

Quantum Ignition

Growing Up (outtakes 2)

Bob Cox

Author's Note

These fragments are excerpts from the first draft of my sequel to *Quantum Ignition: Earth and Moon*. The action takes place in the decades following the conclusion of the first novel, starting with Lilliana's meeting with President Riley a few days after her UN speech. My plan for this book was to tell the story of the growth of the Luna Concord from minor colony to powerful nation.

The chapters included have been excised from the sequel, which is going in different directions. The outtakes included in this manuscript are the personal stories of two girls (not Lilliana's twin daughters) who are being trained in the "Next Physics". However, the events described herein are still relevant and part of the *Quantum Ignition* universe.

The sequel novel is now tentatively titled *Quantum Ignition: War of the Anas*. Not all of my first draft has been relegated to these outtakes. Several chapters are being worked into the new book, which will have a grander scope than my original plans.

Bob Cox — May 2024

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Kamaria's Climb [2079]

Author's Note

Kamaria Parvin and Samaya Regas are two girls, children of Lunar immigrants, who showed the remarkable mathematical talent needed to be trained in the Next Physics. Kamaria was an abandoned orphan about two years old, found crying in an alley in northern Afghanistan by the Parvin family just before their departure for Luna. Samaya, at the time of her family's emigration from Australia, was about four years old. In 2079, Kamaria is (will be?) 16 years old and Samaya is 14.

At this juncture, Lilliana's daughters, Ana Phoebe and Ana Blanca, are 26 years old, and fully established as scientific equals of their mother. Ana Phoebe is married to Dr Emily Williams, Ana Blanca's close collaborator in the application of the Next Physics to medical science.

More about the history of all these Anas will be in the revised sequel, *War of the Anas*. Also see the Timeline in the attached Appendix to this volume.

Kamaria - The Getaway

All I had left from my mother was a note, hand written with her usual precision: "*No worst, there is none.*" A quote from the depressive poetry she had been reading the last few months.

It was horrible. She'd somehow managed to get into an inter-hab tunnel and then hanged herself with some fine wire. Suicide was difficult on Luna, but she had managed it. The security officer who found her told me they were only a few moments too late to save her.

I was alone. My father had run away from Luna back to Earth years earlier. I didn't know what to do. I didn't know what to feel. I didn't even know how to think any more.

Everyone was good and kind to me. Ana Lilli said I should come live with her and her husband Ed in Hab A. Phoebe told me, "You're my little sister, Kami. Emily and I want you to live with us." It was tempting. I loved Phoebe, who had spent so much good time with me and Samaya.

My best friend Samaya hugged me, but she didn't know what else to do. Her parents said I should come live with their family, it would give me life. It was another tempting offer. The two younger Regas children were fun and might help distract me from my bleak and empty thoughts.

My thoughts. My feelings. Gloom. Despair at times. My brain didn't work. Just a few days ago I'd been planning a project to prove my place among the Anas, to be the first Ana not from Lilliana's family. I had been ready and eager to do something useful. Now I could scarcely bring any mathematics into my mind. The math that I loved and had been learning since I was two sometimes seemed like an alien language to me when I tried to focus.

I talked to a therapist, Abby Kranish. She listened and asked questions, gently. She taught me some practices to help when my feelings overwhelmed me into paralysis. The most important things Abby told me were, "Kamaria, you will find your way back. In time. It takes time to get your feelings organized again, to get the right way *for you* to think of what's happened. I know you are a mathematical genius, but you are still just a person otherwise, and a young person. You can't calculate your way out of this. You have to *live* your way out of it." I wasn't a mathematical genius, not like Phoebe, but otherwise I understood what she said. Understood in my brain, but not in my "gut".

Too much compassion. I had to get away, I had to learn to think again, to plan again. Without distractions, without concerned people hovering over me. I chose the Shaft City. Aariz, they called it.

Some of the huge volume of rock being transmuted into Luna's atmosphere came from vast shafts sunk into the crust. Each was 1 kilometer across and at least 20 kilometers deep. Aariz had been built around the first of these shafts: 63 levels, 314 meters apart vertically, and a 200 meter cap at the top. A vast spiral ramp rose from bottom to top around the perimeter, and at each level were gateways to cultural hubs carved back into the rock. I could wander between the different cultures and be lost. Which is just what I was already — lost.

Ana Phoebe

“Let her go”, was the advice we got from Dr Kranish. “At least for a month, or two, or three.”

I didn't like it. She was only 16, and she was vulnerable. Sure, her identity ring could summon help in an instant if she was in danger or hurt. But it was emotional harm, not physical harm, which I was afraid of. Even before this terrible event, Kami had been shy and introverted with anyone she didn't know well. How would she function in the still growing wild mix of the Shaft City? Groups which set up their own semi-isolated colonies to preserve their “lifestyles” and “cultures”. The whole place was a social experiment, approved by the Psych Branch of the Concord. Was it better to mix all different groups up in the residential hubs or to let them segregate themselves (within reason)?

Emily convinced me to let Kami go. It wasn't easy for me. Kami was only 10 years younger than I was, but in my mind she felt younger than that. Emily said, “What were you and Blanca like when you were 16 years old?”

I thought, and said, “We both wanted to make our marks, to do something different than Mama, to establish ourselves as separate people. Not just as ‘junior-grade Ana Lillis’.”

Emily answered, “That's what Kamaria wanted before her mother's death. That's still there, mixed up with her tremendous sudden loss. She has to untangle these feelings herself. Abby might help her. This trip might. She can get some self confidence in her dealings with the kooks, the dedicated, and the just plain different people which she'll find in the Shaft. She'll be okay, Pheeb.”

I said, “I'll keep an eye on her. How about that?”

Emily reacted sharply, “No! Don't spy on her. She's a young woman now, not a little girl to be protected from bruises. You're too wrapped up in her, rightly so, to be a helicopter ‘mom’.” Then she had to explain that term to me. We didn't have helicopters on Luna. Oil Age noisy flying machines.

So I didn't try to interfere when Kami just up and left. She translocated to the bottom level in the Aariz Shaft, carrying only a few things with her in a belt pocket. For the first time I really registered that she was taller than I, and that she was lovely. I hoped she'd find what she needed.

Kamaria - The Shaft

The Aariz Shaft surprised me with its beauty. I arrived at the center of the shaft, on a large gray fused rock circular floor, stretching 500 m from the translocator in all directions. Where to go? Before I could figure that out, I looked upwards — into infinity. Above me was a transparent ceiling, and above that the shaft: 20,000 meters high, my view tapering away as I looked up, up, up. There were rings around the shaft spaced evenly apart. I thought, “Those must be the platforms at each habitat level.”

Between the rings, the vertical walls of the shaft glinted, reflecting the lights which ran vertically in an interlacing double helix to infinity.

But ... where to go? I looked around. The walls were too far away to make out any details. I should have brought binoculars!

I suddenly realized the floor near me had some markings, things I'd barely seen at the periphery of my vision. There were two big arrows pointing in opposite directions. "Ramp A" was lettered inside one of them, and "Ramp Z" inside the other. Someone's idea of a joke. Then I got it — Ramp A paralleled one of the light helices, and Ramp Z the other.

The old me might have pointlessly agonized over the choice of "A or Z". Now, I didn't care. I chose "Z" just because, and followed the arrow. Now and then I stopped to look up at the shaft. Really, there should have been a sign labeled "Warning: Looking up may cause neck problems". And another one saying "Warning: Do not attempt to walk while looking up". Twice I failed to keep my balance while looking up in the middle of a low-gravity bouncing stride, and I stumbled on landing. At least falling in one-sixth gee isn't painful, even onto a fused rock floor.

Suddenly I realized that in the last few moments my bad thoughts had gone on a mini-vacation. Being in this new place and trying to understand it gave me a temporary lift. With that perception, the negativity flooded back. What was the point of going on? Why had my mother given up? Why had she left me? **Why had she left me?** I must have failed her.

I stopped short of the wall and breathed deeply, slowly, like Abby had suggested. It helped. The despair didn't go away, but it seemed a little less overwhelming. I looked ahead, and saw the opening to Ramp Z ahead of me and to the left. I'd gotten a little off course, but the brightly lit passageway was easy to spot, especially with the big "Z" in lights over the entrance.

The ramp sloped up steeply, but in Lunar gravity it was easy climbing — the floor was rough, and provided solid friction. Up and up, slowly turning clockwise. When I got up a little ways, the inside wall of the tunnel I was in changed from rock to transparent. I was above the ceiling of the bottom and now I could look out into the shaft as I walked.

Up and up in space. I trudged slowly, not in any hurry, not going up in mood. Neither the mild work of climbing nor the impressive view to my right were enough to break me out of my cycle of gloom, then despair, then 'what should I have done differently', then 'why me?'. Step/hop, step/hop, step/hop. I noticed markers along the wall, saying how high I had climbed: 50 meters, 100 meters, 150 meters — almost halfway to level 1 at 314 meters up. What was the point of going on? I'd certainly never be a true genius like Phoebe. I'd failed as a daughter. What good was I?

Then I remembered another tip from Abby Kranish: hard exercise involving motion. I started to run/skip up the slope. Luckily, they'd planned the ceilings for this, so I didn't hit my head. Although I supposed the pain would be another way to knock my brain out of the doom loop. I wasn't in such good physical condition, and was breathing hard. That *did* give me something else to think about. Legs burning. Air coming in and out, in and out, heart pounding, cheeks flushed.

I arrived, gasping, at the first level. My breathing slowed down and I looked around. There was a wide platform circling the shaft. Except for the "Z" over the entrance to the ramp, there were no signs. Were there other people here? Where to go? I shrugged, and turned left, walking anti-clockwise. About 10 steps along, I found a vending machine, like ones scattered all over Luna,

resupplied by a small internal translocator. Simple foods and other items could be obtained. Next to it was a water dispenser. Beyond was a small door which led to a washroom.

Well, those last two things were useful. I hadn't thought to bring water, and after running up the ramp, I needed it. Of course, I hadn't thought to bring anything to *put* water in, either. But the vendor gave me a nice one liter bottle, for 10 credits. I didn't worry about credit, I had plenty from my studies. In addition, I'd inherited some from my mother. Normally, Luna didn't allow credits to be inherited, but an exception was made for children — which I still was, legally.

Water when you are thirsty and dry-mouthed is the best thing. I actually felt good again, for a little while. I used the washroom, got a food bar from the machine, and plodded around the platform. The food bar didn't have much taste, but I had just taken the first one listed. I didn't have the mental energy to choose something which I actually liked.

The next noticeable thing I came to was a pair of metal doors, each one 6 meters high and 3 meters wide, in the outside wall. There was nothing to tell me what was beyond. I was on a journey of discovery, so why not? Except the doors wouldn't open. "Nobody home," I said to myself. Maybe an empty hab would have been a good place for me to sit and brood. I could get food and water from the vendor, and otherwise do nothing.

"Stop it!" said the voice in my head which came from my therapist. She was right. I'd check out the rest of this level, and go on up if there weren't any habs here yet. I knew there were some projects here, but also knew that the Shaft City was still partly empty.

Around I went. Looking out at the shaft. Looking at the walls, the floor, the ceiling. There wasn't much to see. Wait, another pair of doors. Also non-opening. Then another pair of non-functional doors. Then I was back at the ramp opening. Already? It should have been over 3 km around the platform, and I hadn't walked *that* far. Or had I?

Idiot. This was Ramp A, 180 degrees opposite my own Ramp Z. Just beyond, another vendor and washroom door. The setup made sense. There would be three more pairs of doors, then I'd be back to where I started. If none of them led anywhere, I'd march up to level 2. At least I wouldn't starve.

My mind was trained for planning, and I used that to plot out the dreariest scenario. I'd climb all the way to the top, 62 more levels, finding nothing but closed doors, vendors, and washrooms. I'd have to walk down all the way back to the bottom to get to the translocator and give up. Maybe I could just live on the landings, wandering up and down the levels. I could get clothes or towels from the machine, pile them up, and make a bed. The Phantom of Aariz — I would become a legend.

Except I didn't have to keep climbing that day. The last pair of doors was surrounded by garish and weird paintings on the wall's smooth rock face. Distorted human figures, skeletons, flowers, flames, and so on. Whatever was inside, it would be different from anyplace I knew. Which is what I told myself I wanted.

Kamaria - The Stoners

The hab was not exactly what I expected. It was a circle about 200 m across, a very common size, but the roof was low, only about 50 m high. There were titanium column supports for the roof. Modern habs used force generators instead of columns to provide support to back up the titanium cap, in case of rock fracturing and local collapse.

There were no real buildings. Just a few large tents, which seemed to be sewn together from smaller patches of many different colors. The place seemed kind of empty.

Closing the doors had made a noise, and a few people lounging around the nearest tent looked over at me. A woman got up and came over, loudly proclaiming, “Hey, a new dropout has dropped in!”

She greeted me, “Hi. Here my name is Candy. Because I’m sweet. What’s yours, honey?”

I said, “No, my name’s not Honey, it’s Kami.”

Candy laughed so hard she bent over for a moment. Then she said, “Of course it is. Welcome to Hippie Land, Kami honey. Everyone here is running away from something. If that’s you, this is the place. Relax, get high, do your own thing. Kick in some help now and then, or some credits when we need something from the machines. Peace, sister.” She flashed a two-fingered V at me.

I wanted different. This was different. I asked, “Where do people sleep? Are there any houses?”

Candy laughed again, not so hard. “No houses. We make what we need here, from what the machines supply. Those tents — we sew them together from towels. We live on minimum support credits from the Concord. We don’t bother them otherwise, and they don’t bother us. No pigs here.” That last remark left me confused.

She motioned to me to walk with her. “Come meet the welcoming committee. Not that we’ve gotten many visitors to welcome just yet. The Shaft is pretty new.”

