothing but smile. Except, possibly for that brief look, we were simply friends.

Randi didn't say anything about her night in Nikhil's tent; I didn't expect her to. She gave me a very warm and long hug after she talked to Cathy. We were all very kind to each other as we broke camp and began casting ourselves along a trail of great caverns with the strides of milligee giants.

Cathy passed out the last of our calcium retention pills that morning. In a week or so we would start to suffer some of the classic low gravity symptoms of bone loss and weakness. It didn't worry us greatly—that was reversible, if we survived.

At day's end, I was not physically exhausted, but my mind is becoming

numb with crystal wonders. Where are these crystals coming from? Or rather where had they come from; Sam and Nikhil concurred that the existing gas flow, through surprising in its strength, is nowhere near enough to deposit these crystal forests in the few hundred million years since Miranda's remaking.

We were 150 kilometers deep now and Nikhil said these rocks must withstand internal pressures of more than ninety atmospheres to hold the caverns open. Not surprisingly, the large caverns didn't come as often now, and when they did, the walls were silicate rather than clathrate; rock slabs instead of dirty ice. I thought I heard them groan at a higher pitch last night.

"It's after midnight, universal time," Cathy announced. She seemed recovered from her near panic earlier, and ready to play her doctor role again. But there seemed something brittle in her voice. "I think we should get some sleep now." She said this as we pushed our baggage through yet another narrow crack between the Rift galleries Sam kept finding with his sonar, so Randi and I had a chuckle at the impossibility of complying with the suggestion just then. But she had a point. We had come one-half of the way through Miranda in five of our twenty days—well ahead of schedule.

Nikhil, on lead, missed her humor and said: "Yes, dear, that sounds like a very good idea to me. Next gallery, perhaps."

"You humans will be more efficient if you're not tired," Sam pointed out in a jocular tone that did credit to its medical support programmers. But I thought its feigned robot chauvinism probably did not sit well with Cathy.

"We," I answered, "don't have a milligram of antihydrogen in our hearts to feed us."

"Your envy of my superior traits is itself an admirable trait, for it recognized—"

"Shiva!" Nikhil shouted from the head of our column.

"What is it?" Three voices asked, almost in unison.

"Huge. A huge cavern. I ... you'll have to see it yourselves."

As we joined him, we found he had emerged on another ledge looking over another cavern. It didn't seem to be a particularly large one to start—our lights carried to the other side—just another crystal cathedral. Then I looked down— and saw stars. Fortunately, my experience in "Randi's Room" kept my reaction in check. I did grab the nearest piton line rather quickly, though.

"Try turning off your strobes," Nikhil suggested as we stuck our heads

over the ledge again.

The stars vanished, we turned the strobes on again, and the stars came back. The human eye is not supposed to be able to detect time intervals so small, so perhaps it was my imagination. But it seemed as though the "stars" below came on just after the strobe flashed.

"Ninety kilometers," Sam said.

"Ninety kilometers!?" Nikhil blustered in disbelief, his composure still shaken. "How is this possible? Clathrate should not withstand such pressure."

Randi anchored herself, dug into the supply pallet I'd been towing, and came up with a geologist's pick. She took a swing at the ledge to which the gentle three and a half centimeters per second local gravity had settled us and a sharp plink made its way to my ears, presumably through my boots.

"Nickel iron?" Nikhil asked.

"Uh-huh. Think so," Randi answered. "Fractured, from here down."

"Maybe this is what broke Miranda up in the first place," Cathy offered.

"Pure supposition," Nikhil demurred. "Friends, we must move on."

"I know. Take samples, analyze later." Randi said. "Got to move."

"Across or down?" I asked. This wasn't a trivial question. Our plan was to follow the main rift, which, presumably, continued on the other side. But down was an unobstructed ninety kilometer run leading to the very core of the moon. I thought of Jules Verne.

"We need to get out of this moon in less than two weeks," Nikhil reminded us. "We can always come back."

"Central gas reservoir, chimneys, connected." Randi grunted.

After a nonplussed minute, I understood. If we went down the chimney, our path would leave the chord for the center. The Rift is along the chord; Sam could see it in his rangings. But, not being a gas vent, it wouldn't be well enough connected to travel. We had to find another back door.

"Oh, of course," Nikhil said. "All roads lead to Rome, which also means they all *go from* Rome. The outgassing, the wind from the core, is what connected these caverns and eroded the passages enough to let us pass through. She means our best chance is to find another chimney, and the best place to do that is at the core, isn't it."

"Uh-huh," Randi answered.

No one said anything; in the silence I swore I could hear dripping, and

beneath that a sort of dull throbbing that was probably my pulse. At any rate, the pure dead silence of the upper caverns was gone. I risked another peek down over the edge. What was down there?

"We have a problem," Cathy informed us. "Poison gas. The nitrogen pressure is up to a twentieth of a bar, and that's more than there was on old Mars. It's enough to carry dangerous amounts of aromatics—not just methane, but stuff like cyanogen. I don't know if anyone else has noticed it, but this junk is starting to condense on some of our gear and stink up our tents. It might get worse near the core, and I can't think of any good way to decontaminate."

"Uh, rockets," Randi broke the silence. "Sam's rockets. Our reaction pistols. Try it first."

So we did. We figured out how far to stand from the jets, how long to stand in them—enough to vaporize anything on the surface of our coveralls and equipment, but not long enough to damage it—and how many times we could do it. Sam had enough fuel for 120 full decontaminations—more than we'd ever live to use. Cathy volunteered to be the test article, got herself blasted, then entered a tent and emerged saying it smelled just fine.

We decided to go for the core.

This close to the center of Miranda, gravitational acceleration was down to just over five centimeters per second squared, about one three-hundredth of Earth normal. Five milligees. Release an object in front of you, look away while you count one thousand one, and look back again: it will have fallen maybe the width of a couple of fingers, just floating. So you ignore it, go about other things and look back after ten minutes. It's gone. It has fallen ten kilometers and is moving three times as fast as a human can run; over thirty meters per second. That's if it hasn't hit anyone or anything yet. Low gravity, they drill you over and over again, can be dangerous.

That's in a vacuum, but we weren't in a vacuum any more. Even with the pallet gear apportioned, we each weighed less than ten newtons—about the weight of a liter of vodka back in Poland, I thought, longingly—and we each had the surface area of a small kite; we'd be lucky to maintain three meters per second in a fall at the start, and at the bottom, we'd end up drifting like snowflakes.

For some reason, I thought of butterflies.

"Could we make wings for ourselves?" I asked.

"Really, wings?" Nikhil's voice dripped with skepticism.

"Wings!" Cathy gushed, excited.

"Sheets, tent braces, tape, line. Could do." Randi offered.

"We are going to be very, very, sorry about this," Nikhil warned.

Four hours later, looking like something out of a Batman nightmare, we were ready.

Randi went first. She pushed herself away from the precipice with seeming unconcern and gradually began to drift downward. Biting my lip and shaking a bit, I followed. Then, came a stoic Nikhil and a quiet Cathy.

Ten minutes after jumping, I felt a tenuous slipstream and found I could glide after a fashion—or at least control my attitude. After some experimentation, Randi found that a motion something like the butterfly stroke in swimming seemed to propel her forward.

Half an hour down, and we found we could manage the airspeed of a walk with about the same amount of effort. Soon we were really gliding, and could actually gain altitude if we wanted.

After drifting down for another hour we came to the source of the dripping sound I had heard the night before. Some liquid had condensed on the sides of the chimney and formed drops the size of bowling balls. These eventually separated to fall a kilometer or so into a pool that had filled in a crack in the side of the chimney. The Mirandan equivalent of a waterfall looked like a time lapse splash video full of crowns and blobs, but it was at macroscale and in real time.

"Mostly ethane," Sam told us. Denser and more streamlined than we were, the robot maintained pace and traveled from side to side with an occasional blast from a posterior rocket: a "roam fart" it called it. If I ever get out of this, I will have to speak to its software engineers.

"Wojciech, come look at this!" Cathy yelled from the far side of the chimney. I sculled over, as did Randi and Nikhil.

"This had better be important," Nikhil remarked, reminding us of time. I needed one, having been mesmerized by drops that took minutes to fall and ponds that seemed to oscillate perpetually.

Cathy floated just off the wall, her position maintained with a sweep of her wings every three or four seconds. As we joined her, she pointed to a bare spot on the wall with her foot. Sticking out near the middle of it was a dirty white "T" with loopholes in each wing.

"It's a piton. It must be."

What she left unsaid was the fact that it certainly wasn't one of ours.

"Sam, can you tell how old it is?"

"It is younger than the wall. But that, however, looks to be part of the original surface of one of Miranda's parent objects. Do you see the craters?"

Now that he pointed it out, I did. There were several, very normal microraters of the sort you find tiling the fractal surface of any airless moon, except two hundred kilometers of rock and clathrate lay between these craters and space. I had the same displaced, eerie feeling I'd had when, as a child, I had explored the top of the crags on the north rim of the Grand Canyon of the Colorado on Earth, over two thousand meters above sea level—and found seashells frozen in the rock.

"The piton," Sam added, "is younger than the hoar crystals, because the area was first cleared."

Something clicked in place for me then. The crystals surrounding the bare spot were all about a meter long. "Look at the length of the nearby crystals," I said, excited with my discovery. "Whatever cleared the immediate area must have cleared away any nearby crystal seeds, too. But just next to the cleared area it must have just pushed them down and left a base from which the crystals could regenerate. So the height of the crystals just outside the cleared area is the growth since then."

"But what do you think that growth rate is?" Nikhil asked. "We can't tell, except that it is clearly slow now. I regret to say this, because I am as interested as anyone else, but we must move on. Sam has recorded everything. If we regain the surface, other expeditions can study this. If we do not, then it does not matter. So, shall we?"

Without waiting for assent from the others, Nikhil rotated his head down and started taking purposeful wingstrokes toward the center of Miranda.

"Damn him," Cathy hissed and flew to the piton and, abandoning one wing sleeve, grabbed the alien artifact. So anchored, she put her feet against the wall it protruded from, grasped it with both hands, and pulled. Not surprisingly, the piton refused to move.

"Other expeditions. We'll come back." Randi told her.

Cathy gasped as she gave up the effort, and let herself drift down and away from the wall. We drifted with her until she started flying again. We made no effort to catch up to Nikhil, who by this time was a kilometer ahead of us.

The air, we could call it that now, was becoming mistier, foggier. Nikhil, though he still registered in my helmet display, was hidden from view. Sam's radar, sonar, filters, and greater spectral range made this a minor inconvenience for him, and he continued to flit from side to side of this great vertical cavern, gathering samples. When we could no longer see the walls, we gathered in the center. Incredibly, despite the pressure of the core on either side, the chimney widened.

"This stuff is lethal," Cathy remarked. "Everyone make sure to maintain positive pressure, but not too much to spring a leak; oxygen might burn in this. If this chimney were on Earth, the environmental patrol would demolish it."

A quick check revealed my suit was doing OK, but the pressure makeup flow was enough that I would think twice about being near anything resembling a flame. Our suits were designed, and programmed, for vacuum, not chemical warfare; we were taking them well beyond their envelope.

"Chimney needs a name." Randi said. "Uh-huh. Job for a poet, I think."

That was my cue. But the best thing I could come up with on the spot was "Nikhil's Smokestack." This was partly to honor the discoverer and partly a gentle dig at his grumpiness about exploring it. Cathy laughed, at least.

Having nothing else to look at, I asked Sam for a three-dimensional model of the chimney, which it obligingly displayed on my helmet optics. A three-dimensional cut-away model of Miranda reflected off my transparent face plate, appearing to float several meters in front of me. Our cavern was almost precisely aligned with Miranda's north pole, and seemed to be where two great, curved, hundred-kilometer chunks had come together. Imagine two thick wooden spoons, open ends facing.

These slabs were hard stuff, like nickel-iron and silicate asteroids. Theories abound as to how that could be; radioactivity and tidal stress might have heated even small bodies enough to become differentiated; gravitational chaos in the young solar system must have ejected many main belt asteroids and some might well have made it to the Uranian gravitational well; or perhaps the impact that had set Uranus to spinning on its side had released a little planetesimal core material into its moon system.

My body was on autopilot, stroking my wings every ten seconds or so to keep pace with Randi while I day-dreamed and played astrogeologist, so I didn't notice the air start to clear. The mist-cloud seemed to have divided

itself to cover two sides of the chimney, leaving the center relatively free. Then they thinned and through gaps, I could see what looked to be a river running . . . beside? above? below?

"Randi, I think I can see a river."

"Roger, Wojciech."

"But how can that be? How does it stay there? "

"Tides."

"Yes," Nikhil added. "The chimney is almost three kilometers wide now. One side is closer to Uranus than Miranda's center of mass and moving at less than circular orbital velocity for its distance from Uranus. Things there try to fall inward as if from the apoapsis, the greatest distance, of a smaller orbit. The other side is farther away than the center and moving at greater than orbital velocity. Things there try to move outward."

"The mass of Miranda now surrounds us like a gravitational equipotential shell, essentially canceling itself out, so all that is left is this tidal force. It isn't much—a few milligees, but enough to define up and down for fluids. In some ways, this is beginning to resemble the surface of Titan, though it's a bit warmer and the air pressure is nowhere near as high."

"Is that water below us?" Cathy asked.

"No," Sam answered. "The temperature is only two hundred kelvins, some seventy degrees below the freezing point of water. Water ice is still a hard rock here."

At the bottom, or end, of Nikhil's Smokestack was a three-kilometer rock, which had its own microscopic gravity field. The center of Miranda, we figured, was some 230 meters below us. Close enough so that we were effectively weightless. We let Sam strobe the scene for us, then set up our tents. Decontamination was a bit nervy, but most of the bad stuff was settled on either side of the tidal divide, and the air here was almost all cold dry nitrogen.

Nonetheless, set-up took until midnight, and we all turned in immediately.

It had been a very long day.

Nikhil and Cathy forgot last night that, while they were in a vacuum tent, the tent was no longer in a hard vacuum. Much of what we heard was

thankfully faint and muffled but what came through in the wee small hours of the morning of day eight clearly included things like:

"... ungrateful, arrogant pig ..."

"... have the self-discipline of a chimp in heat ..."

"...so cold and unfeeling that ..."

"... brainless diversions while our lives are in the balance ..."

Randi opened her eyes and looked at me, almost in terror, then threw herself around me and clung. It might seem a wonder that this steely woman who could spit in the face of nature's worst would go into convulsions at the sound of someone else's marriage falling apart, but Randi's early childhood had been filled with parental bickering. There had been a divorce, and I gathered a messy one from a six-year-old's point of view, but she had never told me much more than that.

I coughed, loud as I could, and soon the sound of angry voices was replaced by the roar of distant ethane rapids.

Randi murmured something.

"Huh?" Was she going to suggest another respite?

"Could we be married? Us?"

It was her first mention of the subject. I'd developed my relationship with her with the very specific intention of creating and reporting this expedition, and had never, never, hinted to her I had any other designs on her person or fortune. I'd been pretty sure that the understanding was mutual.

"Uh, Randi. Look, I'm not sure we should think like that. Starving poets trying to fake it as journalists don't fit well in your social circle. Besides, that," I tossed my head in the direction of the other tent, "*that* doesn't seem to put me in the mood for such arrangements. Why—"

"Why is: you don't do that." Randi interrupted me. This was startling; she never interrupted, except in emergencies—she was the most nonverbal person I knew.

OK, I thought. This was an emergency of sorts. I kissed her on the forehead, then stifled a laugh. What a strange wife for a poet she would be! She sat there fighting with herself, struggling to put something in words.

"*Why* ... is sex, working together, adventure, memories of this, not being afraid, *not fighting*."

My parents had had their usual share of discussions and debates, but raised voices had been very rare. The Ray's loud argument had, apparently, opened some old wounds for Randi. I held her and gave her what comfort I could. Finally, curiosity got the better of me.

"Your parents fought?"

"Dad wouldn't go to parties. Didn't like social stuff. Didn't like mom's friends. His money." Randi looked me in the eye with an expression somewhere between anger and pleading.

"So. She had him shot. Hired someone."

I'd never heard anything like that, and anything that happened to papa Gaylord Lotati would have been big news. "Huh?"

"Someone Mom knew knew someone. The punk wasn't up to it. Nonfatal chest wound. Private doctor. Private detective. Real private. A settlement. Uncontested divorce.

"I was six. All I knew then was dad was sick in the hospital for a week. Later mom just didn't come home from one of her trips. A moving van showed up and moved . . . moved some stuff. One of the movers played catch with me. Another van came and moved dad and me to a smaller house.

"And there was no more yelling, never, and no more mom. So you know now. When you hold me, that kind of goes away. I feel secure, and I want that feeling, forever."

What in a freezing hydrocarbon hell does one say to that? I just rocked her gently and stared at the wall of the tent, as if it could give me an answer. "Look, I care about you, I really do," I finally told her. "But I need to find my own 'whys.' Otherwise, the relationship would be too dependent." I grinned at her. "We should be more like Pluto and Charon, not like Uranus and Miranda."

"Who gets to be Pluto and who gets to be Charon?" she asked, impishly, eyes sparkling through embryonic tears, as she began devouring me. One does not escape from a black hole, and once I fell beneath her event horizon and we merged into a singularity, the question of who was Pluto and who was Charon, to the rest of the universe, mattered not. Nor did whatever noise we made.

We reentered the real Universe late for our next round of back-door searching; Cathy and Nikhil were almost finished packing their pallet when we emerged from our deflated tent. We stared at each other in mutual embarrassment. Nikhil put his hand on his wife's shoulder.

"Sorry. Bit of tension is all, we'll be all right." He waved at Miranda around us. "Now, shall we have another go at it?"

"Any ideas of where to look?" I asked.

"Ethane outlet?" Randi inquired.

Yes, I thought, those rivers had to go somewhere. I had, however, hoped to avoid swimming in them.

"There is," Sam announced, "a large cavern on the other side of this siderophilic nodule."

"This what?" Cathy started.

"This bloody three-kilometer nickel iron rock you're standing on," Nikhil snapped before Sam could answer, then he caught himself and lamely added: "dear."

She nodded curtly.

Randi took a couple of experimental swings at the nodule, more, I thought, in frustration than from doubting Sam. "No holes in this. Best check edges," She suggested. We all agreed.

After five hours of searching, it was clear that the only ways out were the ethane rivers.

"Forgive me if I now regret giving in on the rift route," Nikhil had to say. Cathy was in reach, so I gave her hand a pat. She shrugged.

We had a right-left choice, a coin flip. Each side of the tidal divide had its own ethane river and each river disappeared. Sam sounded and sounded around the ethane lakes at the end of Nikhil's Smokestack. The inner one, on the side toward Uranus, appeared to open into a cavern five kilometers on the other side of "Cathy's Rock," as we called the central nodule. The other one appeared to go seven kilometers before reaching a significant opening, but that opening appeared to lead in the direction of the rift. No one even thought to question Nikhil this time.

Now that the route was decided, we had to face the question of how to traverse it.

"Simple," Cathy declared. "Sam carries the line through, then we all get in a tent and he pulls us through."

"Unfortunately, I cannot withstand ethane immersion for that period of time." Sam said. "And you will need my power source, if nothing else, to complete the journey."

"Cathy," Randi asked. "Ethane exposure, uh, how bad?"

"You don't want to breathe much of it—it will sear your lungs."

"Positive pressure."

"Some could still filter in through your tightsuit pores."

She was right. If moisture and gas from your skin could slowly work its way out of a tightsuit, then ethane could probably work its way in.