I was introduced to Stan, Bud, and Flower. There was a sweet-acrid smell around them, and Flower handed me a smoking paper tube. I’d seen these in videos — a cigarette. I said, “Smoking, on Luna? Where do you get tobacco?”

More laughing. They seemed to laugh a lot. Flower said, “Not tobacco. Cannabis, honey. Chills you out. Take a puff, but don’t suck it in too hard, or you’ll start coughing. Takes getting used to.”

It did indeed, and I coughed anyway. In a few seconds, I started to feel strange. Relaxed, unfocused, not caring much about anything. Candy looked at me and said, “Whoa, that hit you fast. First time? Oh, of course for the first time. Where would a kid like you get emjay on Luna? Honey, sit down and let yourself float.”

My mind and feelings floated. It wasn’t bad; in fact, it was good. My brooding thoughts were muted way down, and they just didn’t seem to matter. Everyone around me looked good, and the garish patchwork tent had become beautiful. Candy offered me the cigarette again, and I took in another puff. Everything seemed even easier and nicer.

The first few days there were like that. I “chilled out” and felt a little better. Worry about the future? Why bother? Live hour to hour. Stay a little high. Not too much, though. I was cautious enough to smoke only a couple puffs, two or three times a day.

At night, I tried my tricks to help sleep come back when I woke too early. Math tricks, like thinking about semi-primes. Or about my favorite physics subject: electromagnetic field theory — Maxwell’s equations, quantum electrodynamics, the Next Physics. It didn’t work. I mean, I couldn’t summon up the math. I couldn’t center my thoughts.

I wandered through the five habs they had. People lived in tents, or even out in the open — there wasn’t any weather. How they lived made sense to me. Why did we need buildings to live in?

We controlled the atmosphere and surroundings. None of that chaos which people had to endure on Earth, which I barely remembered.

There were some crops growing in vertical racks — I recognized a few of them. There were some colorful flowers I'd never seen before. Candy told me those were Stan's. He hadn't seemed the lover-of-beauty type. Frankly, he'd struck me as a crude jerk, like a lot of the men and some of the women. His only positive trait was that he actually cared about keeping their habs organized and functional.

I noticed some tech as well. Vendors in each hab. One translocator in the entry hab. Also, what looked like a digging machine, against the back wall of an inner cave.

I talked to Stan and Candy, who seemed to be in charge as much as anyone was, about expansion. "Why don't you spread out more? Dig some more habs?"

Stan said, "It costs credits to dig. Or at least, it costs credits to make the result livable: energy, water, lights, washrooms, and so on. A Concord tech has to come out here to install the tech for those things, and they charge us. We have better things to spend our credits on. We only get the subsistence level pay." I mentally calculated that at about 80,000 credits per year, per person. Plenty for food and minor items.

Candy added, "I don't know why the hab digging machine can't make those things when it builds the cave. It builds the metal cap and support columns automatically, and even sets up the washrooms and lights. They just don't work until the tech comes out."

They lived on Luna and they didn't know anything about how the technology worked, the technology they depended on for life. I didn't want to say too much, but I answered, "I think the tech has to install some working Ana tech chips. Those have to be brought here and ignited. They can't be made here, and most of the time can't be translocated while they are ignited and working. I guess you are paying for the tech's time and the cost of the chips. How much does digging and setting up one new hab cost?"

Stan said, "Digging is about 20,000 credits, at least that's what I remember, and the setup is about the same. We've only done it once, so I'm not completely sure now. If we knew how to run the digging machine, we could cut the cost in half." It didn't seem so much to me. If they didn't consume all their subsistence pay, the leftovers could be pooled to finance the expansions. I made a mental note to ask Candy or Flower about that idea.

That evening, as we cleaned up after eating, Candy asked, "Kami, honey, are you going to stick around? If so, everyone has to contribute. What can you offer?"

I'd been thinking since our conversation earlier, and said, "You mean work? I guess I could help with the farming, and with meal prep. If you want to build a new hab, I think I could figure out how to use the digging machine. At least, I've seen them being used."

Candy stared at me. "You have? What did you do before running away to here? I won't ask you why you are running, that's not my business."

I'd prepared an answer to her question. "A few months ago, I met someone who worked on hab construction. He let me ride along a few times. The digger operation isn't so complicated. The machines mostly run themselves, but some care is required in case something unusual happens with the rock being removed. Of course, it's important to pay attention and keep track of what it's doing." All this was true. It just wasn't the whole truth.

Later, Candy talked to Stan, and they came back together. Stan said, “Kami, let’s me and you take a look at the digger tomorrow. I know there are some instructions there, but I didn’t understand them very well. Maybe you can.”

I skipped the usual cannabis puffs in the morning. Stan, Candy, and I walked back to the digger, and opened it. I hopped into the seat, and looked around. Different than the ones I’d seen, but mostly just simpler. The technical manual inside told how it was designed to build a single size and shape of hab. There weren’t many options — location of the water outlets, washrooms, and passageways to neighboring habs were the important ones. There were some terse instructions on how to maneuver the digger as it operated, and what to look out for. Nothing difficult, if someone knew a little about it already.

I said, “I can run this, but when I’m done, we’ll just have a dark cave with soil ready to plant. No water supply, no air circulation, no vendors, no working washroom, no electricity. This hole won’t be much use until the Qcoh chips for those things are brought here, ignited, and installed by a Concord tech.”

Stan and Candy looked at each other, then Stan said, “If we get the chips, can you do all that and get them working?”

What the hell? Get the chips? I said, “No, we don’t have the equipment here. Not even the instructions for that part of the job are given. How would you get the chips?”

Candy grinned, and Stan just rubbed the side of his nose once with his index finger. Some private code? Did they think to steal Qcoh chips? Nothing more was said.

I was still worrying after supper. A puff or two would help me relax. I didn’t need anything more to worry about. Flower was sitting with me, and passed a “joint”, as they called the cigarettes. She said, “You know, Kami, you should be careful around Stan. He’s looking at you in a way I don’t like.”

I could feel the floating sensation start, and my worrying receded. I answered, “Oh, I can take care of myself. But thanks, Flower.”

She shook her head. “You’re letting the dope talk, which is always a mistake. Stan is the controlling type, and takes what he wants. That’s why he’s the closest thing we have to a leader. No one else cares very much. But he’s a lech.” Not a word I knew, but I didn’t ask what she meant.

I didn’t worry. It was so nice not to agonize, even if I needed some pharmaceutical help. That’s what it was, I said, medicine. I felt I’d found a place here. I could cut the costs of their new habs in half, and they’d be grateful. I could drift along, lightly doped, and stop obsessing about my failures in life.

The next day, Stan and I had a discussion about digging a couple new habs. He said, “We can pool our moola and pay 40,000 to get two habs up and running.” (‘Moola’ meant credits, I gathered.) “Let’s go to the digger and plan what you’ll start on.”

There wasn’t much to plan. I offered to start the digger up and make a small part of a new hab, partly to show him I knew what I was doing, and partly to reassure myself that I could do it.

It wasn’t difficult. Going slowly, in a few hours I had a tunnel to the new cavern, and had carved out a 40 meter portion of the hab-to-be. I stopped there, and walked back through the tunnel. “Come and see. There’s no point in building more now. It’ll be too dark to use. There’s a little light from this hab and digger which we can see by. I’ll get a headlamp from the vendor to help.”

Inside the dark cave, Stan looked around, and whistled. “This is great, Kami. How long would it take you to finish?”

I said, “A trained digging tech could do it in a few hours, but I’d go slower and take several days. It’s my first time.”

Stan had a strange intense expression. He said, “Say a week per hab. We could string some power in here ourselves to give some light. Maybe fake up some pipes for water, some fans for air movement. We could start planting things and making products to sell. Right now we consume most of what we can grow. Let’s see, one new hab next to each old hab. Yes, we could do well. We’ll make a good team, Kami, you and me. I can organize things, get these stoners working a little harder, and you’ve got the smarts to get the setup running. And you’re damn beautiful, too.”

I was confused, really confused. “Grow crops? You can’t compete with the existing farm habs and their equipment. What would you sell? I’m not even sure you can get enough light into these dark habs to get plants to grow.” I didn’t know what to say to his final statement, but that was the most disturbing thing I’d heard.

Stan laughed. “The Concord doesn’t grow everything that we grow. Cannabis and opium. We can sell these in the right places. Or trade them for what we want, since the Concord’s computers won’t allow credit transfers for unregistered products. Customers will buy things for us, and we’ll give them things in return. Everyone’s happy. I’d like to grow coca as well, but that’ll have to wait. I don’t know how to refine cocaine from the leaves, at least in detail. Opium is easy.”

I must have looked shocked. Stan looked at me, and smirked. “Supply creates demand, sweetie.” In one motion, he stepped forward, grabbed me, and kissed me hard. Holding me close against his body.

It’s hard to react to something you’ve never prepared for, thought much about, or experienced. I was just stiff. Not scared, at first. Until his hands behind me started wandering, mostly down. That accelerated me, and I shoved him off. At least, I tried to.

“Kami, Kami. We’re right for each other, the only two smart people here. Don’t worry. I can tell you ran here because of some troubles, things keeping your mind in the wrong place. That’s over. Here, you’re safe. You’ve got me, you’ve got sweet emjay. Life will be great, the two of us together.”

He was right, I *was* running. But not to *this*, not to *him*. I managed to break free, or maybe he let me go. I stared at him, but couldn’t think of anything to say. I was in a mental loop, but not the worry and doom loop — it was an anger and fear loop. I was almost paralyzed, but snapped out of it. I had to get out. To go *now*.

Luckily, I was the one closest to the opening. I turned and ran/skipped down the tunnel, the fastest way I knew to move. I didn’t look back to see if Stan followed me. I raced through the neighboring hab and out into the entrance hab. “Go go go,” I kept thinking. Not really thinking, though: feeling.

Flower and Candy stared at me as I raced in, breathing hard. Flower said, “What’s wrong, Kami? Something happen with the machine?” I stopped. I had to get my stuff and leave.

Candy said, right after Flower, “Is Stan okay? Where is he?”

Some of my breath caught up with me. I blurted out, “Stan’s not okay. He grabbed me, kissed me, felt me. He wants me to help him sell drugs. I’m getting out of here.”

Flower shook her head, and turned to help me gather my few things. Candy said, “He what!? That two-timer. You led him on, you whore! Get out, get out,” she almost screamed. Then she rushed away, back the way I had come. I looked after her, and saw Stan coming into the hab at a normal loping pace, laughing.

Flower said, “She’s right, Kami. Get out. This hab isn’t a good place for you. Leave. Stan won’t follow you. If he does, use your ID ring to get help. But he won’t. He’s afraid of Security.” She added, “As he should be. I’m pretty sure that when he starts trading opium, the hammer will fall. I think I’ve packed all your stuff up. So long, Kami. I really wish I could get to know you better.”

I gave Flower the headlamp I was still wearing. I didn’t have time for anything else, since I didn’t want Stan to catch up with me.

Kamaria - The Shaft

Up up up again, as fast as I could. I didn’t want to rely on Flower’s confidence that Stan wasn’t following me. Ramp Z again, since it was closest. I kept looking back and listening, but there was no one else. I calmed down a little.

This was all my fault, like everything else. I showed off my knowledge, and look what it got me. I must have done something to lead Stan on. But what? Was there any point in going on, when I failed at everything?

I stopped at the level two platform. Deep breaths, deep breaths. Calm yourself, Kami. I remember Aunt Penni talking to me about being a woman among men. “No matter what you do or don’t do, if they act like assholes or worse, you didn’t cause it. *Do not blame yourself.*” Then she’d offered to show me how to break someone’s arm. “It’s not as hard as you might think,” she’d said. Maybe I should have taken her up on the arm breaking lessons.

I laughed at myself then. Should I have broken Stan’s arm? Not really. Actually, I did pretty well in the moment. I got away clean, and seemed to be safe now. Okay, I was feeling a little better. I took stock of my situation. First things should be first. At the nearest washroom, just anti-clockwise, I cleaned up. A nice warm shower washed the feeling of Stan’s hands off of my body. I filled my water bottle, got an extra pair of food bars for “just in case”, and headed around clockwise. On level one, I’d walked anti-clockwise around 90% of the platform before I’d found the open hab, so I’d be cleverer this time.

Nothing. All six doors were sealed. No decorations, no sign of humanity. I did notice one thing I must have missed on level one. There was an extension of the platform several meters out into the shaft, and an airlock to gain access — just the type used for accessing a flying hab. The vast shaft must be filled with the gas mix being created for the surface, much thicker than the pressurized Earth-type air everyone breathed underground. The surface air was designed to be breathable when it was only under the pressure made by the low Lunar gravity.

Did people fly in the Shaft? I looked out, but didn’t see anything. This space was so vast compared to the flying habs. Soaring in there would be like being a bird on Earth: wide open space around me, up and down and sideways. I wished I had learned to fly. The feeling of potential ecstasy at my bird-vision changed to gloom again — another failure of mine.

Level three was empty also. I *knew* there were other groups in Shaft Aariz, not least from something Candy had mentioned. Something like a zoo? I continued upwards.

The first pair of doors on level four had a sign: “Welcome to the Monkey House”. This must be what she had meant. I hesitated. The last place, “Hippie Land”, hadn’t been such a good idea. Maybe I should just go home, go back to Dr Kranish and back to my friends.

No. I was here, but I wasn’t quite ready to go in. I had to think. What was going on with me?

At first, I’d liked the worry-banishing effect of the cannabis. I’d felt relaxed and capable of doing anything. But I couldn’t think about math in any real way. Almost my earliest memories were of playing math games with Blanca and Phoebe — good memories. I couldn’t let that part of me be erased.

Why had my mother fallen so far? Yes, my father had run away back to Earth, but it had been eight years ago. Was she afraid of losing me to Ana Lilli, Phoebe, and Blanca? In the last two years I’d spent so much time with them, but she understood — at least, I’d thought she understood. I should have been closer to her, helped her.

I was so mixed up. I was guilty of not seeing what was happening to my mother, because I was so focused on mastering the Next Physics — and I was so close to that goal. I was proud of what had kept me away from being close to her. Becoming an Ana was the greatest thing in my life, and it had destroyed my life. How could I go forward? Or should I go sideways, and give up science? I didn’t have answers.

My thoughts and emotions came to a dead end, or to a limit cycle. Okay, a simpler question. Go into the “Monkey House” or go farther up? That was easy.

Kamaria - The Great Apes

The doors opened to a long tunnel, at least 100 meters. As I walked, I got heavier and heavier. On Earth, this would have been weird and scary. Here, it was just the gradual transitioning to a change of gravity. Up to half of Earth’s one gee, I guessed from the feel of it.

At the end of the tunnel, I expected a hab with living quarters of some sort. Instead, it was set up mostly like a single big office space. When I got there, a young man came over and said, “Namaste. Are you here to volunteer?”

I said, “Actually, I’m climbing the shaft, and I don’t know what to expect or to find. Volunteer for what?”

He answered, “This project is to build a replacement habitat for the great apes of Earth. We can use volunteers to help make our habs into spaces they can live in. If you want to join us, Director Brooke can fill you in.”

Brooke was an intense man, with dark hair and an educated British accent. He started off with what seemed like a prepared speech about their project. “The great apes of Earth are dying off. Their remaining living spaces are being destroyed rapidly.” “Our long term goal is to build wild habitats back on Earth in which the surviving apes can flourish.” “Our short term goal is to establish populations here on Luna.” “At first, we’ll have to feed them, as is done in wild animal parks. Something like refugee camps.” “Orangutans are the worst off. Only a few thousand Borneo orangutans are left, and no Sumatran ones.” “My family has many contacts in Borneo, and I have made arrangements to bring as many orangutans as possible here, as soon as possible.”

I asked, “You’ll need a lot of space, and a lot of food. How can you afford this?”

He answered impatiently, “We have the backing of Ana Lilli for our project. As everyone knows, ‘What Ana Lilli wants, Ana Lilli gets’. So the Concord government supports us to a limited extent. They won’t charge us for setting up the Ana tech in hab spaces after we have built them. I converted my entire fortune on Earth to Lunar credits in this project’s account, which is another source of funds. We’ll get by, and I’m working on getting more resources from Earth conservation organizations.”

He added, “Do you want to help us? We are just starting up, and you would be one of our earliest volunteers.”

I’d never seen an orangutan in person, just pictures. They were beautiful and needed to be saved. I said, “Yes. At least for a time.”

Brooke said, “Fine. Good.” He spoke into his ID ring. “Message to Maya J. Please come to the HQ hab to meet a new volunteer.” To me, he said, “Thank you. James, the man who showed you here, will take care of you until Maya arrives.” And I was dismissed.

James and I chatted for a few moments, until Maya showed up. She introduced herself, and said, “James, I’ll take Kami around and show her what’s happening.”

As we headed to a tunnel, I asked, “Why is the gravity set higher here? For physical conditioning?”

Maya said, “Yes, but not for you and me. For the apes. The few orangutans here now haven’t adapted well to one-sixth gee. A lot of their lives are spent jumping around, and the change was too confusing. This half gee is a compromise which works for them and for us humans.”

We walked through a residential hab, and then into another tunnel. At its end was a door. Maya stopped. “Beyond here is our first hab for the orangutans — oh, and don’t call them oranges. It’s offensive to people from Malaysia. In this hab, we have some trees planted so the apes can have a semi-normal place to live. We still have to feed them, though. The trees don’t provide enough fruit yet.”

She waved her identity ring over a marked space on the door, and then pushed it open. Inside was humid and warm. There were some small trees around, nothing big. Maya said, “It will take decades to grow a proper environment. I feel sorry for the orangutans, making them live in this place that isn’t much better than a zoo. But the only other choice is extinction.”

“How many orangutans do you have on Luna now?”

She answered, “About 50, scattered between 5 interconnected habs. Fortunately, they don’t fight with each other very often. Unlike chimpanzees. We’ll have to come up with a different hab strategy for them. Right now, we are making more and more orangutan habs, and trying to make them marginally acceptable. There isn’t much time left on Earth for these apes.”

I asked, “What does ‘marginally acceptable’ mean? In particular, what can I do here to help?”

Maya shrugged. “At a minimum, you could plant trees, or work in the tree nursery. It’s too bad that Ana Lilli can’t just spin up full grown productive trees for us, but we can’t have everything handed to us on a platter. At least our hab digging machines are programmed to leave behind some towers the orangutans can climb. We hang ropes on them — those guys like to climb and swing around. That’s what I mean by saying it’s like a zoo, especially until the trees are in place and growing.”

She pointed out other features of the orangutan habs to me as we wandered through. “The fruit trees aren’t all what they are used to, but these species grow fast. Peaches, figs, and so on. The

beasts are adaptable.” She said “beasts” with a fond tone in her voice — clearly this was a work of passion for her. I envied that. I didn’t have the passion I’d had just a few weeks before.

I said, “If there are only 10 orangutans per hab, we’ll need hundreds of habs just for them. Can that be done? Where will all those habs go?”

Maya said, “Let’s talk about these things while we get some dinner.” Back in the residential hab, we went over to a structure which turned out to be a large sturdy tent.

I said, “Three levels down, they have tents, too. But they just sew theirs from cheap towels they get from the vendors.”

That made her laugh. “You were at the stoners’ level? A few of our guys go down there on their days off, but since they aren’t allowed to operate power machinery the day after they return, it’s not so popular. They trade food for dope, mostly. I don’t know any women here who have gone there more than once, though.”

I said, “I can understand why.” I didn’t say any more.

She shook her head. “I’m glad you got out of there. No one hurt you, I hope?”

“Not really. But it wasn’t nice.”

The tent was a dining hall. Maya said, “It’s pretty basic right now. Cafeteria style, with not much choice. Vegan. I hope it’s okay with you. Brooke is against exploiting animals.”

As we ate, she said, “We’ll need hundreds and then thousands of habs. Brooke has big plans. Plans which might not all be achievable in his lifetime. Right now, we have lots of limitations. Digging habs — we have three machines, and only five operators. If we had more operators, we could dig around the clock and expand faster. But then we’d have to grow more trees and plant them, which will take more space for the nurseries. Brooke convinced the Council to give him 5 levels exclusively. We’re allowed to build out five kilometers around our shaft, since the shafts are spaced 10 or 11 kilometers apart. That could give us about 300 square km of space. For a start.”

I said, “That’s about 4000 habs. I can see why you want to start digging faster. The whole enterprise strikes me as fantastic. Can it get done in time?”

“Fantastic isn’t the word I’d use, but ambitious certainly fits. Brooke thinks it very likely that the apes will never be able to go back to Earth. The people there have destroyed the forests, and they’ll never grow back. At least, not in our lifetimes. He wants to keep expanding to occupy all the levels of the neighboring shafts — and more. Basically, he dreams of establishing large permanent underground ecosystems here for the great apes and other species. Maybe even take over some of the spaces people abandon when they move to the surface.”

I couldn’t believe it could all be done. But perhaps at least the orangutans could be saved. I asked, “So what can I do?”

Maya said, “The practice is that all volunteers start on nursery and tree planting duty — at the bottom. So they can personally see what’s involved in our project. Then maybe move onto something else.”

I worked in the nursery in the mornings, and then on tree planting duty after lunch. The saplings weren’t hard to plant, as the manufactured soil wasn’t hardened. But it was tedious, and while doing one tree was easy, doing dozens of them was tiring. At first, I’d wake up a little sore in the mornings. In the nursery, the baby trees were lit up 16 hours per day to accelerate their growth. I had

to carefully inspect the leaves for potential problems, and make sure the saplings' water supply was correct.

I roomed next to Maya. She was easy to get along with, and she liked to cook — unlike many Lunies. She would take over the cafeteria kitchen to make Indian fare, “like my mother did, but not as good.” To me, it was hard to imagine that her mother’s food could have been better than Maya’s. Her dosas and parrottas with spicy flavorful fillings were wonderful.

Helping her in the kitchen, we talked about ourselves. I tried to disguise my past from her, but I’m not sure I succeeded. Cooking one of her mother’s recipes, she asked, “What about *your* mother, Kami? Isn’t she worried about you, wandering around alone?”

I answered, “No, she’s not worried now.” True, but also a lie. “I’m taking a little time off from my education. Trying to figure things out.”

She said, “You certainly seem like a bright kid. What are you aiming at, for the long term?”

For that, I didn’t have a good answer ready. “Oh, some sort of engineering or science, maybe. I’ve been studying a lot of math. That’s the key to everything.”

Fortunately, she dropped that line of conversation. Instead, she went on with, “Your week of servitude with the saplings is about over. Do you want to continue, or try something else? For example, after a hab is dug and turned on, there’s still some work to make it ready for planting. Hanging the ropes for the orangutans is one thing, but it doesn’t take much time. Laying the drip irrigation lines is more labor intensive. Sowing the seeds for the grass and other low-level plants is another perpetual task.”

Without thinking, I said, “Why aren’t the irrigation lines pre-manufactured by the diggers? Surely the digging software could have that little feature added. Doesn’t sound so hard.”

She didn’t notice that I’d just given myself away. Who but an Ana, or an Ana in training, would have any idea of how difficult it was to program the quantum software inside the digging machines? She just said, “Each hab gets a different layout, so the resulting forest won’t be the same everywhere. I guess that’s the reason, but I never thought about it.”

I was about to say it would be easy to allow the operator to input the desired layout for the irrigation system, but caught myself. I thought, “Don’t shoot yourself in the second foot, Kami — one foot is quite enough.” Instead I said, “Oh. I didn’t think of that. I just said the first thing which came into my mind. Not that I know anything about it, of course.”

A couple of days later, Brooke called me into his office. “Kami, Maya tells me you seem to know something about the diggers and how they work. Do you know how to operate one?”

I said cautiously, “Yes, in principle. I’ve ridden along with hab excavation operations, and seen how the machines are run. I even ran one a little bit, just once. Down on the stoner’s level.”

He laughed. “How did *that* go? Never mind. More than anything, I need more habs opened up. I’d like you to get checked out by one of our trained operators. If you measure up, you’ll increase our expansion rate by 20%. Which is not something at which we should sneeze.”

So my big mouth got me back at the controls of a hab digger. This one was a little more complex than the one the stoners had, but not much. Really, it just had more options in its software menus — whether to include washrooms, the type of soil to make, lighting options, and so forth. The basic shape was similar: 300 meter diameter, 50 meter ceiling.

It turned out James, the young man who had met me when I entered, was the operator who ran through the machine's controls with me. Afterwards, he said, "You seem to understand pretty well, but you don't have formal training. I'll tell Brooke we'll give you a tryout, if he agrees."

I asked him, "Where does Brooke come from? How is he so involved in this dream?"

James said admiringly, "It's an unusual story. His very English family governed the Sarawak state of Borneo for over a century, long ago. Not as rapacious white colonizers, either, unlike damn near every other place. From what I've heard and read, they were pretty good rulers. There were plenty of locals who didn't want the last White Rajah to leave, anyway. That all ended over a century ago, but he somehow inherited or invented a love of the place as it once was. He made a fortune on Earth, promoting uses of Ana tech in Europe. Then he cashed it in to fund this effort."

Two days later I was a hab digger. In a way, this was harder than the manual labor of tending for and planting saplings. At least, it required sticking to a schedule and discipline. I had to show up on schedule and work to a plan. After a week of this, it dawned on me that I was put on edge by working alone. Digging required paying close attention to a job that was fundamentally boring. There was no pleasant camaraderie of working side by side with others doing the same task.

I was treated with respect at the dining hall. More hab space was thought of as precious. Personally, I felt the tree growers and planters were more valuable. I was basically an advanced shovel wielder, whereas they were making the caves I dug into livable spaces for a species which would die out without their efforts. But I confess that I enjoyed the respect. While I worked and while I socialized, I felt better. Only when I was alone with my thoughts in my small room did the cycle of despair come back. Was this all I was good for?

But why did my mother hang herself? It wasn't easy to do on Luna, where she probably only weighed about 11 kilograms. I remembered what Abby had told me, "You might never know what drove her down so far. Most people who kill themselves don't leave clear reasons behind. That lack is making you lose all belief in yourself, Kamaria. Repeat this as often as you need to: *I didn't make this happen.*" She went on to talk about brain chemistry, but chemistry was Samaya's thing, not mine.

I took refuge by focusing on the Next Physics version of electrodynamics. Ana Lilli had harnessed it to make free electric power. But that was a bulk application. Surely something more nuanced, more subtle, could be done. Especially using Phoebe's reformulation of the mathematics. I tried to keep this topic in mind when lying in bed. Control of electromagnetism had changed the world in the 20th century. I was sure this field of physics wasn't played out yet.

For a month I dug hab caves five days a week. I refused to work more — after all, the standard work week on Luna was 4 days. Not that I was getting paid. I spent my days off doing a mix of things to keep busy, to keep my mind away from bad directions. Working in the nursery. Helping in the kitchen. And writing out math — always in the privacy of my room. I didn't want to explain myself, even to Maya. She had become my closest friend there, and I had to hide my notes from her when she dropped by to chat.

It all came to an end abruptly. Partway through digging a cave, as I maneuvered the machine forward for its next operations, the whole thing just stopped working. Power was totally dead. Even the computer which directed all the operations was off. The entire digger system had crashed hard.

While I walked out to tell Brooke about it, I thought, a little too much. I had a good idea of what happened. I ran into Maya on the way, and said, “The digger is broken down. I’m going to see Brooke. Want to come along?”