Randi nodded. "Block tightsuit pores?"

A loud "What?" escaped me when I realized what she was considering. Tightsuits worked because they let the skin exhale: sweat and gasses could slowly diffuse through the porous, swollen, fabric. Stopping that process could be very uncomfortable—if not fatal. But Cathy Ray, M.D., didn't seem to be in a panic about it. Apparently, it was something one could survive for a while.

"Big molecules. Got any, Cathy?"

"I have some burn and abrasion coating, semi-smart fibers. The brand name is Exoderm; what about it, Sam?"

"Exoderm coating will not go through tightsuit pores. But it has pores of its own, like the tightsuits, and may allow some ethane to work its way in after a while. A few thousand molecules a second per square meter."

Randi shrugged. "And a tightsuit with pores blocked will cut that way down. Too little to worry about."

"I'm going with you," I announced, surprising myself.

Randi shook her head. "You try the outer passage if I don't make it. Get the gook, Cathy."

Cathy opened up one of the pallets and produced a spray dispenser. I started unpacking a vacuum tent.

"This is going to be a little difficult to do in a tent," Cathy mused.

"Wimps. Is it ready?" Randi asked.

Cathy nodded and gave an experimental squirt to her arm. For a moment, the arm looked like it was covered with cotton candy, but the fluff quickly collapsed to a flat shiny patch. Cathy pulled the patch off and examined it. "It's working just fine, all I need is some bare skin and a place to work."

Randi answered by hyperventilating, then before anyone could stop her, she dumped pressure, fluidly removed her helmet, deactivated her shipsuit seals and floated naked before us.

Cathy, to her credit, didn't let shock stop her. "Breath out, not in, no matter how much you want," she told Randi, and quickly started spraying Randi's back while Randi was still stepping out of the boots. In less than a minute, Randi was covered with the creamy gray stuff. Calmly and efficiently, Randi rolled her tightsuit back on over the goo, resealed, checked, and rehelmeted. It was all done in less than three minutes. Nikhil was speechless and I wasn't much better.

"You OK?" I asked, though the answer seemed obvious.

Randi shrugged. "One-tenth atmosphere, ninety below, no wind, no moisture, no convection, air stings a bit. Bracing. No problem—goo handles stings. Can hold breath five minutes."

"You . . . you'd best get on with it, now," Cathy said, struggling to maintain a professional tone in her voice. "Your skin will have as much trouble breathing out as the ethane has getting in."

Randi nodded. "Line dispenser. Clips. Piton gun."

I got my act together and dug these things out of the same pallet where Cathy had kept the Exoderm. Randi snapped the free end of the line to her belt, took it off, double-checked the clip, and snapped it back on again.

"Three tugs, OK? Wait five minutes for you to collect yourselves, then I start hauling. OK?"

We nodded. Then she reached for my helmet and held it next to hers.

"I'll do it. If not, don't embarrass me, huh?"

I squeezed her hand in an extremely inadequate farewell, then she released her boot clamps, grabbed her reaction pistol, and rocketed off to the shore of the ethane lake fifteen hundred meters away.

There was, I thought, no reason why one couldn't weave a fiber-optic comm line into the test line, and use it for communications as well as for hauling, climbing, and bungee jumping. But ours weren't built that way, and we lost radio with Randi shortly after she plunged into the lake. The line kept snaking out, but, I reminded myself, that could just be her body being carried by the current. I wondered whether that had been a line attached to the alien piton we'd found above, and how long it had hung there.

Assuming success, we prepared everything for the under-ethane trip. Tents were unshipped, and pallets resealed. I broke out another line reel and looped its end through a pitoned pulley on Cathy's Rock; just in case someone did come back this way.

"I doubt that will be needed," Nikhil remarked, "but we'll be thankful if it is. You're becoming quite proficient, Mr. Bubka."

"Thanks."

I kept staring at the dispenser, fighting back the irrational desire to reel her back.

Cathy grabbed the packed pallets and moved them nearer to the shore, where the changed orientation of the milligee fields left her standing at right angles to Nikhil and myself. She chose to sit there and stare at the lake where Randi had vanished.

I stayed and pattered with my pulleys.

Nikhil came up to me. "I don't think of myself as being Bengali, you know," he said out of the blue. "I was ten when my parents were kicked out of Calcutta. Politics, I understand, though the details have never been too clear to me. At any rate, I schooled in Australia and Cambridge, then earned my doctorate at Jovis Tholus."

I knew all this, but to make conversation, responded. "J.T.U. is New Reformationist, isn't it."

"It's officially non-sectarian, state supported, you know. The council may lean that way, but the influence is diffuse. Besides, there is no such thing as New Reformationist geology, unless you're excavating the Face of Mars." Nikhil waved his hand in a gesture of dismissive toleration. "So you see, I've lived in both worlds; the cool, disciplined, thoughtful British academic world, and the eclectic, compulsive, superstitious Bengali hothouse."

No question of which one he preferred. I thought, however, to find a chink in his armor. "You are an Aristotelian then?"

"I won't object to the description, but I won't be bound by it."

"Then the golden mean must have some attraction for you, the avoidance of extremes."

"Quite."

"OK, Nikhil. Consider then, that within rational safeguards, that the spontaneity may be useful. A safety valve for evolutionary imperatives. A shortcut to communication and ideas. Creativity, art. A motivation for good acts; compassion, empathy."

"Perhaps." He gave me a wintry smile. "I am not a robot. I have these things . . ." disgust was evident in the way he said 'things,' . . . within me as much as anyone else. But I strive to hold back unplanned action, to

listen to and analyze these biochemical rumblings before responding. And *I prefer myself that way.*"

"Does Cathy?"

I regretted that as soon as I said it, but Nikhil just shook his helmeted head.

"Cathy doesn't understand the alternative. I grew up where life was cheap, and pain, commonplace. I saw things in Dum Dum, horrifying things . . . but things that nevertheless have a certain fascination for me." The expression in his unblinking brown eyes was contradictory and hard to read—perhaps a frightened but curious seven-year-old peered at me from beneath layers of adult sophistication. But did those layers protect him from us, or us from him? What had Randi's night with him been like?

"Well," he continued, "Cathy will never experience that sort of thing as long as I keep a grip on myself. She means too much to me, I owe her too much." He shook his head. "If she just would not ask for what I dare not give. . . . Between us, fellow?"

I'm not sure how I should have answered that, but just then Sam told us the line had stopped reeling out, I nodded briskly to him and we glided "down" to the ethane river shore to wait for the three sharp tugs that would signal us to follow.

They didn't come. We pulled on the line. It was slack. So we waited again, not wanting to face the implications of that. I updated my journal, trying not to think about the present.

## IV

It was almost the end of the schedule day when I finally told Cathy to get ready to put the Exoderm on me. There was no debate; we'd probably waited longer than we should have. "Don't embarrass me," Randi had said. Grimly, I determined to put off my grief, and not embarrass her. The fate, I recalled, of many lost expeditions was to peter out, one by one. Damn, I would miss her.

The plan had been to take the other outlet, but we silently disregarded that: I would go the same way, just in case there was any chance of a rescue. I needed that little bit of hope, to keep going.

By the laws of Murphy, I was, of course, standing stark freezing naked in ethane-laced nitrogen half covered with spray gook and holding my breath when the original line went taut. Three times. Cathy and Nikhil had to help seal me back in. I was shaking so hard, almost fatally helpless with relief.

We had to scramble like hell to get Sam, Cathy, and Nikhil bagged in an uninflated tent. Since I was ready for immersion, and Randi had apparently survived said immersion, I would stay on the outside and clear us around obstacles. I was still double-checking seals as Randi started hauling. By some grace of the Universe, I had remembered to clip my pulley line to the final pallet, and it trailed us into the ethane lake.

It was cold, like skinny-dipping in the Bering Sea. The ethane boiled next to my tightsuit and the space between it and my coveralls became filled with an insulating ethane froth. With that and the silvery white sheen of maximum insulation, my suit was able to hold its own at something like 290 kelvins. I shivered and deliberately tensed and relaxed every muscle I could think about, as we slipped through the ethane.

There wasn't much to see, the passage was wide, broadened perhaps by eons of flow. Strobes revealed a fog of bubbles around me, otherwise the darkness smothered everything.

The line drew us up? down? to the inside of the passage, out of the current. I grabbed the line and walked lightly against the tension of the pulling line as if I were rappelling on a low-gravity world. The tent with my companions and our pallets were thus spared bumping along the rough surface.

I asked for the time display, and my helmet told me we'd been under for an hour. We rounded a corner and entered a much narrower passage. I became so busy steering us around various projections that I forgot how cold I was. But I noted my skin starting to itch.

Then I caught a flash of light ahead. Did I imagine it?

No. In much less time than I thought, the flash repeated, showing a frothy hole in the liquid above us. Then we were at the boiling surface and Randi was waving at us as she pulled us to shore.

I flew out with a kick and a flap of my hands and was in her arms. A minute must have passed before I thought to release the rest of the expedition from their tent cum submarine.

"No solid ground at the end of the main branch. I came up in a boiling sea, full of froth and foam, couldn't see anything. Not even a roof. Had to

come back and take the detour." She trembled. "I have to get in a tent quick."

But with all our decontamination procedures, there was no quick about it, and it was 0300 universal on day ten before we were finally back in our tubular cocoons. By that time, Randi was moaning, shivering and only half-conscious. The Exoderm came off as I peeled her tightsuit down and her skin was a bright angry red, except for her fingers and toes, which were an ugly yellow black. I linked up the minidoc and called Cathy, who programmed a general tissue regenerative, a stimulant, and directed that the tent's insulation factor be turned up.

By 0500, Randi was sleeping, breathing normally, and some of the redness had faded. Cathy called and offered to watch the minidoc so I could get some sleep.

The question I fell asleep with was, that with everyone's lives at stake, could I have pushed myself so far?