Brooke’s first question was, “What could have happened? We’ve never had trouble like this before. Could it be something you did?”

That stung, and turned me temporarily stupid again. “No, there’s no way I could turn the entire machine off so violently, even if I hit it with a shovel. The way it works, at its core is a set of Qcoh chips. They do the transmutations, the translocations, the shaping, and they provide the power for everything else. They must have quenched, which is why the whole system is dead.”

Maya said, “Quenched? I never heard of that. How could it happen?”

I knew too much, and said too much. “Once ignited, Qcoh chips are reliable, self maintaining. Unless perturbed violently at a quantum level. I guess that the device ran into some small but intensely radioactive spot which spontaneously aborted part of the quantum coherence, and then the rest collapsed. I don’t think this has happened before on Luna, but I know it has happened on Earth.”

They both stared at me. Oops. What I said was trivial physics, but it wasn’t common knowledge. I tried to brush it off by saying, “Brooke, you need to contact someone in the Concord. They can send a tech out to reignite the chips in the digger, or maybe replace them. I think we should leave the machine in place so their techs can survey that area to check what really happened. I’m just guessing, you know.” I tried to look innocent and ignorant.

Back in my tiny room, I sat on the bed, glum. I was sure I’d given myself away. Nearly the last thing I wanted was to be outed as a trainee Ana. The names Kamaria and Samaya were known, to let people understand that the line of Anas didn’t depend only on Lilliana’s children, that there was no hereditary caste, and that the tech we all lived by would continue on indefinitely. But images of us had never been distributed, to keep our privacy until we were full fledged Anas. Kids don’t need to be recognized everywhere they go.

Maya knocked and came in. She said, “Why are you so down, Kami? It’s not your fault the digger failed. Brooke and I both believe you.”

I asked, “Why do you believe what I said? Maybe it’s just BS which I made up to avoid responsibility.”

She shook her head slightly. “You had the ring of knowledge in your voice, and frankly, I don’t think you will ever make a very good liar. It’s obvious you know something about Ana tech, more than we do, anyway. Also, I have to say that you haven’t been able to hide from me the math you’ve been working on. I’ve seen you doing it when you left the door cracked open. What are you doing?”

It wouldn’t be long before she, or Brooke, followed the bread crumbs. Kami ... Ana tech ... math. I had to leave.

I told her, “I’m sorry, Maya. I have to get away from the Monkey House. I’ve been happy here, and I’m so glad I met you. Hold up your ID ring and I’ll sync you my contact information.”

She automatically lifted her hand — not that it was necessary, but it had become a custom somehow. Then she glanced at the data, and said, “*You* are Kamaria? The Ana?”

I said, “No! That is, I’m not an Ana yet. I ran away. I’m trying to straighten out my mind from something bad which happened to me. Please get in touch with me in a few months. Don’t spread

any rumors. What I'm doing has nothing to do with Lilliana, or Phoebe, or Blanca. They are all wonderful people. I just need to get away for a while."

"But why do you have to leave here? I won't tell anyone who you really are."

"It will come out. I'm not very good at lying, as you noticed. I'm not even good at disguising myself. Sometimes my mouth does its own thing without input from my brain. Like back in Brooke's office just now. I don't want people to fawn over me, or treat me weirdly. Or try to get 'special' things from me. I'm just a lost teenager trying to figure out her life."

Suddenly, Maya hugged me. "You're more than that, Kami. You're my friend. Whatever else happens to you in your quest, remember you made a real connection here. I don't think that you are so lost."

I gathered up the little I had. Mostly math notes. I liked to work on paper, which marked me as some sort of primitive. But Ana Lilli still worked out math on paper, too, so I was in good company. Then I turned to Maya and said, "I'm leaving now. I'm sure Brooke will figure it out soon, and then the news will get out. I don't want to face that recognition, not yet."

Kamaria - The Shaft

As I climbed the Shaft (Ramp Z again), I reflected that at least I wasn't fleeing in fear like before. I was leaving because I'd let my big mouth run on, showing off my knowledge. I should have just said, "I don't know what happened. It died, that's all." Stupid, stupid, stupid.

At the next level, I paused. Was I so stupid? Maya had said I wasn't good at hiding who I am. Was that bad? Should I have to hide who I am? Maybe I don't have to advertise it, but I don't have to deceive people, either. On the other hand, I hadn't really needed to offer an explanation for the digger breakdown. Summoning a tech would have been enough. Where was the line between telling the truth and showing off?

I thought about Ana Phoebe, the one I was closest to. She didn't hide who she was — the smartest person I ever met or heard of. She didn't go out of her way to demonstrate her intelligence and knowledge. I could do worse than try to follow her example. In my situation, she probably would have said something like, "The Qcoh chips in the digger failed. You'll have to get some tech down here to figure it out and fix it." Why is it always so much easier to think of the right thing to say *after* you let the stupidity run wild with your voice, instead of before?

This level was empty, and the next one. They were reserved for Brooke's project, if he managed to expand his empire enough. He was not easy to warm up to, but he had a vision. I hoped he'd get somewhere close to achieving his noble goals.

On level seven I walked the whole circle of the platform. There were two colonies there, with neighboring entrances, about 400 meters apart. One had beautiful pictures painted around the doors and a sign "Warning: Artists Inside." The other one had musical notes around the doors and said, "Welcome to the Music World." I'd always felt I was more visual than musical, but something made me open the Music door.

Gerald Kaleo - The Musicians

As the “young guy”, it was one of my services to the community to hang out near the front doors to see who wandered in. Usually, it was just one of the artists from nextdoor, but once in a while we got a tourist. I twice got people who wanted to join our little musical society. However, not much happened on most of the days I was on entrance duty. I passed the time practicing on my guitar, or writing out kind of crummy composition sketches. Clearly I needed to study more.

I heard the doors open, and looked up from the guitar. It’s a little embarrassing to say, but the sudden sight of a really pretty girl, when I’d expected it to be one of our neighbors, hit me hard. But I was only 18 then, and hormones still reacted faster than anything else.

By the time she was close, the rest of my brain had caught up, and I intoned in a mock serious way, “My lady, I welcome you to the fairy tale land of music and musicians.” Then I bowed.

She smiled and said, “And you are the Guardian of the Gates? My name is Kami. I’m climbing the shaft. I’d like to stay a little while and get to know you people.”

I said, in a normal voice, “Today it’s my day to be Guardian. Tomorrow, I’ve got a class in composition. My true name is Gerald. Indeed you are welcome here.”

Kami settled into one of our few guest quarters. I made it a point to look her up, and offered to show her around. She seemed a little shy to me, and I wondered why someone who wasn’t more extroverted was going on such a trip between diverse and oddball communities. At least in Music World, we were all pretty focused on our groups and didn’t really have much to show tourists.

Walking around, I said, “Most of our hubs are organized by music types. Jazz in ‘New New Orleans’, Country in ‘New Nashville’, and so on. We have a few performance hubs, where everyone can gather. I live in ‘New Laurel Canyon’, where we are trying to bring back and extend the rock music of a century ago. But I also study in the Classical hab ‘New Vienna’ because I really want to fuse the two genres.”

After seeing all the hubs and introducing her over and over again, I asked, “What would you like to do here, Kami? You’re welcome, of course, but my impression is that music isn’t a big part of your life.” She hadn’t really known much about any of the fields of music we’d wandered through.

She said, “I don’t have an exact plan. I just want to meet people. Tell me Gerald, can you play some of that old classic rock for me? This performance hab is empty now.”

I said, “I could use the piano up there, but I’d rather fetch my guitar — it’s better suited for this music. Wait here five minutes.”

When I got back, she was seated at the piano, plinking a few notes. “This is fun, not much like what I was doing before.” What that had been she hadn’t said, and I hadn’t inquired. She had an aura of “don’t ask me about me” wrapped around herself.

“This is my favorite song. It’s not exactly rock, but rock back then was a mix of lots of things. Anyway, here goes.” And I played the classic “Uncle John’s Band”, singing along.

When I finished, she clapped. “I liked that. It’s friendly and inviting — I wish we had rivers here, running through forests. Someplace to wander.”

I asked, “Is that what you want, Kami? To wander through Nature like the wind?”

She said, “Yes. No. I want to understand” And she trailed off.

I thought she wanted to talk, but couldn’t get started. I felt a little sorry for her. She seemed lonely, and needed a community. But I didn’t think she’d find one here.

Kami stayed on longer than I thought she would. She was easy to like, if a little withdrawn, and was happy to be something almost every musician wants — an audience. We “hung out” (that 20th century slang was so “cool”) a decent amount. She took to staying with me when I was the “Gate Guardian,” and I’d play some more classic songs for her.

One day, she asked, “How did you get here, Gerald? What are you, 18 years old? That’s under the usual minimum for immigration by yourself.”

I told her, “It’s been a long strange trip.” And stopped.

She pointed at me, and said, “You sang that song two days ago. Tell me your story.”

I started, “I’m from Hawai’i. I grew up loving music, in my grandfather’s house. The stereotype instrument for Hawaiians is the ukulele, but my first love was a harpsichord.” I had to stop to explain what *that* was, a kind of pre-piano. “My grandfather had one, a valuable old instrument from the early 1800s. He kept telling me ‘don’t touch’, but I was only four. He was at the far end of the house, and I started messing with it. By the time he got over to stop me, I’d actually made up a tune and was plinking it out. I still remember it.” I picked it out, note by note, on my guitar. “My grandfather didn’t yell at me. Instead, he showed me how to hold my little hands and how to press the keys.”

She said, “What happened then?”

“I was really too small to play such a big instrument. My grandfather got me lessons on a kiddie-sized electronic piano keyboard. It was great. I fell into it like my brain was hard-wired for music. Okay, I was a little kid, and wasn’t so coordinated then. But my teacher, Mrs Okani, was patient and very kind. One thing led to another, one instrument to another. Then things changed.” I stopped.

Kami said, “How? Why?”

I went on, “My grandfather died, my only close relative. I was just fourteen. He left me his money in a trust, which was good. I wasn’t rich, but I wasn’t poor either. But I didn’t have anyone to be a ‘parent’ for me. I had been hoping to go to Juilliard or some other conservatory in a few years, but now I was lost. How to go forward?”

I looked at her. My last statements had touched something in Kami. Her face had taken on a distant expression, like she was absorbing my statements into herself. After a moment, she said, “And then? You ended up here, so you found a way forward?”

“Not right away. My trustee, cousin Joseph, moved in with me in the house I’d inherited. He’s not a bad man, but he didn’t think music was a viable career for me. For two years, I drifted, just playing my instruments, barely going to school, and trying to get along. He encouraged me to talk to a counselor. That helped me a lot. I learned to see my cousin wasn’t thwarting me on purpose, that he was actually concerned about me.”

I sipped some juice, and continued, “Then I heard something about the culture habitats being built on Luna, and the story included an interview with the Music World founders. ‘Music World’ sounded like the place I wanted to be — it was my way forward. I jumped over the roadblocks. Too young to emigrate: it doesn’t apply to emancipated minors over sixteen. I was able to get a lawyer to break the trust and get me emancipated by the courts. I converted what funds I could to Lunar credits, and gave the rest to cousin Joseph. Next thing you know, I’m here, trying not to trip over my feet and fall on my face.”

She said slowly, “So you knew what you wanted when it hit you.”

I answered, “I’d always wanted that, since I was four. I just lost my way for a little while, but I had my passion. It wasn’t gone, just muted down after my grandfather’s death. When I found out how to give the passion an opening, it raced back out.”

Kami sat in silence, thinking. I didn’t say anything, either. After five minutes, she got up, saying, “After dinner, I’d like to tell you a story about someone I know. But not where anyone else might hear us — it’s kind of a secret.”

Kamaria - The Story

We found an unused sound stage in a back hab. I told the story to Gerald.

There was a little girl, maybe two years old. Crying in a street alone. The first thing she remembers is that two nice people picked her up and gave her food. The second thing she remembers is that she was in a place where she had trouble walking without falling down, but she could jump way way up in the air. The third thing she remembers is meeting two bigger girls, also very nice. Nobody spoke the little girl’s language, but the big girls had some cards with colored dots on them. The little girl played with the cards, and put them together to make the dots all nicely fitting. I can’t explain it any better, but the big girls were excited. They all clapped hands, which was fun.

The little girl spent a lot of time with the big girls in the next few days. They had more cards, this time with funny marks which didn’t make sense. Until they suddenly did, and the little girl was so excited by how she could put these new cards together to make the marks nice and matching. And then, make new marks to match what the marks on the cards meant when put together.

Years went by. The little girl got bigger, and learned that she was doing “mathematics” and it was very important. The big girls grew up.

The little girl was happy. Her adoptive parents were kind. The big girls and their mother were friendly and helped the little girl learn exciting new things. Then some bad things happened.

The little girl’s father and mother yelled at each other. More than once. Then one day the father was gone. He didn’t say goodbye. The mother cried and cried. She said, “He went back to Earth. I don’t think we’ll see him again.”

Then one of the big girls was gone. She did say goodbye, and promised to come back. The little girl was sad. People who went away didn’t come back. But the other big girl stayed and helped the little girl a lot.

The first big girl came back. By then, the little girl wasn’t so little any more. Everything seemed good again. But the little girl’s mother was sad. She read sad books. The little girl didn’t know what to say, so she didn’t say anything. She studied and learned amazing new things. Half of her was happy and half of her was sad.

Then her mother died. She didn’t have to die. She chose to die. The girl, no longer little, lost her happiness, lost her ability to think, and became 100% sad. She doesn’t like being sad, and wants to find a way back to her good life. But maybe it is all her fault? Or who can she trust? People keep leaving her. I stopped. Gerald stayed silent for a few moments, looking at me. Then he took my hands in his.

He said, “That’s a sad story, mixed up with a happy story. The girl found her passion when she was little and has been working towards it ever since. I’m positive her passion is still there, just covered up.”

He stopped for a moment, then went on, “Kami, you can trust your friends. The big girls are good people you can trust. The one who left came back, remember? And it’s not your fault when other people make bad, even terrible, decisions. Even if those decisions hurt you. It’s hard to tell what’s going on inside someone else’s head, and mostly it’s about themselves, not about you. That’s one thing my counselor taught me.”

He stopped again, and looked as if he was thinking about what to say. The pause went on and on. Finally, he said, “Kamaria, you can trust me. You can trust Ana Phoebe, Ana Blanca, Ana Lilli. Let your friends help you. You told me your story, what’s in your heart and head. Tell them, too.”

I smiled at him, as a few tears leaked out of my eyes. “Was I so obvious, Gerald?”

He smiled at me, and it was beautiful. “Yes, Kamaria. You aren’t very proficient at hiding yourself. Which is good. You’re a good person who has some trouble now. Let your friends help you get back to your passion.”

Impulsively, I kissed him on the cheek. Then I said, “Would you like to hear my ideas? About math and physics, I mean?”

He laughed, saying, “If I can understand them. Keep it simple, please.”

I said, “Electromagnetism fascinates me. It’s the basis of so much of our lives — the light we see by, the electricity which runs things, the flow of logic through chips. Ana Lilli found how to control it better than anyone else ever did, but she just used her invention to get energy from the vacuum, move things around, and so on. I want to control electromagnetic fields more intricately, with more nuance. I want to make light and radiation themselves parts of our lives, not to illuminate objects, but as controlled things themselves. You might not realize the big changes in technology which have happened in the last 25 years are just the beginning. These ID rings we have — we are each carrying around a quantum physics tool on our hands at all times. I want to use that widespread power to make lives better, fuller.”

I stopped, a little embarrassed. I’d said more to Gerald than I ever had to anyone else. He said, “I’m not sure what you mean in all that, but I know you can do it, Kamaria. Take your passion, and run with it. Run hard.”

I said, with less energy, “Ana Lilli needs my help with the surface terraforming project. But I don’t want to get involved with the intricate tedious details of making vast quantities of chemicals to prepare the Lunar surface for living organisms. I know it is really important, but that kind of work is not for me. But her daughter, Ana Blanca, went into medicine, and Ana Phoebe into improving the Next Physics itself. Who’s left to help Luna start the next stage of terraforming?”

Gerald said, “Isn’t there another girl in training, a few years behind you? The news feeds are good at keeping detailed information about the Ana trainees away from the public, but there are a few stories now and then.”

I said, “Samaya, yes. Two years behind me, about. I think Ana Lilli is impatient to get the huge chemistry projects underway, though. I know enough to get started, and Samaya isn’t quite there yet. I know that I *should* do it, but Gerald, I don’t *want* to.”

He said, “Then *don’t*. You’ve lost too much. You can’t lose your passion. Let the project wait two years for Samaya, if she herself is willing and able. Luna has centuries yet to come — you don’t have to throw yourself down a hole to speed things up a little.”

I smiled at him. “Did you know that if you went to the top of the shaft, went through the airlock, and threw yourself off, you’d probably survive? The terminal falling speed through the dense air inside and in the low lunar gravity would only be about 35 kilometers per hour. If you wore some padding and a helmet, you wouldn’t be hurt when you hit the bottom.”

He said, “I’m not going to try it. I don’t want *you* to try it. *And* I don’t want you to throw yourself down the rabbit hole of chemistry. There might not be a fatal impact, but it wouldn’t be pleasant.”

I stood up. “Let’s go back, Gerald.” I took his hand, and we walked back to the residential hab.

Kamaria - The Shaft

The next morning, I left the Music World. Overnight, Gerald and I had cuddled. He slept, but I had trouble dropping off. What was next for me? How to get to where I needed to be?

On the platform, just outside the door, I kissed Gerald. I said, “I’m going to walk to the top of the shaft. I want to see what else is here, but my real goal is to have time to think. Walking up the 56 levels left will give me a few days to straighten myself out and make a plan.”

He said, “I’d like to join you, Kamaria. But I can’t really help you with your plan. I don’t know enough. You can always call me. Just don’t throw yourself down the shaft to test your calculations, please!”

“I *will* call you, Gerald. Every night after dinner time. Oh, and the calculations are trivial!” With that and a wave, I set out, up “my” Ramp Z again.

I thought about my parents. Gerald had said they didn’t leave *me*. They left their old lives behind, and I was only a part of those lives. It occurred to me that they *did* love me, but for each of them, something else had come to overwhelm them. My father had yelled at my mother, but never at me. My mother had tried to be more upbeat around me, I had seen. She just couldn’t do it.

Of course, Blanca had had to go away to medical school. As a girl, I’d only thought of how it affected me, especially after my father vanished from my life. But Blanca had come back, and she was doing fantastically important work now, following *her* passion.

I would do the same. I would take my passion, my knowledge, and turn it into important changes for Luna, and for Earth. Behind me, Samaya would do the same. Something very different than what I chose, but something just as significant.

I knew Blanca and Phoebe would support me. I was a little afraid of Ana Lilli, though. She was so famous, so predominant in Lunar society. “What Ana Lilli wants, Ana Lilli gets.” I’d never thought of it that way, but what if she wanted *me* to work on *her* projects? She’d always been good to me, but I’d always been a little scared of her. I’d never stood up to her before, because I’d never had to. What if she was angry with me? Or sorrowful?

I estimated it would take me 7-8 days to climb to the top, walking around each level to see what was there. I’d be walking for about 250 km — a long way to walk on Earth, but not quite so hard on Luna. I hoped there would be vendors and washrooms on each level, at the least. Otherwise I’d have to turn back to more habitable territory.

After I arrived at the mental roadblock of “What will Ana Lilli say?”, I kept playing out imaginary conversations in my head. Ones where I explained things so rationally that she had to agree. Ones where she exploded at me, or looked unhappy, or explained logically why I was wrong wrong wrong. That occupied me for hours, as I climbed up and explored each level. There was no interruption of

finding other settled habs to visit, of finding other people to talk with, which could break up the fantasies I played and replayed inside my brain.

Lunch saved me. I ate at the vendor on level 10, which gave me something else to think about. Where would I sleep if I didn't find any open habs? I decided I'd order up a bunch of towels and make a "mattress" out of them. That should work. I could sleep in a washroom, abandoning the towels when I headed up the shaft again. Working out little practical details helped switch my mind into less worrying directions.

Before I'd talk to Ana Lilli, I'd talk to Phoebe. She'd listen. She was only about 10 years older than I was, and we were close. She could tell me how to talk with her mother. Blanca would help, too. Once I played out *those* conversations in my mind about a hundred times, I felt better. It would work. Right?

By evening, I was feeling more confident. I'd still not run into any more places to visit. Maybe only the bottom of the shaft was occupied yet. At the vendor, I discovered I could order up some foam pads, and used a bunch of those to make my bed. I took some time and explored the vendor options a little more. None of the food available was exactly mouth watering, but there were better menu items than I'd noticed before.

Gerald called me while I was eating. "Hi, Kami. How are you? Where are you?"

"I'm fine. I'm feeling more positive. I thought about what you said yesterday, and I thought a lot about convincing Ana Lilli that I have to go my own way. What did you do today?"

Our conversation drifted into ordinary things. I talked about the food from the vendor, and about the bed I'd made. He talked about his composition efforts. He told me of his dream: an opera about the Grateful Dead, their history and music. I said with a laugh, "By the time you get to that point, maybe I can give you some light and visual effects to fill the stage and entire arena." We agreed it would be incredible to work together.

The next few days, I worked in my head, trying to get back on track with math and physics. Phoebe's demo program "Sparkly" would be a good place to start. That was a toy, but combine it with my ideas, build it up, and it could become something useful. A true 3D video display, for example, not like the projectors now used. Ideas raced across my mind, chased by notions of how to make them work.

And electromagnetism could work the other way, too. I saw how I could read out 3D electric and magnetic fields with precision which even Phoebe and Blanca couldn't match. I worked out part of the math for that right there on Ramp Z. Put the reading and creation of electromagnetism together, and we could build computers from Qcoh chips which worked on light alone.

There was no end to my ideas, once I was unlocked. I could read minds! Well, that might be a little *too* hard. There was a fantastic amount of detail in the electric fields of a human brain, so I'd have to extract just some important components from all that data. But it might help with treatment for brain functional disorders. Depression, for example. I'd need help from brain scientists and doctors. Blanca and Emily could get me pointed in the right directions and to the right people.

I was so absorbed in my attempts to do complicated math in my head that I just walked past several occupied habs near the top level. One looked like an order of Buddhist nuns. I decided the shaft was being filled in from its ends.

The top level was different though. There was another translocator there (whew! I wouldn't have to walk all the way back down — or go into an occupied level to use theirs — or jump), and there was a door labeled "Flying Club". I looked in to see what was going on. There were only a few people there, assembling and setting up equipment and lockers. One of them saw me, and said, "Are you here to help out? We need some muscle to wrestle these stupid things into place. We didn't bring any lifters."

I answered, "No, I'm just a tourist climbing the shaft. But I can give you a hand for a bit. What's going on?"

"We're getting ready to open the shaft for flyers and other sports enthusiasts. When we finish here, we'll do something similar at the bottom. Here, let's all push and shove this piece of junk over there." I added my inconsiderable strength to the operation, and the bulky object slid across the floor slowly but satisfactorily.

After a couple hours, they broke for lunch, and I joined them. The food they'd brought was much better than what I'd got from the vendor machines, so I was glad to have dropped in. They were curious about the inhabitants I'd met, and I told them stories. Jaime, the organizer said, "You know, we should walk down and make a list of who's in residence. We could post a guide to the shaft for flyers. They might like to stop by the Music World. That one sounds fun."

I asked, "Who else will use your facility here, besides flyers?"

Jaime said, "There's talk of starting a periodic foot race up the shaft, bottom to top, then dive down to the bottom with a little parachute to kill the speed at the bottom. Like the ultra marathons on Earth, in a way. I'm sure some other ideas will come up, as well."

The conversation ended with a return to work. I said, "I'm going home now. I've been away long enough, and I have things to do. Good luck and good fun to you all."

Ana Phoebe

Kamaria returned about two months after she left. She looked much better than when she'd left. I concluded that Emily had been right. As she usually was when judging people.

Kami said, "I'm back, and I want to talk to you about something important." She was very serious, and I had to stop myself from hugging her. It seemed to me she'd grown up a fair amount while she was gone.

She explained she wanted to find her own paths to applying the Next Physics. "Like you and Blanca did." She didn't want to work on the chemistry projects needed to accelerate the transformation of the Lunar surface, which Mama was unsubtly pushing. Instead, she outlined a vast series of ideas, all about applying the Next Physics extensions to quantum electrodynamics.

I let her talk. It was delicious to see her excited again about math and physics. She had some very good ideas. When she finished, I said, "Well. That's just about a lifetime's worth of projects, Kami. Even assuming you don't think of something else along the way — which you will. I'll back you up as needed. I suggest you start with something small, and work your way up in complexity. That 3D display sounds like a good beginning."

She said, with less confidence, "Thank you, Phoebe. I'm afraid of talking to Ana Lilli about this, though. I know she wants the chemical synthesis projects started right away. But I just can't make

myself do that chemistry stuff. What if she tries to force me to do it?" Now she looked anxious, maybe a little scared.

I reassured her, "Mama isn't like that. She tried a little with Blanca, but had to give in. A little later, she tried with me. She's raised up a crop of smart people to help her change and maintain the worlds, and now she's got to live with the results — those people, we four, are independent and driven from within, not from without. Luna will get by, even if full surface habitability has to be delayed a few years. Blanca will support you, too, I'm sure. Frankly, I'm really pleased. You are ready to prove yourself and join the three of us as a full equal."

I added, "We have a little news for you, too. We found another little girl who is just starting training. She's three years old, and was born here on Luna. I hope you'll make time to help her while she's climbing up her own path. You and Samaya are closer to her in age, and you two can better remember what it was like in your early years. Her name is Leslie, and she's a ball of energy right now."

Four Anas, and Samaya not far behind. Leslie in the training pipeline. Luna's future looked secure.

Samaya's Spaceship [2080-85]

Ana Samaya

My “aunt”, former Presider Cydney, gave me some actual paper books for my 14th birthday! My father had a few such things leftover from medical school. I'm pretty sure he kept them mostly for nostalgia. Otherwise, I'd never actually handled such objects. What's more, these gifts were books she wanted me to read. “Golden Age” 1950s science fiction. The “science” parts were drivel, of course. In addition, Cydney told me to mentally substitute female characters in for some of the males. Change “Roger” to “Rose”, and so forth.

I got it that these books had (mostly) been written to appeal to teenage boys of the time. Space operas, heroic adventures, conquest of space, colonization of planets, aliens! But they appealed to *me* also. I was tired of living in a collection of highly civilized caves.

It dawned on me that Ana Lilli had unintentionally killed space exploration. Not the robotic type. Probes using her momentum drive had advanced science all over the solar system, all the way to the Oort cloud. There was even a pair of heavily shielded probes on their long way to the Alpha Centauri system, cruising at one-tenth the speed of light. But there was no *human* space exploration. For a while, a few unmanned freighters had brought equipment from Earth to Luna which could not be translocated — notably, the sizable components needed for our chip factories. Those ships were mothballed now. If you could call them “ships”. They had basically been metal boxes with some Qcoh chips to push them around.