Day ten was a short one. We were all exhausted, we didn't get started until 1500.

Randi looked awful, especially her hands and feet, but pulled on her back-up tight suit without a complaint. My face must have told her what I was thinking because she shot me a defiant look.

"I'll do my pitch."

But Cathy was waiting for us and took her back into the tent, which repressurized. Nikhil and I shrugged and busied ourselves packing everything else. When the women reappeared, Cathy declared, very firmly, that Randi was to stay prone and inactive.

Randi disagreed. "I do my pitch ... I, I, have to."

My turn. "Time to give someone else a chance, Randi. Me for instance. Besides, if you injure yourself further, you'd be a liability."

Randi shook her head. "Can't argue. Don't know how. I don't . . . don't want to be baggage."

"I'd hardly call it being baggage," Nikhil sniffed. "Enforced rest under medical orders. Now, if you're going to be a professional in your own right instead of Daddy's little indulgence, you'll chin up, follow medical orders, and stop wasting time."

"Nikhil dear," Cathy growled, "get your damn mouth out of my patient's

psyche."

Nikhil was exactly right, I thought, but I wanted to slug him for saying it that way.

"Very well," Nikhil said, evenly ignoring the feeling in Cathy's voice, "I regret the personal reference, Randi, but the point stands. Please don't be difficult."

Lacking support from anyone else, Randi's position was hopeless. She suffered herself to be taped onto a litter improvised from the same tent braces, sheets, and tape we had used earlier to make her wings.

This done, Nikhil turned to me. "You mentioned leading a pitch?"

Fortunately, the route started out like a one-third-scale-version Nikhil's Smokestack. It wasn't a straight shot, but a series of vertical caverns, slightly offset. Sam rocketed ahead with a line, anchored himself, and reeled the rest of us up. The short passages between caverns were the typical wide low cracks and I managed them without great difficulty, though it came as a surprise to discover how much rock and ice one had to chip away to get through comfortably. It was hard work in a pressure suit, and my respect for Nikhil and Randi increased greatly.

At the end of the last cavern, the chimney bent north, gradually narrowing to a funnel. We could hear the wind blow by us. At the end was a large horizontal cavern, dry, but full of hoar crystals. The rift was clearly visible as a fissure on its ceiling. That was for tomorrow.

The ethane level was down enough for us to forego decontamination, and before we turned in we congratulated ourselves for traversing 60 percent of the rift in less than half our allotted time.

As we turned in, Randi said she had feeling in her fingers and toes again. Which meant she must have had no feeling in them when she was demanding to lead the pitch this afternoon.

She slept quietly, it was only midnight, and I was going to get my first good night's sleep in a long time.

Day eleven was thankfully over, we were all exhausted again, and bitterly disappointed.

The day started with a discovery that, under other circumstances, would have justified the entire expedition: the mummified remains of aliens, presumably those who had left the strange piton. There were two large bodies and one small, supine on the cavern floor, lain on top of what

must have been their pressure suits. Did they run out of food, or air, and give up in that way? Or did they die of something else, and were laid out by compatriots we might find elsewhere?

They were six-limbed bipeds, taller than us and perhaps not as heavy in life, though this is hard to tell from a mummy. Their upper arms were much bigger and stronger than their lower ones and the head reminded me vaguely of a panda. They were not, to my memory, members of any of the five known spacefaring races, so, in any other circumstances, this would have been a momentous event. As it was, I think I was vaguely irritated at the complication they represented. Either my sense of wonder wasn't awake yet, or we'd left it behind, a few geode caverns back.

"How long?" Cathy asked Sam in a hushed voice. She, at least, was fascinated.

"If the present rate of dust deposition can be projected, about two hundred and thirty thousand years, with a sigma of ten thousand."

"Except for the pressure suits, they didn't leave any equipment," Nikhil observed. "I take that to mean that this cavern is *not* a dead end—as long as we do press on. You have your images, Sam? Good. Shall we?"

We turned to Nikhil, away from the corpses.

"The vent," he said, looking overhead, "is probably up there."

"The ceiling fissure is an easy jump for me," Sam offered. "I'll pull the rest of you up."

We got on our way, but the rift quit on us.

Once in the ceiling caves, we found there was no gas flowing that way, the way where Sam's seismological soundings, and our eyes, said the rift was. We chanced the passage anyway, but it quickly narrowed to a stomach-crawling ordeal. Three kilometers in, we found it solidly blocked and had to back our way out to return to the cavern. Another passage in the ceiling proved equally unpromising.

"Quakes," Nikhil said. "The rift must have closed here, oh, a hundred million years ago or so—from the dust." So, when dinosaurs ruled the Earth, Miranda had changed her maze, no doubt with the idea in mind of frustrating our eventual expedition.

Finally, Sam found the outlet airflow. It led back to the north.

"I hereby dub this the Cavern of Dead Ends," I proclaimed as we left, with what I hoped was humorous flourish.

Surprisingly, Nikhil, bless his heart, gave me one short "ha!"

Randi was not to be denied today, and took the first pitch out in relief of Nikhil. But she soon tired, according to Cathy, who was monitoring. I took over and pushed on.

The slopes were gentle, the path wide with little cutting to do, and we could make good time tugging ourselves along on the occasional projecting rock and gliding. We took an evening break in a tiny ten-meter bubble of a cavern and had our daily ration crackers, insisting that Randi have a double ration. No one started to make camp, a lack of action that signified group assent for another evening of climbing and gliding.

"We are," Sam said, showing us his map on our helmet displays, "going to pass very close to the upper end of Nikhil's Smokestack." No one said anything, but we knew that meant we were backtracking, losing ground.

There was a final horizontal cavern, and its airflow was toward the polar axis. We could pretty much figure out what that meant, but decided to put off the confirmation until the morning. I'd once read a classic ancient novel by someone named Vance about an imaginary place where an accepted means of suicide was to enter an endless maze and wander about, crossing your path over and over again until starvation did you in. There, you died by forgetting the way out. Here, we did not even know there *was* a way out.

The beginning of day twelve thus found us at the top of Nikhil's Smokestack again, on a lip of a ledge not much different than the one about a kilometer away where we had first seen it. We were very quiet, fully conscious of how much ground we had lost to the cruel calendar. We were now less than halfway through Miranda, with less than half our time left.

Sam circled the top of the Smokestack again, looking for outlets other than the one we had come through. There were none. Our only hope was to go back down.

"Do we," I asked, "try the inner river, or try the other branch of Randi's River and fight our way through the Boiling Sea?"

Nikhil, though he weighed less than four newtons, was stretched out on the ledge, resting. His radio voice came from a still form that reminded me in a macabre way of the deceased aliens back in the Cavern of Dead Ends.

"The Boiling Sea," he mused, "takes the main flow of the river, so it should have an outlet vent. It is obviously in a cavern, so it has a roof.

Perhaps we could just shoot a piton up at it, blindly."

But I thought of Nikhil's Smokestack—a blind shot could go a long way in something like that.

"Sam could fly up to it," I offered. "If we protect it until we reach the Boiling Sea's surface, it could withstand the momentary exposure. Once at the ceiling, it could pull the rest of us up."

Cathy nodded and threw a rock down Nikhil's Smokestack, and we watched it vanish relatively quickly. Dense, I thought, less subject to drag. As it turned out, I wasn't the only one with that thought.

"Look what I have," Randi announced.

"What" was a large boulder, perhaps two meters across, and loose; Randi could rock it easily, though it must have had a mass of five or six tons. "Bet *it* doesn't fall like a snowflake," she said as she hammered a piton into it.

Even in the low gravity, it took two of us to lift it over the edge.

Two hours later, about a kilometer above Cathy's Rock, we jumped off into the drag of the slipstream and watched the boulder finish its fall. It crashed with a resounding thud, shattered into a thousand shards, most of which rebounded and got caught in the chimney walls. We soon reached local terminal velocity and floated like feathers in the dust back to the place we had first departed three days ago.

Cathy decided that Randi was in no shape for another immersion and didn't think I should risk it either. I did have a few red patches, though I'd spent nowhere near as much time in the ethane as Randi. We looked at Nikhil, who frowned.

Cathy shook her head. "My turn, I think." But her voice quavered. "I'm a strong swimmer and I don't think Nikhil's done it for years. You handle the spray, Wojciech. You don't have to cover every square centimeter, the fibers will fill in themselves, but make sure you get enough on me. At least fifteen seconds of continuous spray. Randi, I can't hold my breath as long as you. You'll have to help me get buttoned up again, fast."

When all was ready, she took several deep breaths, vented her helmet and stripped almost as quickly as Randi had. This, I thought as I sprayed her, was the same woman who panicked in a tight spot just over a week ago. The whole operation was over in a hundred seconds.

The pulley I'd left was still functional, but that would only get us to the branch in the passage that led to the Cavern of Dead Ends. From there on, Cathy would have to pull us.

It was not fun to be sealed in an opaque, uninflated tent and be bumped and dragged along for the better part of an hour with no control over anything. The return of my minuscule weight as Sam winched us up to the roof of the Boiling Sea cavern was a great relief.

Randi, Nikhil, and I crawled, grumbling but grateful, out of the tent onto the floor of the cave Sam had found a couple of hundred yards from the center of the domed roof of the cavern. The floor sloped, but not too badly, and with a milligee of gravity it scarcely mattered. I helped Nikhil with the tent braces and we soon had it ready to be pressurized. Sam recharged the pallet power supplies and Randi tacked a glowlamp to the wall. Cathy then excused herself to get the Exoderm out of her tightsuit while we set up the other tent.

Work done, we stretched and floated around our little room in silence.

I took a look out the cave entrance; all I could see of the cavern when I hit my strobe was a layer of white below and a forest of yellow and white stalactites, many of them hundreds of meters long, on the roof. The far side, which Sam's radar said was only a couple of kilometers away, was lost in mist.

Then I noticed other things. My tightsuit, for instance, didn't feel as tight as it should.

"What's the air pressure in here?"

"Half a bar," Sam responded. "I've adjusted your suits for minimum positive pressure. It's mostly nitrogen, methane, ethane, and ammonia vapor, with some other volatile organics. By the way, the Boiling Sea is mainly ammonia; we are up to 220 Kelvins here. The ethane flashes into vapor as it hits the ammonia— that's why all the boiling."

Miranda's gravity was insufficient to generate that kind of pressure, and I wondered what was going on.

"Wojciech," Randi whispered, as if she were afraid of waking something. "Look at the walls."

"Huh?" The cave walls were dirty brown like cave walls anywhere—except Miranda. "Oh, no hoar crystals."

She rubbed her hand on the wall and showed me the brown gunk. "I'd like to put this under a microscope. Sam?"

The robot came quickly and held the sample close to its lower set of eyes. I saw what it saw, projected on the inside of my helmet.

"This," it said, "has an apparent cellular structure, but little, if any

structure within. Organic molecules and ammonia in a kind of gel."

As I watched, one of the cells developed a bifurcation. I was so fascinated, I didn't notice that Cathy had rejoined us. "They must absorb stuff directly from the air," she theorized. "The air is toxic, by the way, but not in low concentrations. Something seems to have filtered out the cyanogens and other really bad stuff. Maybe this."

"The back of the cave is full of them," Randi observed. "How are you?"

"My skin didn't get as raw as yours, but I have a few irritated areas. Physically, I'm drained. We're going to stop here tonight, I hope."

"This is one of the gas outlets of the Cavern of the Boiling Sea," Sam added. "It seems to be a good place to resume our journey. The passage is clear of obstructions as far as I can see, except for these growths, which are transparent to my radar."

"They impede the airflow," Nikhil observed, "which must contribute to the high pressure in here. I think they get the energy for their organization from the heat of condensation."

"Huh?" I wracked my memories of bonehead science. "Wojciech, when a vapor condenses it undergoes a phase change. When ethane vapor turns back into ethane, it gives off as much heat as it took to boil it in the first place. That heat can make some of the chemical reactions this stuff needs go in the right direction."

"Are they alive?" I asked.

"Hard to say," Cathy responded. "But that's a semantic discussion. Are hoar crystals alive? There's a continuum of organization and behavior from rocks to people. Any line you draw is arbitrary and will go right through some gray areas."

"Hmpf," Nikhil snorted. "Some distinctions are more useful than others. This stuff breeds, I think. Let's take some samples, but we need to get some rest, too."

"Yes, dear." Cathy yawned in spite of herself.

In the tent, Randi and I shared our last regular meal; a reconstituted chicken and pasta dish we'd saved to celebrate something. The tent stank of bodies and hydrocarbons, but we were used to that by now, and the food tasted great despite the assault on our nostrils. From now on, meals would be crackers. But we were on our way out now, definitely. We had to be. Randi felt fully recovered now and smiled at me as she snuggled under her elastic sheet for a night's rest.

It must have been the energy we got from our first good meal in days. She woke me in the middle of our arbitrary night and gently coaxed me into her cot for lovemaking, more an act of defiance against our likely fate than an act of pleasure. I surprised myself by responding, and we caressed each other up a spiral of intensity which was perhaps fed by our fear as well.

There were the tidal forces near Randi's event horizon; she was not just strong for a woman, but strong in absolute terms; stronger than most men I have known including myself. I had to half-seriously warn her to not crack our low gravity-weakened ribs. This made her giggle and squeeze me so hard I couldn't breathe for a moment, which made her giggle again.

When we were done, she gestured to the tent roof with the middle finger of her right hand and laughed uncontrollably. I joined her in this as well, but I felt momentarily sad for Nikhil and Cathy.

It was another of those polite mornings, and we packed up and were on our way with record efficiency. We looked around for the vent and Sam pointed us right at the mass of brown at the rear of the cave.

"The gas goes into that, right through it," it said.

We called the stuff "cryofungus." It had grown out from either side of the large, erosion widened vertical crack that Sam found in the back of our cave until it met in the middle. However, the cryofungus colonies from either side didn't actually fuse there, but just pressed up against each other. So, with some effort, we found we could half push, half swim, our way along this seam.

We had pushed our way through five kilometers of "cryofungus" before a macabre thought occurred to me. The rubbery brown stuff absorbed organics through the skin of its cells. Did said organic stuff have to be gas? I asked Cathy.

"I did an experiment. I fed my sample a crumb of ration cracker."

"What happened?"

"The cracker sort of melted into the cryofungus. There are transport molecules all over the cell walls."

I thought a second. "Cathy, if we didn't have our suits on—"

"I'd think water would be a little hot for them, but then again water and ammonia are mutually soluble. If you want to worry, consider that your tightsuit is porous. It might," I could see her toothy smile in my mind,

"help keep you moving."

"Nice, dear," Nikhil grumbled. "That gives a whole new meaning to this concept of wandering through the bowels of Miranda."

A round of hysterical laughter broke whatever tension remained between us, and resolved into a feeling of almost spiritual oneness among us. Perhaps you have to face death with someone to feel that—if so, so be it.

At the ten-kilometer point, the cryofungus started to lose its resiliency. At twelve, it started collapsing into brown dust, scarcely offering any more resistance than the hoar crystals. This floated along with the gas current as a sort of brown fog. I couldn't see, and had Sam move up beside me.

After three kilometers of using Sam as a seeing-eye dog, the dust finally drifted by us and the air cleared. It was late again, well past time to camp. We had been underground thirteen days, and had, by calculation, another eight left. According to Sam, we were still two hundred and fifteen kilometers below the surface. We decided to move on for another hour or two.

The passageway was tubular and fairly smooth, with almost zero traction. We shot pitons into the next curve ahead, and pulled ourselves along.

"Massive wind erosion," Nikhil remarked as he twisted the eye of a piton to release it. "A gale must have poured through here for megayears before the cryofungus choked it down."

Each strobe revealed an incredible gallery of twisted forms, loops, and carved rocks, many of which were eerily statuesque; saints and gargoyles. This led us into a slightly uphill kilometer-long cavern formed under two megalithic slabs, which had tilted against each other when, perhaps, the escaping gas had undermined them. After the rich hoarcrystal forest of the inbound path, this place was bare and dry. Sam covered the distance with a calculated jump carrying a line to the opposite end. We started pulling ourselves across. We'd climbed enough so that our weight was back to twenty newtons—minuscule, yes, but try pumping twenty newtons up and down for eighteen hours.

"I quit," Cathy said. "My arms won't do any more. Stop with me, or bury me here." She let go of the line, and floated slowly down to the floor.

It was silent here, no drippings, no whistling, reminiscent of the vacuum so far above. I tried to break the tension by naming the cavern. "This was clearly meant to be a tomb, anyway. The Egyptian Tomb, we

can call it."

"Not funny, Wojciech," Nikhil snapped. "Sorry, old boy, a bit tired myself. Yes, we can make camp, but we may regret it later."

"Time to stop. We worked out the schedule for, for, maximum progress." Randi said. "Need to trust our judgment. Won't do any better by over-pushing ourselves now."

"Very well," Nikhil conceded, and dropped off as well. He reached Cathy and put his arm around her briefly, which I note because it was the first sign of physical affection I had seen between them. Randi and I dropped the pallets, and followed to the floor. We landed harder than we expected—milligee clouds judgment. Worse perhaps, because it combines a real up and down with the feeling that they don't matter.

We were very careful and civilized in making camp. But each of us was in our minds, trying to reach an accommodation with the idea that, given what we had been through so far, the week we had left would not get us to the surface.

Before we went into our separate tents, we all held hands briefly. It was spontaneous, we hadn't done so before. But it seemed right, somehow, to tell each other that we could draw on each other that way.

## V

That last was for day thirteen, this entry covers days fourteen and fifteen. Yes, my discipline in keeping the journal is slipping.

We'd come to think of Randi as a machine—almost as indestructible and determined as Sam, but last night, at the end of day fourteen that machine cried and shook.

Low rations and fatigue are affecting all of us now. We let Sam pull us through the occasional cavern, but it has mostly been wriggling through cracks with a human in the lead. We changed leads every time we hit a wide-enough place, but once that was six hours. That happened on Randi's lead. She didn't slack but when we finally reached a small cavern, she rolled to the side with her face to the wall as I went by. We heard nothing from her for the next four hours.

We ended up at the bottom of a big kidney-shaped cavern 160

kilometers below the surface; almost back to the depth of the upper end of Nikhil's Smokestack. We staggered through camp set-up, with Sam double-checking everything. We simply collapsed on top of the stretched sheets in our coveralls and slept for an hour or so, before our bodies demanded that we answer our needs. Washed, emptied, and a bit refreshed from the nap, Randi snuggled into my arms, then let herself go. Her body was a mass of bruises, old and new. So was mine.

"You're allowed a safety valve, you know," I told her. "When Cathy feels bad, she lets us know outright. Nikhil gets grumpy. I get silly and tell bad jokes. You don't have to keep up an act for us."

"Not for you, for, for me. Got to pretend I can do it, or I'll get left behind, with Mom."

I thought about this. A woman that would attempt to murder her husband to gain social position might have been capable of other things as well.

"Randi, what did that mean? Do you want to talk?"

She shook her head. "Can't explain."

I kissed her forehead. "I guess I've been lucky with my parents."

"Yeah. Nice people. Nice farm. No fighting. So why do you have to do this stuff?"

Why indeed? "To have a real adventure, to make a name for myself outside of obscure poetry outlets. Mom inherited the farm from her father, and that was better than living on state dividends in Poland, so they moved. They actually get to do something useful, tending the agricultural robots. But they're deathly afraid of losing it because real jobs are so scarce and a lot of very smart people are willing to do just about anything to get an Earth job. So they made themselves very, very nice. They never rock any boats. Guess I needed something more than nice."