It was a shame, but I knew why it had happened. The Asian wars had been a huge setback for a large fraction of humanity. The effects of climate change had focused attention on Earth towards “home”. Luna was preoccupied with building itself from a dead world. But ... in the late 21st Century, we had the technology to go out there ourselves. In style and comfort, unlike the old rocket ships. Plus, we could go quickly. No long Hohmann-style orbits in freefall. Propulsion all the way, courtesy of vacuum energy and the Next Physics.

This was what I wanted to do! Build spaceships ... okay, maybe just design them and have someone else build them. As long as I got to go along for the rides.

One truism remained from the earlier age of space travel: People are fragile, and the systems need to be over-engineered to keep them breathing. Which meant a lot of details. So what? On Luna, we already lived inside un-propelled spaceships. We just called them “habs”, and we knew how to keep people alive in them. The main thing missing was the drive to move a hab-sized structure around *reliably*. It wasn't a good idea to squash the people inside if the drive acceleration failed in some uneven way. Or have the ship break open in space.

I was so happy to see Kami come back from her “vacation” — which is what my parents called it. I suppose they were trying to shield me from Kami's problems, which was just silly. Kami and I had been as close as sisters for a decade.

Kami firmly announced to us all that she was going to focus on control of electrodynamics — creation, control, and detection — and would *not* work on the chemical synthesis project urgently needed for the Lunar surface project. Her first goal: a Qcoh projection system for 3D display which would show the same thing to everyone, no matter what angle they were looking from. She said,

“I worked out most of the math in the shaft. I’ll try to have a demo for you in a few weeks. Then I can start work on some *real* projects. Like mind reading.” She was only half kidding with that last one.

I was truly glad to see her on fire like that. However, it also meant that I was next in line for the chemistry project: making a mix of chemicals and injecting them into the water production. They would get spread around the Lunar surface and help make the Lunar soil hospitable for the Earth organisms which would follow. Bacteria, fungi, worms, and so on.

I was learning the basics of the Next Physics by then, and had been thinking about creating an organized system for manipulating atoms and molecular building blocks. It seemed to me that I had a lot to learn before I could do anything with those thoughts. But the “soup” project landed on me. It wasn’t that I objected, but it wasn’t wildly exciting. Not that I didn’t appreciate chemistry. In fact, I liked it a lot, unlike the older Anas. Most physicists look down on chemistry as being “trivial” — which it is *not*. I would have been more energized by making soup earlier, but space travel had firmly rooted itself in my mind.

As I studied the Next Physics and started writing “baby” programs, I kept my twin tracks in mind: large scale chemical synthesis and large scale spaceship propulsion. For the soup, “large scale” meant making hundreds of billions of kilograms of various organic compounds. For the spaceships, “large scale” meant synchronizing the operation of enough distributed Qcoh chips to accelerate the entire structure very uniformly — and to be robust against failure of any subset of the Qcoh chips.

On the soup front, I worked with some organic chemists to understand the “easy” ways to assemble molecules. Using Ana Phoebe’s tools, I was able to develop a whole new software setup for building compounds from parts. Using Kami’s new display, I was able to visualize and edit the Qcoh operations hanging in space in front of me. My resulting Qcoh software would allow a competent chemist to set up the system to produce whatever was wanted. No extra Ana programming would be needed. I really didn’t want to have to get involved just to add an extra chemical compound which some ecologist decided was necessary.

All that took me two-plus years. A lot of consulting with chemists and chemical engineers — some of which was just learning to speak each other’s language. A lot of testing, first in small lab setups. Then in medium size reactors. Then in a full-size working water synthesis plant, which had to be retrofitted with gen4 Qcoh chips to accommodate my software.

The engineer in charge of the water makers, José Castillo, didn’t like having to tear my chosen synthesis unit apart to install the new chips. “It will take four days to get these things in place, and get the plant back online. Can’t you find a better way to get this project done, *pequeña señorita*?”

I didn’t like his tone, and I *really* didn’t like his calling me “little miss”. I told him, “This *is* the better way, *gran quejoso*. These machines are using obsolete tech, and they should have been designed better. It’s past time they were upgraded. If you want your grandchildren to grow up in open spaces, then get to work.”

He objected, “There are over 20,000 water plants. At that rate, it will take ... about 50 years to change them all over.”

I shrugged. “Hire some more technicians. Once you all get some practice, it should go faster. Besides, only about a thousand of the plants have to be retrofitted for this fertilization project.

I budgeted a year to get them all fixed up. Read the appendix to my plan document, sometime when you have trouble falling asleep.”

They did what I told them, and of course it worked. In the four days, I picked up a lot of useful swear words from those guys. A few of which I passed on to my younger brothers, for educational purposes. The others I kept for my own armamentarium, for when they would be needed.

From this point forward, I was “Ana Samaya” — with more responsibilities about to land on me. However, I was also ready to strike out and claim my own territory, as Kami had done. She had actually made progress with her “mind reading”. From scanning the electromagnetism of the brain, she could reliably tell if someone was lying. For her next act, she was starting to collaborate with neuropsychiatrists to look for brain signal patterns in mental illnesses and social disorders.

Ana Phoebe

At the Council meeting where Sami was “promoted”, Mama congratulated her on the “soup project” results. “Sami, I mean Ana Samaya, you carried out this project with tremendous creativity. You went far beyond the brute force chemistry methods I used, and created something so flexible and powerful we’ll probably be using it for decades — here, on Earth, and someday on Mars. Even more impressive is your visualization system for Next Physics programs.”

All that was true. Samaya had organized her developments very cleverly and systematically. Almost as important, in my view, was that she — at the age of 17 — had held her own when dealing with the engineering teams overseeing the atmosphere project synthesizers. Without once going to Mama, she had stood up to them with courage and intelligence, and gotten them to revamp the hardware along the lines she needed. A big job for them, modifying such big machines, but that’s what the engineers were there for.

I knew that Mama was about to launch into a list of new efforts which had to be addressed. Many of them were relatively minor engineering tweaks requested from Earth clients — part of Luna’s trading “comparative advantage”. I’d done my share of those. Generally, they were both easy and boring.

Sami must have anticipated this new direction for our discussion. It wasn’t hard. Half of the Council’s meetings had these kinds of issues come up. Before Mama could get started, Sami said, “Thank you, Ana Lilli. Your words mean a lot to me. Truly. Now, I want to work on something completely different. I have an equally important project which I want to focus on.”

She paused, probably for dramatic effect. She was confident, as she had always been for the 13 years I’d known her. “I want to restart human space travel. To design and build spaceships to explore the Solar System. We have the ability, we just need a little focus. It’s time to look outwards again.”

It didn’t go exactly as she wanted. Mama and Blanca were strongly opposed to spending any effort on human spaceflight. “It’s not time yet. We have so much to do for the surface project. Also for extending the abilities of the new Qcoh identity rings — they have so much potential, and realizing those possibilities is up to us.” I knew that Blanca wanted to program medical self-scans into the ID rings, to provide a continuous health checkup for all Lunies. This project was revolutionary. And it might well end up being a nearly endless task.

Kamaria waffled. She really wanted to support Samaya. They were so close from their years together. However, Kami also strongly felt that the urgent projects which affected many more people than a few hypothetical space explorers should have priority. “I think we should wait a few years before building spaceships. Until we take care of the backlog of important issues waiting for us.”

I had kept quiet until this point, but I could see that Sami was about to explode. Patience had never been her strongest attribute. I stepped in, saying, “That backlog will never go away, not for decades at least. Of course we have to set priorities. One priority is keeping ourselves from being burned out. Sami, how long do you think it will take you to design a prototype spaceship?”

She was glad to grasp the lifeline. “I’ve got ideas in my head and sketched out in 3D. Detailed design, with propulsion and life support — about a year. Maybe two. I’ll need to consult with the remnants of Earth’s spaceflight experts to make sure I’m not missing anything, naturally.”

Compromise, which no one ever likes. Three to two, Samaya was allowed to work one-third time on the design of a prototype spaceship. Subject to “critical needs”, of course. Construction would be postponed for an indeterminate interval.

Afterwards, I talked to Sami privately. She wasn’t happy. I tried to make her take the longer view, “Sami, Mama really wants to be able to live on the surface with Daddy. He’s 68 now, and she’s worried that he won’t live long enough the way things are going. That’s why she wants your help so much. Your work on the chemical ‘soup’ is a big step forward, but there are more steps needed. Steps which you can handle — you’ve proved that. Also, I think that designing your ship will be more intricate than you’ve thought out so far. Don’t rush it.”

Ana Samaya

So I didn’t “rush it”. But I didn’t slow-walk it, either. Issues that Phoebe raised with me had to be dealt with. How big would the ship be? What size crew was I planning for? How much acceleration would I design for? How would the ship be built? How would I launch the ship from its construction site? What kind of life support would I build in? What duration of voyages was I going to allow for? How would I protect the crew from cosmic and solar radiation? Safety backups for everything, and backups for the backups.

My spaceship design work took over a year, but less than two. Much of my time was spent on other projects. I worked closely with Ana Lilli on the efforts related to Luna’s surface, and got to appreciate her more. So much weight had been piled on her, by herself of course, but that didn’t make the burden less. I started to realize the pressures on her, all piled on by the decisions she’d made decades earlier. Although I still didn’t agree with her opposition to my plan, I came to better understand her position.

I also collaborated with Blanca and with Phoebe’s wife Emily on creating a Qgol library for the new identity rings. My library provided the support for each person’s ring to do medical scans on its owner. Chemical markers of disease, scans for arterial blockages and aneurysms, and so forth. I had quietly resented doing this work at its start, but as the project went on it came to me how important this was. I began to understand just how many illnesses and conditions could afflict the human body.

Designing the ship also gave me new respect for the old time American and Russian engineers. They had far more primitive technology than I did, but they had sent people into space and

gotten them back alive, repeatedly and mostly reliably. Riding on top of giant pillars of fire. My ship was complicated enough, but *theirs* were fantastically intricate. And fantastically dangerous.

I didn't want to consult with any of my Ana colleagues about my spaceship design. I was stubbornly determined to do it all myself. To prove I could. I could be pigheaded in those days. When I thought I was done, I planned to show my design to the rest of the Anas, hoping that they would endorse my going ahead with the construction. I carefully prepared myself for the meeting, bending enough to consult with Phoebe on how to "sell" my project.

The planet Earth itself intervened to delay my glorious presentation. A major natural disaster happened in America, in the state of Hawai'i, and Luna decided to help. We had the technology. First Phoebe went, then she summoned me down there. I spent a few months helping with the air contamination problems, while Phoebe was working on halting the lava. Directly seeing the impact of my efforts brought it home to me that my chemistry work was actually changing people's lives for the better. Before the cleanup, hundreds of people with asthma and other problems had died. It felt good to have helped save lives, lives of individuals that I could see in front of me.

I also have to say that once I had some time to rest, Hawai'i was about the ideal place to do it. My parents and brothers joined me on the beach for a well-earned week. Of course, my brothers complained about the gravity a lot, and spent as much time as possible floating in water. So did my parents, for that matter.

Finally, we returned, and I had my chance. I put up a picture of what my ship would look like. A burnished silver-gray ball, the thin outermost shell made of titanium. "The launching problem set the parameters for most of my design decisions. The prototype will be built underground. Instead of building a giant airlock, the entire ship will be translocated outside when it is finished. That decision limits the size to the largest translocator which can be built, a little over 11 meters across. So we'll build a 10.5 meter radius spherical ship. Then we'll build the launching translocator around it. That will probably be for just one use. I don't think the ship will ever land again. Unless there's a problem in space and it needs fixing back down here."

Ana Lilli said, "That's kind of small for a spaceship, isn't it? Also, your image is pretty featureless. Is this just a sketch, or is that how you plan to make it?"

I answered the second question first, "The walls will be solid — no airlocks, no doors, no viewports. Access only by translocator, looking outside only by remote sensing. This choice will make the ship structurally impregnable. As well as making the design much simpler. About the size: it will be bigger inside than the manned spacecraft used in the days of rockets. Larger ships can come later. They'll have to be assembled on the surface, when that's ready, or in space."

Ana Lilli looked relieved, saying, "I thought you were planning to build a big ship, a spaceliner to hold dozens of people. A much smaller project like this is a good place to start."

Blanca said, "I think you should plan on bringing the ship back down to Luna, back to your big translocator. I feel sure that after some space experience, you'll want to change some of your setup. That will be much easier down here than up in orbit." Everyone else nodded, and I had to agree. I was proud of my design, but it wasn't realistic to think it was perfect.

We discussed my design plans for several hours. I could feel that things were going well. Then Ana Lilli brought up a point I hadn't considered at all. (I was still a teenager, remember.) "Sami, you've again done a good job, and what you've designed is practical and will work. I'm even in favor —

building it won't take that many resources. I'm sure you can have all the gen4 Qcoh chips you need. Ed and Phoebe are starting to think about a gen5 chip, by the way. But there is one thing I haven't heard you address. Security."

I must have looked blank. Phoebe, who thought more quickly than anyone else I'd ever met, said, "Of course. If someone steals the ship, running it at 2 gee for 3 months straight will get it up to half the speed of light. It would be a tremendous hypervelocity weapon. Let's see ... about a one megaton explosion's energy per kilogram of spaceship. The mass of your design is ... about five hundred thousand kilograms. A suicide bomb to destroy a continent. Or a planet."

I didn't know what to say. Finally, I opened my mouth ... but Kami intervened. She said, "The issue comes down to trust. Is the pilot-commander of such a ship to be trusted? We five are trusted with the Next Physics. This problem ties in with my recent work. I have two solutions, one short-term and one long-term."

That discussion took at least another two hours. Blanca sent out for food. We were meeting in the conference complex next to Ana Lilli's home, and her husband Ed brought in our dinner. He smiled at us, and said, "I thought this meeting would run for a long time. The food is here, and here's dessert. Whipped it up myself." As he turned to leave, he winked at me. I took that as encouragement, and I looked forward to eating his cake. Ed was an excellent cook and baker.