"But you're, uh, nice as they are."

"Well trained, in spite of myself." Oh, yes, with all the protective responses a nonconformist learns after being squashed time and time again by very socially correct, outwardly gentle, and emotionally devastating means. "By the way, Randi, I hate that word."

"Huh?"

"Nice."

"But you use it."

"Yeah, and I hate doing that, too. Look, are you as tired as I am?" I was

about to excuse myself to the questionable comforts of my dreams.

"No. Not yet. I'll do the work."

"Really . . ."

"Maybe the last time, way we're going." We both knew she was right, but my body wasn't up to it, and we just clung to each other tightly, as if we could squeeze a little more life into ourselves. I don't remember falling asleep.

Day fifteen was a repeat, except that the long lead shift fell on Cathy. She slacked. For seven hours, she would stop until she got cold then move forward again until she got tired. Somehow we reached a place where I could take over.

What amazed me through all of that was how Nikhil handled it. There was no sniping, no phony cheeriness. He would simply ask if she was ready to move again when he started getting cold.

We ended the day well past midnight. For some reason, I was having trouble sleeping.

Today the vent finally led us to a chain of small caverns, much like the rift before we encountered the top of Nikhil's Smokestack. We let Sam tow us most of the way and had only two long crack crawls. The good news is our CO<sub>2</sub> catalyst use is down from our passivity, and we might get another day out of it.

The bad news is that Randi had to cut our rations back a bit. We hadn't been as careful in our counting as we should have been, thinking that because the CO<sub>2</sub> would get us first, we didn't have a problem in that area. Now we did. It was nobody's fault, and everyone's. We'd all had an extra cracker here and there. They add up.

We ended up exhausted as usual, in a five-hundred-meter gallery full of jumble. I called it "The Junk Yard." Sam couldn't find the outlet vent right away, but we made such good progress that we thought we had time to catch up on our sleep.

Day eighteen. We gained a total of fifteen kilometers in radius over the past two days. "The Junk Yard" was a dead end, at least for anything the size of a human being. There was some evidence of gas diffusing upward through fractured clathrate, but it was already clear that it wasn't the

main vent, which appeared to have been closed by a Miranda quake millions of years ago.

We had to go all the way back to a branch that Sam had missed while it was towing us through a medium-sized chimney. Logic and experience dictated that the outlet would be at the top of the chimney, and there was a hole there that led onward. To "The Junk Yard." Miranda rearranges such logic.

We spotted the real vent from the other side of the chimney as we rappelled back down.

"A human being," Cathy said when she saw the large vertical crack that was the real vent, "would have been curious enough to check that out. It's so deep."

"I don't know, dear," Nikhil said, meaning to defend Sam, I supposed, "with the press of time and all, I might not have turned aside, myself."

We were all dead silent at Nikhil's unintentional self-identification with a robot. Then Randi giggled and soon we were all laughing hysterically again. The real students of humor, I recall, say that laughter is not very far from tears. Then Nikhil, to our surprise, released his hold to put his arms around his wife again. And she responded. I reached out and caught them before they'd drifted down enough centimeters for their belt lines to go taut. So at the end of day seventeen, we had covered sixty kilometers of caverns and cracks, and come only fifteen or so nearer the surface.

By the end of day eighteen, we'd done an additional fifteen kilometers of exhausting crack crawling, found only one large cavern, and gave in to exhaustion, camping in a widening of the crack just barely big enough to inflate the tents.

What occurred today was not a fight. We didn't have enough energy for a fight.

We had just emerged into a ten-meter-long, ten-meter-wide, two-meter-high widening gallery in the crack we were crawling. Cathy was in the lead and had continued on through into the continuing passage when Nikhil gave in to pessimism.

"Cathy," he called, "stop. The passage ahead is getting too narrow, it's another bloody dead end. We should go back to the last large cavern and look for another vent."

Cathy was silent, but the line stopped. Randi, sounding irritated, said

"No time," and moved to enter the passage after Cathy.

Nikhil yawned and snorted. "Sorry, little lady. I'm the geologist and the senior member, and not to be too fine about it, but I'm in charge." Here he seemed to loose steam and get confused, muttering "You're right about no time—there's no time to argue."

No one said anything, but Randi held her position.

Nikhil whined. "I say we go back, an' this time, back we go."

My mind was fuzzy; we still had four, maybe five days. If we found the right chain of caverns, we could still make the surface. If we kept going like this, we weren't going to make it anyway. He might be right, I thought. But Randi wouldn't budge.

"No. Nikhil. You owe me one, Nikhil, for, for, two weeks ago. I'm collecting. Got to go forward now. Air flow, striations, Sam's soundings, and, and my money, damn it."

So much for my thoughts. I had to remember my status as part of Randi's accretion disk.

"Your *daddy's* money," Nikhil sniffed, then said loudly and with false jollity, "But never mind. Come on everyone, we'll put Randi on a stretcher again until she recovers . . . her senses." He started reaching for Randi: clumsy fumbling really. Randi turned and braced herself, boots clamped into the clathrate, arms free.

"Nikhil, back off," I warned. "You don't mean that."

"Ah appreciate your expertise with words, old chap." His voice was definitely slurred. "But these are mine and I mean them. I'm too tired to be questioned by amateurs anymore. Back we go. Come on back, Cathy. As for you . . ." He lunged for Randi again. At this point I realized he was out of his mind, and possibly why.

So did Randi, for at the last second instead of slapping him away and possibly hurting him, she simply jerked herself away from his grasping fingers.

And screeched loudly in pain.

"What?" I asked, brushing by the startled Nikhil to get to Randi's side.

"Damn ankle," she sobbed. "Forgot to release my boot grapples. Tired. Bones getting weak. Too much low g. Thing hurts."

"Broken?"

She nodded, tight lipped, more in control. But I could see the tears in

her eyes. Except for painkiller, there was nothing I could do for her at the moment. But I thought there might be something to be done for Nikhil. Where was Cathy?

"Nikhil," I said as evenly as I could. "What's your O<sub>2</sub> partial?"

"I beg your pardon?" he drawled.

"Beg Randi's. I asked you what your O<sub>2</sub> partial is."

"I've been conserving a bit. You know, less O<sub>2</sub>, less CO<sub>2</sub>. Trying to stretch things out."

"What ... is ... it?"

"Point one. It should be fine. I've had a lot of altitude experience—"

"Please put it back up to point two for five minutes, and then we'll talk."

"Now just a minute, I resent the implication that—"

"Be reasonable, Nikhil. Put it back up for a little, please. Humor me. Five minutes won't hurt."

"Oh perhaps not. There. Now just what is it you expect to happen?"

"Wait for a bit."

We waited, silently. Randi sniffed, trying to deal with her pain. I watched Nikhil's face slowly grow more and more troubled. Finally I asked:

"Are you back with us?"

He nodded silently. "I think so. My apologies, Randi."

"Got clumsy. Too strong for my own bones. Forget it. And you don't owe me, either. Dumb thing to say. It was my choice."

What was? Two weeks ago, in his tent?

"Very well." Nikhil replied with as much dignity as he could muster.

Who besides Randi could dismiss a broken ankle with "forget it." And who besides Nikhil would take her up on that? I shook my head.

Randi couldn't keep the pain out of her voice as she held out her right vacuum boot. "This needs some work. Tent site. Cathy." Nothing would show, of course, until it came off.

"Quite," Nikhil responded. "Well, you were right on the direction. Perhaps we should resume."

I waved him off for a moment and found a painkiller in the pallet for Randi, and she ingested it through her helmet lock, and gagged a bit.

"Still a little ethane here," she gave a little laugh. "Woke me up. I'll manage."

"Let me know." I was so near her event horizon now that everything I could see of the outside world was distorted and bent by her presence. Such were the last moments of my freedom, the last minutes and the last seconds that I could look on our relationship from the outside. My independent existence was stretched beyond the power of any force of nature to restore it. Our fate was to become a singularity.

It was a measure of my own hunger and fatigue that I half seriously considered exterminating Nikhil; coldly, as if contemplating a roach to be crushed. A piton gun would have done nicely. But, I thought, Cathy really ought to be in on the decision. She might want to keep him as a pet. Cathy, of course, was on the lead pitch. That meant she was really in charge, something Nikhil had forgotten.

"Cathy," I called, laying on the irony. "Randi has a broken ankle. Otherwise, we are ready to go again."

There was no answer, but radio didn't carry well in this material—too many bends in the path and something in the clathrate that just ate our frequencies like stealth paint. So I gave two pulls on our common line to signal OK, go.

The line was slack.

Cathy, anger with Nikhil possibly clouding her judgment, had enforced her positional authority in a way that was completely inarguable: by proceeding alone. At least I fervently hoped that was all that had happened. I pulled myself to where the passage resumed, and looked. No sign of anything.

"Sam, take the line back up to Cathy and tell her to wait up, we're coming."

Sam squeezed by me and scurried off. Shortly, his monitors in my helmet display blinked out; he was out of radio range as well.

Again, we waited for a tug on a line in a silence that shouted misery. Nikhil pretended to examine the wall, Randi stared ahead as if in a trance. I stared at her, wanting to touch her, but not seeming to have the energy to push myself over to her side of the little cave.

Both hope and dread increased with the waiting. The empty time could mean that Cathy had gone much farther than our past rate of progress had suggested, which would be very welcome news. But it could also mean that some disaster ahead had taken both her and Sam. In which case, we

were dead as well. Or, like Randi's detour from the Boiling Sea, it could mean something we had neglected to imagine.

"Wojciech, Nikhil," Randi asked in her quiet, anticipatory, tone, "would you turn off your lamps?"

I looked at Nikhil, and he stared off into space, saying as much that he could not care less. But his light went out. I nodded and cut mine. The blackness was total at first, then as my pupils widened, I realized I could sense a gray-green contrast, a shadow. My shadow.