Ana Phoebe

Samaya got what she needed to build her small ship. It really wasn't much. One hundred thirty self-igniting gen4 chips. A small empty hab as a construction site, with bare rock for the floor. Mama was going to assign her a crew of techs to help with the project, but Samaya had another plan. "I've got a few friends interested. The actual labor required isn't much, to start with. I'll supervise them myself."

Mama asked me to keep an eye on her. "You're closest to her, Phoebe. She won't be upset if you pop in and see how it's going. I'm still worried about security and safety. Also, I know she wants to do it alone, but she really could use some help with some aspects of her plan."

When I went over to the "Spaceship Epsilon" hab, I found Sami and two helpers operating a digging machine. They were carefully carving out a wide trench around a 15 meter diameter cylinder of rock embedded directly into the floor. At the moment, the trench was about one meter deep.

Sami introduced her companions. "Ana Phoebe, I'm so glad you're here. This is Ian and this is Maddie." Ian was a tall strong-looking man with a nice smile, maybe 30 years old. Maddie was a young woman, a few years younger than Ian. Sami continued, "They are space enthusiasts, too. Maddie just immigrated a few months ago."

Maddie said, "*You're* Ana Phoebe? Samaya talks about you all the time. Your mother is Ana Lilli?" She sounded a little awestruck. I'd seen this reaction before, and like my mother, didn't really care for it.

I answered, "Maddie — is that short for Madeline? Or something else?"

She nodded, and said, "But I don't really like 'Madeline', it sounds so formal." She smiled, a confident infectious smile.

Ian turned out to be the brother of one of the astrophysicists I was working on for the new terameter radio telescope project. He said, "Wouldn't it be great if we could go out in person to all the

sites where the telescope nodes will be sent? To upgrade them, to fix them, and just to see with our own eyes.” He was eager and enthusiastic.

I asked, mostly to make conversation, “So, what’s the plan?” Sami started to answer, but I added, “Let Maddie explain. I know what’s been discussed already, and I want to see if your team understands.”

Sami said, “Not just my team, but my *crew*. We’ll have three berths, and you’re looking at the roster for the first flight of *Epsilon*.”

I laughed a little. Maddie hesitantly took up the challenge I’d laid out, “Well ... we will cut a big cylinder of rock, like you see now. Fifteen meters across, and then fifteen more down. Then we’ll build the scaffolding around it to hold the quantum chip things. Samaya will program those to transform the rock into the structure of the ship. I think that will take a couple of months. Maybe more” Maddie tailed off and looked at Sami for confirmation. She nodded.

Ian took over, “The first level transformation will leave the outer spherical shell of the ship, and also make the interior floors and walls at the same time. Samaya will set up a translocator inside, and that’s how we’ll get in and out. Then the inside will be built. By hand, by us, mostly. It will be pretty simple. Three small rooms .. I mean cabins ... below for sleeping, with other space for storage, equipment, and sanitation below. The upper floor ... I mean deck ... will be one open space for the common area and controls. We’ll have to install all the quantum chips in the places Samaya tells us. Then, we’re good to go. At least on a short test run.”

Maddie broke in, excited, “We should go to Mars on the first trip. Samaya says it’s only about two days each way at the full two gee acceleration she’s programming. We’d be the first people ever on Mars!”

I smiled again, but shook my head. “A short cruise, say a couple times around Luna and then once around Earth, will be a better start. Make sure the ship doesn’t kill you, while you are in translocator range. Simple things are important — like breathing. Don’t want the air system to go bad when you’re two days from help.”

Maddie looked stubborn, but Ian spoke up. “Ana Phoebe is right. After all, the quantum chips will have multiple functions — pushing us around, keeping the air clean, processing the sewage, letting us look outside, and so on. Make sure the whole system works together, under propulsion and so forth. See if it holds up under the load. Spend a few days in the ship close to home. If all is okay, then restock the supplies, stretch our legs, and punch our round trip ticket to Mars. Two days out, two days back, two or three days on site.”

At that point, Maddie glanced at her ID ring, and said, “Oopsie. I have to go, my folks are sending for me. Look, Sami, are we still on for tonight?” Before any answer, even a nod, Maddie rushed off and translocated away.

Ian looked at Samaya and asked, “Are you going out on the rounds with her again?”

Samaya looked at me, then back at Ian, and said quite firmly, “Yes. Maddie’s fun. Jumping from hab to hab, snacking at different places, loud music ... you know, *fun*.” I had to remember she was only 19 years old. I tried to recall what I was like at that age, 11 years ago. More serious, I thought. Blanca had been on Earth, and I had been remaking Mama’s math breakthroughs from scratch.

However, I just said, “Enjoy yourself, but not *too* much — just the right amount.”

When I left, I went to Hab A. Talking with Mama and Blanca, I said, “I’m sure she can construct the ship. I’m a little concerned about her ‘crew’, as she calls the two volunteers helping her now. The older guy, Ian, seems mature enough, but inexperienced. Of course, nowadays, who has experience in manned space flight? A few old men and women, that’s all. What bothers me more is the younger woman, Maddie. She seems a little flaky. If there’s an emergency, I worry that she might fall apart. Any of them could, of course, but I’d put Maddie at the top of the list.”

Blanca said, “I read that they used to do psych workups on astronauts. To make sure they were stable under pressure, when they were in a spot where no one could provide aid. Should we do that? Kami can help, and there are people at VIM that could get involved.”

Mama suggested, “Pheebs, just keep dropping in on them for the next several weeks, while they are waiting for the ship’s structure to be transformed. Try to get a better read on Ian and Maddie. For that matter, try to get some insight on Samaya in her new role.”

Ian MacLean

Money didn’t mean that much to me. When I was a kid, I wanted to be rich, really rich. But by the time I went to college, that idea had faded. Instead, I wanted to make a difference, which is maybe a more grandiose ambition. When my brother moved to Luna to work on astrophysics projects, I decided to follow him there after a year or so. I’d always wanted to travel in space, and Luna was the nearest thing to that which was left. I’d been in a space enthusiasts’ club, mostly young men like myself, for a few years, but it was kind of depressing. We talked of colonizing Mars and the asteroid belt, but we really knew nothing was moving in that direction. It was a miserable shame, because Luna obviously had the technology to move outwards. They just didn’t want to, for reasons that we didn’t understand.

I left my software engineering job at the gigacorp. Of course, I told everyone I was emigrating to Luna. It was too exciting a thing for me to just up and quit for no reason. Some people were jealous, but they were tied down to their Earth lives, or afraid of the big changes that came with living on the Moon.

Before I left, I got a call from the CEO of my employer — actually, from his assistant. The CEO wanted to talk with me, in person. That was surprising and strange. He was about 7 levels above me in the gigacorp, and was world famous. How could he have even known my name?

I went to his palatial home, not his office. Impressive place. I’d never seen anything like it.

He started with, “Hello, Ian. I’ve heard you are emigrating to Luna soon. Congratulations. From everything I know, I’m sure you’ll like it there. What will you be working on?”

I said, “At first, I’ll be on the team for the software which manages their translocator network. Lots of details there, to get everyone and everything to the right places without trouble. Once I get used to the place ... then I’ll see, sir.”

He told me, “Call me Erez, Ian. You’re not my employee any more, or won’t be soon. In addition, on Luna, everyone goes by their first name. Even their Presider. You’ll have to get used to that.”

I asked, “Erez, what am I doing here? I mean, why do you want to talk to me? I can’t be the first employee to leave for Luna.”

Erez said, “No, of course not. There has been a handful of others before you. I’ve had a similar conversation with several of them. I’m very interested in space travel and colonization. I try to keep up with what’s going on with those fields, and nowadays that means keeping up with Luna.”

I said, “I didn’t know that about you. I’m really into space flight myself. And if anything is going to happen, it will have to be from the Concord. Earth has lost interest and doesn’t have the technology. But it seems to me that Luna doesn’t have the interest, either. At least not right now.”

He said, “That’s about right. But they may change their minds. Ian, I’d like you to keep your eyes open when you’re on Luna. Let me know if you hear anything about space efforts, even rumors, or even anything remotely relevant. Doesn’t have to be human space flight. For example, if you wanted to colonize Mars, would you just go there and get started?”

I answered, “Of course not. I’d send equipment ahead, in as large a quantity as I could manage, along with supplies. Before that, I’d scout out the planet in as much detail as possible. Luna could do all that easily, with their tech — if they cared to make the effort.”

Erez replied, “Of course they could. But they have a monopoly on the tech. Someday, that might change. But for now, at least I’d like to know if they are doing anything in space. I’m not asking you to be a spy or agent. Just to pass on any tidbits which you hear. The kind of thing that wouldn’t make any news feeds.”

I agreed. It was a little heady, being treated as an equal by a trillionaire. What he wanted from me, what could it hurt? It’s not like I’d be privy to secrets, anyway.

Madeline Preux

I was so zipped to be working with Samaya on a spaceship! Space was a dream for me since I was little. I grew up viewing story after story about NASA’s glory days, and then about the Lunar colony. Ana Lilli was my hero, and now I was best friends with her colleague, another Ana — one of only five in both the worlds.

I met Samaya by accident, at a snack place in a French-oriented hab. My grandfather was French, so I hung out there a lot. We got to talking. I didn’t have any idea who she was that day, but I loved her assertive attitude. And her damped down Australian accent. We ended up making the rounds of various fun theme habs — Italian, Moroccan, Tamil, and so on. Places and food which I liked. Paneer masala dosa, mmmmm. Along the way, she pointed out various features of the habs I’d never noticed. Details about how the air was circulated, how the columns supporting the arched roofs had been made, and so on. Naturally, I had a few drinks here and there, and I noticed that she didn’t. That’s okay, of course, but at some point I commented. She answered, “I don’t like to fuzz up my mind. My work requires me to think clearly, really clearly.”

I wasn’t thinking too clearly by then myself, but the next day I put the clues together and said aloud (to myself), “Could she be *Ana Samaya*?” There were no pictures of her available, but she was about the right age. I’m not stupid, even if people think so just because they also say I’m a *little* wild.

She messaged me a few days later and suggested we go hab-hopping again. Again, I was drinking and she was not. We sampled food from half a dozen habs. Japanese, Malaysian, Turkish, Polish, Peru, and Tibetan (their hab was cold, their air was thin, and they had yaks grazing outside!). Somewhere around Little Kraków, feeling tipsy and free, I flat out asked her, “Are you Ana Samaya?” The second I did it, I was sorry. If she wanted privacy, she should have it.

She looked startled, and then laughed out loud. “Would you believe me if I said I was? Or wasn’t? Everyone wants the prestige of being an Ana. No one thinks about studying maths every single day, starting from the same age when you’re also still figuring out switching your walking reflexes from low gee habs to high gee habs. They don’t think about the responsibilities and stresses from being one of just five people on whom the continued progress and survival of Luna depends. Not to mention that little old planet Earth, whose population seems to have an unlimited ability to screw itself over.”

I stared at her. Then I recovered, and said, “No, I guess I never thought of all that. Here, have a drink. Takes the edge off that stress for a little while.”

She said, “No thanks. Not just now. Maybe some other day.”

Ana Phoebe

Maddie was easy to like. At first. She laughed infectiously, was always friendly, chatted with verve, clearly admired Samaya, and when the time came, worked hard on the ship. After a couple weeks, though, I realized that in fact I did *not* like her. She was shallow. Much worse, she was a bad influence on Sami.

Like all of us, Sami had what we called “incidental projects” to work on. Small stuff, but everything with Qcoh programming must be done with clear focus. To do it right, one has to be in a kind of meditative mathematical frenzy state. Sounds contradictory, but that’s the best way I can put it. Sami was making mistakes. A lot. A look at her programming logs showed that clearly, once Mama and I realized something was happening. She was able to fix them, but she wasn’t as good as she’d been six months earlier.

I cheated. That is, I spied on her. Not by remote viewing, or even by following her around like Jane Bond would. Using Mama’s Prima Ana override, I looked at Sami’s ID ring medical records. I felt bad about doing this, but something had to be done.

Sami was getting drunk two or three times a week. I didn’t have to be a wizard to figure that she was carousing with Maddie. Not that Maddie was to “blame”, but she was the catalyst.

We (the Anas) hadn’t faced this problem before. Kamaria had dealt with some very relatable emotional health problems a few years back. A combination of therapy and her “climb” up the Aariz Shaft had significantly helped her adjust. But this problem was different.

Dr Abby Kranish

Ana Samaya’s problem was quite common in young adults. After listening to Samaya, I told her, “Look, Sami. You are still growing up. You have a lot of responsibility, more than almost any other nineteen year old. It is tough, especially when most people your age are mostly out having fun.”

She blurted out, “I *know*. I don’t want to get drunk. It’s just that it is so so easy. I feel good after the first drink, or even two. After that, I want it to continue getting better. Then it’s hard to stop, even when it doesn’t actually get better.” She paused, and looked worried. “Am I an alcoholic?”

I shook my head with a smile. “No dear, you are not. We do not really use that old word any more. What you are is a little out of control. There is a saying, from a century or more ago, that is still

very true. 'One drink is just right, two is too many, three is not enough.' Keep that in mind. Do not let people pressure you. If they do, cut them off."

Sami said, "I don't have many friends. I have so much work to do. So much depends on what we five Anas do, and I'm the youngest. I feel ... inadequate, I guess."

I answered softly, "Of course. You compare yourself to Ana Phoebe, Ana Lilli, Ana Blanca. But talk to them. *They* do not think you are inadequate. Phoebe admires you and your accomplishments. Also, remember they are older and more experienced than you. Wait until you are 30 and then look back to this time. You will probably laugh at how you didn't *really* understand anything at all. That's universal."