I turned around to the source of the glow. It was, of course, the crack behind me, through which Cathy and Sam had vanished. As my eyes adapted further, it became almost bright. It was white, just tinged with green. The shadows of rocks and ice intrusions made the crack look like the mouth of some beast about to devour us.

"Is there," I asked, "any reason why we should stay here?"

We left. The crack widened rapidly, and after an hour of rather mild crack-crawling, we were able to revert to our distance-eating hand-hauling routine. We covered ten kilometers almost straight up this way. With the sudden way of such things the crack turned into a tubular tunnel, artificial in its smoothness, and this in turn gave into a roughly teardropshaped, hundred-meter-diameter cavern with slick ice walls, and a bright circle at the top. I was about to use my piton gun when Randi tugged my arm and pointed out a ladder of double-looped pitons, set about two meters apart, leading up to the circle.

We were thus about to climb into Sphereheim when Cathy's line grew taut again.

That was, by the clock, the end of day nineteen. We were, it seemed, both too exhausted and too excited to sleep.

The cavern above was almost perfectly spherical, hence the name we gave it, and was almost fifteen kilometers in diameter. A spire ran along its vertical axis from the ceiling to the floor, littered like a Christmas tree with the kind of cantilevered platforms that seventy-five milligees permits.

By now, we had climbed to within forty kilometers of the surface, so this was all in a pretty good vacuum, but there were signs that things had not always been this way.

"Cathy?" Nikhil called, the first words he had spoken since the fight.

"Good grief, you're here already. We waited until we thought it was safe."

"We saw the light."

"It came on as soon as I got in here. Sam's been looking for other automatic systems, burglar protection, for instance."

"There," Sam interjected, "appear to be none. The power source is two stage—a uranium radionic long duration module, and something like a solid state fuel cell that works when it's warmed up. The latter appears to be able to produce almost a kilowatt."

"Good," I said, wondering if Sam's software could discern the contrary irritation in my voice. "Cathy, Randi has a broken ankle." Even in less than a hundredth of  $g$ , Randi wouldn't put any weight on it.

"Oh, no! We need to get a tent up right away. Sam, break off and come down here, I need you. And you!" She pointed at Nikhil. "This is a medical emergency now, and what I say goes. Do you have a problem with that?" The edge in Cathy's voice verged on hysteria.

Nikhil simply turned away without saying anything and began setting up the tent.

Randi reached for Cathy. "Cathy, Nikhil cut his oxygen too thin, trying to save CO<sub>2</sub> catalyst for all of us. He wasn't himself. Ankle hurts like hell, but that was my fault. I'd feel better if you weren't so, uh, hard on him. OK?"

Cathy stood quietly for a couple of seconds then muttered. "All right, all right. Give me a minute to collect things, and we'll get in the tent. I'll see what I can do. Wojciech?"

"Yes, Cathy?"

"As I guess everyone knows, I just blew it with my husband, and I can't fix things right now because I have to fix Randi's ankle. He's in a blue funk." She pulled the velcro tab up on one of her pockets, reached in and produced a small, thin, box. "Give him one of these and tell him I'm sorry."

I looked at her. She seemed on the brink of some kind of collapse, but was holding herself back by some supreme effort of will. Maybe that's what I looked like to her.

"Sorry, Wojciech," she whispered, "best I can do."

I gave her hand a squeeze. "We'll make it good enough, OK? Just hang in there, Doc."

She gave me a quick, tear-filled smile, then grabbed the minidoc and followed Randi into the tent, which inflated promptly.

Nikhil was sitting on the other pallet and I sat next to him. "Look, Nikhil, the way I see it, none of this stuff counts. All that counts is that the four of us get out of this moon alive."

He looked at me briefly, then resumed looking at the ground. "No, no. Wojciech, it counts. Do you understand living death? The kind where your body persists, but everything that you thought was you has been destroyed? My reputation . . . they'll say Nikhil Ray cracked under pressure. It got too tough for old Nikhil. Nikhil beats up on women. It's going to be bloody bad."

I remembered the box Cathy gave me, pulled it out and opened it. "Doctor's orders, Nikhil. She cares, she really does."

He gave me a ghastly grin and took a caplet envelope, unwrapped it and stuck it through his helmet lock. "Can't say as I approve of mind-altering drugs, but it wouldn't do to disappoint the doctor any more now, would it? I put her through medical school, did you know? She was eighteen when we met. Biology student studying evolution, and I was co-lecturing a paleontology section. Damn she was beautiful, and no one like that had ever ..." he lifted his hands as if to gesture, then set them down again. "I broke my own rule about thinking first, and I have this to remind me, every day, of what happens when you do that."

"Look, Nikhil. She doesn't mean to hurt you." I tried to think of something to get him out of this, to put his mind on something else. "Say, we have a few minutes. Why don't we look around, it may be the only chance we get. Soon as Cathy's done with Randi, we'll need to get some sleep, then try to make it to the surface. We've forty kilometers to go, and only two days before our catalyst runs out."

"My line, isn't that? Very well." He seemed to straighten a bit. "But it looks as if the visitors packed up pretty thoroughly when they left. Those platforms off the central column are just bare honeycomb. Of course, it would be a bit odd if they packed *everything* out."

"Oh?"

"Field sites are usually an eclectic mess. All sorts of not-immediately-useful stuff gets strewn about. If the strewers don't expect the environmental police to stop by, it usually just gets left there by the hut site—the next explorer to come that way might find something useful."

"I see. You think there might be a dump here, somewhere."

"It seems they had a crypt. Why not a dump?"

What kind of alien technology might be useful to us, I didn't know. It would take a lot longer than the two days we had to figure out how to do anything with it. But the discussion had seemed to revive Nikhil a bit, so I humored him.

We found the junkyard. It was in a mound about a hundred meters from the tower base, covered with the same color dust as everything else. A squirt from my reaction pistol blew some of the dust away from the junk.

And it was just that. Discarded stuff. Broken building panels, a few boxes with electrical leads. What looked like a busted still. A small wheeled vehicle that I would have taken for a kid's tricycle, an elongated vacuum helmet with a cracked visor. Other things. I'd been rummaging for five minutes before I noticed that Nikhil hadn't gone past the still.

"Nikhil?"

"It is within the realm of possibility that I might redeem myself. Look at that."

The most visible part was a big coil of what looked to be tubing. There were also things that looked like electric motors, and several chambers to hold distilled liquids.

"The tubing, Wojciech."

"I don't understand."

"If we breathe through it, at this temperature, the CO<sub>2</sub> in our breath should condense."

"Oh! We could do without the CO<sub>2</sub> catalyst." Then I thought of the problem. "It wouldn't be very portable."

"No, it wouldn't," Nikhil nodded slowly, judiciously. "But it doesn't have to be. Cathy and Randi can remain here while you, Sam, and I take the remaining catalyst and go for help."

Did I hear him right? Then I thought it through. Randi was disabled, Cathy, by strength and temperament, was the least suited for the ordeal above us. It made sense, but Randi would ... no, Randi would have to agree if it made sense. She was a pro.

"We'd better see if it works first." I said.

## VI

An hour later, our still was working. Tape, spare connectors, the alien light source, and Sam's instant computational capabilities yielded something that could keep two relatively quiescent people alive. They'd have to heat it up to sublimate the condensed CO<sub>2</sub> every other hour, or the thing would clog, but it worked.

Randi's ankle was a less happy situation.

"Randi's resting now," Cathy told us when she finally emerged from the vacuum tent, exhausted. "It's a bad break, splintered. Her bones were weak from too much time in low gravity, I think. Anyway, the breaks extend into the calcaneus and her foot is much too swollen to get back into her vacuum boots. Had to put her in a rescue bag to get out of the tent." Cathy shot a look of contempt at her husband who stared down. "The swelling will take days to go down, and she should have much more nourishment than we have to give her."

"I. . ." Nikhil started, then, in a moment I shall remember forever, he looked confused. "I?" Then he simply went limp and fell, much like an autumn leaf in the gentle gravity of Miranda, to the cavern dust. We were both too surprised to catch him even though his fall took several seconds.

"No, no . . ." Cathy choked.

I knelt over Nikhil and straightened his limbs. I couldn't think of anything else to do.

"Stroke?" I asked Cathy.

She seemed to shake herself back into a professional mode. I heard her take a breath.

"Could be. His heart telemetry's fine. Or he may have just fainted. Let's get the other tent set up."

We did this only with Sam's help. We made errors in the set-up, errors which would have been fatal if Sam hadn't been there to notice and correct them. We were tired and had been eating too little food. It took an hour. We put Nikhil in the tent and Cathy was about to follow when she stopped me.

"The main med kit's in Randi's tent. I'll need it if I have to operate. She'll have gotten out of the rescue bag to sleep after I left. You'll have to wake her, get her back in the bag and depressure—"

I held up a hand. "I can figure it out, and if I can't, she can. Cathy, her

foot's busted, not her head."

Cathy nodded and I could see a bit of a smile through her faceplate.

"Randi," I called, "Sorry to wake you, but we've got a problem."

"I heard. Comsets are dumb, guys. Can't tell if you talk *about* someone instead of *to* someone. Be right out with the med kit."

"Huh?" Cathy sounded shocked. "No, Randi don't try to put that boot on. Please don't."

"Too late," Randi answered. We watched the tension go out of the tent fabric as it depressurized. Randi emerged from the opening with the med kit and a sample bag. Cathy and I immediately looked at her right boot—it seemed perfectly normal, except that Randi had rigged some kind of brace with pitons and vacuum tape.

Then we looked at the sample bag. It contained a blue-green swollen travesty of a human foot, severed neatly just above the ankle, apparently with a surgical laser. I couldn't think of anything to do or say.

"Oh, no, Randi," Cathy cried and launched herself toward Randi. "I tried. Randi, I tried."

"You didn't have time." The two women embraced. "Don't say anything," Randi finally said, "to him," she nodded at Nikhil's tent, "until we're all back and safe. Please, huh?"

Cathy stood frozen, then nodded slowly, took the sample bag and examined the foot end of the section. "Looks clean, anyway. At least let me take a look at the stump before you go, OK?"

Randi shook her head. "Bitch to unwrap. Cauterized with the surgical laser. Plastiflesh all over the stump. Sealed in plastic. Plenty of local. Don't feel anything. I did a good enough job, Cathy."

I finally found my voice. "Randi . . . why?"

"Nikhil's gone. Got to move. It's OK, Wojciech. They can regenerate. You and I got to get going."

"Me? Now?" I was surprised for a moment, then realized the need. Cathy had to stay with Nikhil. And I'd already seen too many situations where one person would have been stopped that we'd managed to work around with two. Also, our jury rigged CO<sub>2</sub> still's capacity was two people, max.

"No. Go as long as we can, then sleep. Eat everything we have left. Push for the surface. Only way."

Cathy nodded. She handed Randi's foot to me, almost absentmindedly, and went into the tent to attend to Nikhil. Randy laughed, took the foot from me, and threw it far out of sight toward Sphereheim's junk pile. In the low gravity, it probably got there.

I tried not to think about it as Randi and I packed, with Sam's help. Moving slowly and deliberately, we didn't make that many errors. What Randi had to draw on, I didn't know. I drew on her. In an hour, we were ready to go and said our farewells to Cathy.

She would have to wait there, perhaps alone if Nikhil did not recover, perhaps forever if we did not succeed. What would that be like, I wondered? Would some future explorers confuse her with the beings who had built the station in this cavern? Had we already done that with the corpses we found in the Cavern of Dead Ends?

I wished I had made love to Cathy that night we spent together. I felt I was leaving a relationship incomplete; a feeling, a sharing, uncommunicated. Here, even a last embrace would have been nice, but she was in her tent caring for her husband. Out of food, low on time, Randi and I had to go, and go now. In the dash to the surface, even minutes might be critical.

Tireless Sam scaled the alien tower, found the vent in the magnificent, crystal lined dome of the cavern roof, and dropped us a line. I was suspended among wonders, but so tired I almost fell asleep as Sam reeled us up. The experience was surreal and beyond description.

Of most of the next few days, I have little detailed memory. Sam dragged us through passages, chimneys, vents and caverns. Occasionally, it stopped at a problem that Randi would somehow rouse herself to solve.

On one occasion, we came to a wall a meter thick which had cracked enough to let gas pass through. Sam's acoustic radar showed a big cavern on the other side, so, somehow, we dug our way through. For all its talents, Sam was not built for wielding a pick. I leave this information to the designers of future cave exploration robots.

Randi and I swung at that wall in five-minute shifts for a three-hour eternity, before, in a fit of hysterical anaerobic energy, I was able to kick it through. We were too tired to celebrate—we just grabbed the line as Sam went by and tried to keep awake and living as it pulled us through another cave and another crack.

In one of a string of ordinary crystal caverns, we found another alien piton. Randi thought it might be a different design than the one we had found before, and had Sam pull it out and put it in a sample bag, which

we stored on Sam— the most likely to survive.

I mentioned this because we were near death and knew it, but could still do things for the future. Everyone dies, I thought, so we all spend our lives for something. The only thing that matters at the end is: for what? In saving the piton, we were adding one more bit to the tally of "for what?"

This was almost certainly our last "night" in a tent. I think we both stunk, but I was too far gone to tell for sure. We'd gone for thirty-seven hours straight. Sam said we were within three kilometers of the surface, but the cavern trail lies parallel to this surface, and refused to ascend.

In theory, our catalyst was exhausted, but we continued to breathe.

Another quake trapped me.

Randi was in front of me. Somehow, she managed to squeeze aside and let Sam by to help. Sam chipped clathrate away from my helmet, which let me straighten my neck.

As this happened, there was another movement, a big slow one this time, and the groan of Miranda's tortured mantle was clearly audible as my helmet was pressed between the passage walls again. I could see the passage ahead of me close a little more with every sickening wave of ground movement, even as I could feel the pressure at my spot release a bit. But the passage ahead—if it closed with Randi on this side, we were dead.

"Go!" I told Randi. "It's up to you now." As if it hadn't always been so. I was pushed sideways and back again as another train of s-waves rolled through. Ice split with sharp retorts.

Sam turned sideways in the passage, pitting its thin composite against billions of tons of clathrate.

Randi vanished forward. "I love you," she said, "I'll make it."

"I know you will. Hey, we're married, OK?"

"Just like that?"

"By my authority as a man in a desperate position."

"OK. Married. Two kids. Deal?"

"Deal."

"I love you again."

Sam cracked under the pressure, various electronic innards spilling

onto the passage floor. I couldn't see anything beyond him.

"Sam?" I asked. Useless question

"Randi?"

Nothing.

For some strange reason I felt no pressure on me now. Too worried for Randi, too exhausted to be interested in my own death, I dozed.

There was definitely CO<sub>2</sub> in my helmet when I woke again. It was pitch black— the suit had turned off my glowlamp to conserve an inconsequential watt or two. Groggy. I thought turning on my pack would help my breathing, vaguely thinking that the one percent weight on my lungs was a problem. To my surprise, I could actually turn.

In the utter dead black overhead, a star appeared. Very briefly, then I blinked and it vanished.

I continued to stare at this total darkness above me for minutes, not daring to believe I'd seen what I thought I'd seen, and then I saw another one. Yes, a real star.

I thought that could only mean that a crack to the surface had opened above me; incredibly narrow, or far above me, but open enough that now and then a star drifted by its opening. I was beyond climbing, but perhaps where photons could get in, photons could get out.

Shaking and miserable, I started transmitting.

"Uranus Control, Uranus Control, Wojciech Bubka here. I'm down at the bottom of a crack on Miranda. Help. Uranus Control, Uranus Control. ..."

Something sprayed on my face, waking me again. Air, and mist as well.

I opened my eyes and saw that a tube had cemented itself to my faceplate and drilled a hole through it to admit some smaller tubes. One of these was trying to snake its way into my mouth. I opened to help it, and got something warm and sweet to swallow.

"Thanks," I croaked, around the tube.

"Don't mention it," a young female voice answered, sounding almost as relieved as I felt.

"My wife's in this passage, somewhere in the direction my head is pointed. Can you get one of these tubes to her?"

There was a hesitation. "Your wife."

"Miranda Lotati," I croaked. "She was with me. Trying to get to the surface. Went that way."

More hesitation.

"We'll try, Wojciech. God knows we'll try."

Within minutes, a tiny version of Sam fell on my chest and scuttled past Sam's wreckage down the compressed passage in her direction, trailing a line. The line seemed to run over me forever. I remember reading somewhere that while the journey to singularity is inevitable for someone passing into the event horizon of a black hole, as viewed from our Universe, the journey can take forever.

What most people remember about the rescue was the digger; that vast thing of pistons, beams, and steel claws that tore through the clathrate rift like an anteater looking for ants. What *they* saw, I assure you, was in no way as impressive, or scary, as being directly under the thing.

I was already in a hospital ship bed when they found Randi, eleven kilometers down a passage that had narrowed, narrowed, and narrowed.

At its end, she had broken her bones forcing herself through one more centimeter at a time. A cracked pelvis, both collarbones, two ribs, and her remaining ankle.

The last had done it, for when it collapsed she had no remaining way to force herself any farther through that crack of doom.

And so she had lain there, and, minute by minute, despite everything, willed herself to live as long as she could.

Despite everything, she did.

They got the first tubes into her through her hollow right boot and the plastiflesh seal of her stump, after the left foot had proved to be frozen solid. They didn't tell me at first—not until they had convinced themselves she was really alive.

When the rescuers reached Cathy and Nikhil, Cathy calmly guided the medic to her paralyzed husband, and as soon as she saw that he was in

good professional hands, gave herself a sedative, and started screaming until she collapsed. She wasn't available for interviews for weeks.

But she's fine now, and laughs about it. She and Nikhil live in a large university dome on Triton and host our reunions in their house, which has no roof—they've arranged for the dome's rain to fall elsewhere.

Miranda, my wife, spent three years as a quadruple amputee, and went back into Miranda the moon that way, in a powered suit, to lead people back to the Cavern of Dead Ends. Today, it's easy to see where the bronze weathered flesh of her old limbs ends and the pink smoothness of her new ones start. But if you miss it, she'll point it out with a grin.

So, having been to hades and back, are the four of us best friends? For amusement, we all have more congenial companions. Nikhil is still a bit haughty, and he and Cathy still snipe at each other a little, but with smiles more often than not. I've come to conclude that, in some strange way, they need the stimulation that gives them, and a displacement for needs about which Nikhil will not speak.

Cathy and Randi still find little to talk about, giving us supposedly verbally challenged males a chance. Nikhil says I have absorbed enough geology lectures to pass doctorate exams; so maybe I will do that someday. He often lectures me toward that end, but my advance for our book was such that I won't have to do anything the rest of my life, except for the love of it. I'm not sure I love geology.

Often, on our visits, the four of us simply sit, say nothing, and do nothing but sip a little fruit of the local grape, which we all enjoy. We smile at each other and remember.

But don't let this studied difference of ours fool you. The four of us are bound with something that goes far beyond friendship, far beyond any slight conversation, far beyond my idiot critiques of our various eccentric personalities or of the hindsight mistakes of our passage through the Great Miranda Rift. These are the table crumbs from a feast of greatness, meant to sustain those who follow.

The sublime truth is that when I am with my wife, Nikhil, and Cathy, I feel elevated above what is merely human. *Then* I sit in the presence of these demigods who challenged, in mortal combat, the will of the Universe—and won.

*The author would like to acknowledge the inspiration of Fritz Leiber ("A Pail of Air"), Hal Clement (Still River) and, of course, Jules Verne (A*

Journey to the Center of the Earth).

**The End**