I added, "And another thing. Ana Phoebe told me you don't have to work or think about work *all* the time. She does not. She goes flying in a club every other day. Clear your mind, do something else entirely. There are many active clubs here on Luna. Enactment clubs. Sports clubs. Arts clubs. I have heard that the Concord is making a few microgravity habs for 3D ballet and other entertainment, maybe new sports. You're one of the few who understand how that works. Maybe it would be fun that doesn't involve hurting your brain."

Sami said, "But what about when I'm out with Maddie? Maddie's fun, but" She trailed off.

I said, "Here is some advice, something to practice. Whenever you are thinking of taking a drink, repeat the 'one two three' saying. Let the drink slide for a minute or two, and see how you feel. If Maddie wants you to drink with her, deflect her. If she insists ... well, you are an Ana, the top of the social pyramid on this world. If we had royalty, you'd be a princess. She may be older, but you do not have to listen to her."

We went back and forth. Sami was stressed, and she was comparing herself to older people she thought of as giants. She had a dream, space travel, which was going more slowly than she wished. In addition, she had a friend who was oblivious to Samaya's problems and was dragging her down.

At the end of our time, I said, "Samaya, I want something from you. You need to attend a group meeting I have regularly, with other girls about your age, with similar problems. What you are trying to deal with is not unique." She started to say something, but I went on, "You can keep your position in the world hidden. In the group, call yourself 'Sami' or even just 'Sam'. Be vague about what you do. It is not a place where people ask questions. You will be helped by seeing that you are not alone."

She said, "If they don't ask questions or talk about themselves, what do they do?"

I answered her, "The group is about emotions and feelings, and about dealing with them in your thoughts. People talk about those things, share them. I do not know exactly what you do as an Ana, of course, but I have a general idea. You had to learn a totally different way of thinking about physics and reality, and apply that to change the way physics works. Emotions and feelings are the way we process our lives, the way we 'think about' the events in them, the people in them. You are a little skewed sideways now in this kind of 'thinking'. In therapy and in group, a primary goal is to change yourself to a better way of processing life. Better for *you*, I mean. I cannot tell you what that is — you have to find it. And then live it. Talking to other people is a good way to start. I know, this is my profession."

She listened closely. Later that week, she started coming to group meetings.

Ian MacLean

In the first couple years I lived on Luna, I sent a few tidbits of space-related info to Erez. For example, about my brother's terameter radio telescope project, which involved launching a large number of remote sensing stations to locations all over the Solar System. I didn't get much direct feedback from Erez, but someone would show up at my hab with a small gift, at random times. It was always a new immigrant, bringing a short handwritten note from Erez and some Earth delicacy not easily found on Luna. Jamaican Blue Mountain coffee. Fine Belgian chocolates. Once, a bottle of Johnnie Walker Blue Label whisky. I didn't like to drink so much, so I had a small amount — extremely smooth — and then gave the rest to a friend.

That friend introduced me to Madeline Preux. When she wasn't drinking too much, Maddie was a lot of fun. Somehow, after just a few months on Luna, she knew a thousand hangouts and chill zones, and a thousand people who circulated through them. The wild life, in small doses, appealed to me. As did Maddie, who was very pretty. We were both space enthusiasts, and moaned about the death of space travel. Translocation was so easy that no one wanted to go farther out the hard way.

Maddie and I were a "thing" for a while, but that tapered off with no hard feelings. She didn't want a big romantic whoop-doodle, and neither did I.

Sometime after I met Maddie's friend Sami, Maddie "accidentally" mentioned that Sami was actually Ana Samaya. What's more, Maddie said that Samaya was planning to build a spaceship! What the hell? That was about as exciting as it gets. I started paying more attention to Sami. Of course, I mentioned this to Erez in a note I sent by one of his other "observers" who was traveling to Earth. In response, I got a long handwritten note from Erez, full of *very* interesting ideas. I nodded as I read it. I'd have to make some arrangements.

Madeline Preux

One day, Sami told me that from then on, she was "Sam". Okay, why not? We still hung out together, and sometimes with Ian, but she pretty much cut out drinking. Which made Sam less fun than Sami. Or so I felt. I said as much to Ian, and he said, "I can't agree. Sam is growing up, as she should, and making her own path in life. I admire that."

By this point, the ship was taking form. The upper half of the sphere was shaped. The outermost layers were a sandwich of titanium and some kind of plastic which was supposed to cut down radiation. There were also several thick layers of gold, to cut down other kinds of radiation, but you couldn't see them. How she made all this stuff from rock was totally beyond me. I had wanted the outside to be shimmering pure gold, but Sami — Sam — said, "No. Gold on the outside would cause secondary radiation from galactic cosmic rays. The polyethylene will tame those rays, and then the layers of gold will absorb what's left. The titanium layers and struts are for physical strength. It's all calculated to keep us from getting damaged. This is the way it has to be." Oh well. Ana has spoken.

A few days later, Ian and I were out trolling around in the snack bars, and something he said made me look at him hard. I asked him, "Are you and Sami screwing around now? What are you, ten years older than her?"

He looked sheepish, and said, "Twelve, actually. And, yes to the first question. Not that it's any of your business, Miss Snoopy."

I raised my glass to him, and said, “You’re right, it isn’t my business. Oh yes, congratulations. Treat her well. If nothing else, she’s part of the royal family. Or is the order of high priestesses? Princess priestesses? Whatever. Tell me, has she shared any plans for our first voyage? You know, pillow talk.”

He scowled for an instant, then said, “Nothing like that. I don’t know any more than you about the ship or her plans. I don’t even know what she wants to name it. It won’t be *Epsilon*, I’m sure.”

I was about to say something stupid (“Maybe she’ll call it the *Ian*”), but I stopped myself in time. Men can be touchy about things which women will just laugh at.

Ana Samaya

I fell in love with Ian. At least, I thought I was in love. He was open, funny, pretty smart, and good looking. We seemed to complete each other’s thoughts. (And bodies, as well.) Together, we worked to design the interior of the ship, and this part of the project went like a dream. He improved my plans, and I improved his.

My parents didn’t like him. My mother told me, “It’s not that he’s older than you. I know that’s what you think, Samaya, but that’s not true. There’s something about him ... I can’t put it into words, but he’s holding something back. Your father feels it and so do I.”

I said, “You just think I’m too young to be so serious. I’m grown up now, Mother. I do important work. My software is creating billions of tons of chemicals to make the surface of Luna habitable. I’m not a girl anymore. I’m a woman, independent. Ian is *not* hiding anything. He’s totally open with me, and I am with him.”

As an Ana, I received the highest pay rate on Luna. I hadn’t spent much credit before, but now I used my resources to get a top level living unit in a beautiful hab. Ian and I moved in, and thought it was a lovely place.

My colleagues, the four other Anas, didn’t say anything about Ian. Phoebe still dropped by the ship project weekly to see what was going on. She made a number of incredibly astute suggestions about the thrusting mechanism and how to control it. Kamaria mysteriously told me she was working on a “foolproof” security system, and would hand the Qcoh software over to me soon.

When the structure of the ship was finished, the next phase was to build the interior. That was when Ian’s skills really shone. On Earth, he’d worked summer vacations on building a couple of houses — there was a lot in common with that kind of construction and what we needed to do inside the ship. He was great with tools and fitting out the hundreds of detailed things which weren’t feasible to make with Qcoh software. Simple things, like installing beds and seats. Complicated things that you might overlook if you were just writing a novel about it, like plumbing for air, water, and sewage. Maddie provided a valuable extra set of hands for this work. It turned out she also was pretty good with tools, and was stronger than she looked.

Meanwhile, I put the finishing touches on the software for the ship. One of the first parts of the interior fit-out was installing and igniting the 100 Qcoh chips in little cubbies which had been left in the titanium inner spherical hull. Then I would load my software, and start testing it. No one chip was vital — it was a fully distributed system. As long as at least a dozen chips were running, the ship would operate to propel itself, to let us see out and communicate, and keep us alive.

My first priority, after the chips were running, was to test the internal air circulation and purification subsystem. For the first days inside, I had to rig something to pump air in and out via translocator. It was that, or wear breathing apparatus.

These were intense weeks. And wonderful. For too long I'd watched the complicated transmutation process create the ship. Millimeter by millimeter, crawling down the huge rock cylinder. Now we were *doing* something every day. Nights with Ian were wonderful, too.

I tested the momentum drive just a touch, to make sure it worked. Very carefully, I made the ship lift off the floor of the empty cylinder around it. A few centimeters was enough. I left it hovering for a day. This test was equivalent to propelling continuously out in space at one-sixth gee, which was already more impressive than any old fashioned rocket ship could ever have achieved.

The final step was to build the big translocator through which I'd take the ship into Lunar orbit. This task was nothing new, since such max sized things were in common use for moving cargo between Earth and Luna, or between sites on Luna itself. We built the translocator around the ship. Launching to low Lunar orbit would be done by simply pressing a button.

Ana Phoebe

Samaya (I couldn't bring myself to call her "Sam") gave us a tour of the ship before her test flight. I quizzed her closely about every point I could think of. Most of all about backups. My real intent was to impress on her, again, how serious this was. Once out in deep space, there was no rescue if anything bad happened, if anything critical failed.

At the end, Mama asked her, "And what's the ship's name going to be, Samaya? You said it was finished, but I don't see anything on the outside about *what* this ship is called."

Samaya tried to look like she hadn't thought of that issue, but she wasn't a good actor. My guess is that she wanted to name it *MacLean*, as she was clearly besotted with Ian. Uncharacteristically, she didn't have the courage to bring that up at this point. Instead, she said, "I haven't really given it much thought. What do you think?"

Mama said, "I'd suggest you call it after my mother, who in a way is responsible for all of this." She swept her right arm around, taking in the hab, the ship, and all of Luna. Continuing, "But that would be *Blanca*, which of course is also one of us. Perhaps name it *Ortega*?" The Blanca that was present smiled.

I knew that proposal wouldn't go over well, since the younger Anas had no real connection to events and people in the "distant" past. Instead, I quickly suggested something neutral-ish, "How about calling it the *Aleph Zero*? The first level of infinity." And that was the conclusion.

Later, Blanca and I talked privately with Kamaria. Blanca said, "Are you sure your security and control system are foolproof? And the safety backup in case some catastrophe incapacitates the crew?"

Kami stepped us through the contingencies. Finally, I said, "The only thing you haven't thought of is the possibility that Samaya herself becomes the disaster. She controls the ship, so I suppose there is no way to prevent *her* from doing ... whatever else we might be afraid of."

Kami said, "Well, she would have serious trouble ramming the ship into Earth or Luna at hypervelocities. I haven't told her yet, but I've put in a constraint on the drive software to prevent such

insanities. I'm sure she's clever enough to get around that with enough effort, but I doubt it even comes up. But is this a realistic concern?"

Blanca answered before I could, "No, not realistic. But the potential downside is so large that insuring against it is worth the effort."

The conversation turned to Gerald. Kami told us, "He's leaving the Musician's colony in the Aariz Shaft, and moving to a hab in Galileo City. He's going to work in a 1970s America themed hab, playing music and work on his composing. I'm really excited. I'll be able to see him all the time." Blanca and I had both met Gerald several times and liked him. Straightforward guy. Just don't get him talking about the Grateful Dead, because it could be hard to get away without being rude.

I said, "Bring him over for dinner. Emily hasn't met Gerald yet, and she's burning to. Plus, I've got a secret to share with you. Don't tell anyone else. I'm pregnant, with a boy."

The conversation further evolved into a shriek or two, then laughter.

Ana Samaya

The name wasn't so bad. *Aleph Zero* — our first step to infinity after a long pause in even trying. Ana Phoebe was, as always, wise and clever. The voyage of the *Aleph Zero* would be a milestone in history.

My plan was to spend a few hours in Lunar orbit, checking the systems. Then a half gravity slow loop around Earth and back. That shakedown would take about ten hours. Some more time to check the data recorded during flight. Once everything seemed good, we'd take on more supplies, and then a two gravity trip to Mars! About two days, give or take. A few days there, and then two days back. A week roundtrip. Not bad, if I say so myself. Faster than the old Atlantic crossings, and probably more comfortable.

I checked everything possible about seven times. Then, it was launch time. I had wanted to be on board, but Ana Lilli nixed that idea. "Push or pull translocation of humans, without a locus at the other end, is only for urgent situations. You can translocate up to the ship into its own locus, once the ship is launched — uncrewed. Let the ship reignite and power itself up, then go."

The launch observation party was small. Just the five Anas, Maddie, and of course Ian. Nothing much happened. No speeches. I just said, "Okay, it's all set," and pressed the button. *Aleph Zero* vanished.

A tense moment of nothing, while the ship rebooted. Then its neutrino telemetry came through. Orbit as assigned by Lunar traffic control. All systems reported "ready". It was time for me to go. Just me. I would carry out the final checks alone. Saluting everyone, I stepped into the personal translocator locus, and left.

As always, there was no sensation to the translocation. The first thing which told me I was somewhere else is that the gravity went away. The second thing was when I turned on the 3D K-display projection of the outside view. Not our ship construction hab, but Luna and stars. I was in space! In my spaceship!

I'll skip telling about the testing in Lunar orbit. Mostly boring, but our lives depended on everything working. After a few hours, I put the controls back to their standby state. Then I reactivated the ship's internal translocator locus and signaled my 'crew' to come aboard.

And we were off on our maiden voyage around Earth and back. As we moved, Maddie said, "I don't feel anything at all."

I sighed inside my head. Outside my head, I explained, "The *Aleph*'s acceleration affects the ship and us equally. Even at full boost we won't feel anything. You know that. Why else have we been practicing for weeks in the free fall hab?" It bothered me that she didn't remember, but I also realized she was nervous. Her life depended on the ship's hardware and software completely. That is, it depended on me.

Maddie didn't like zero gee. She had complained of nausea and disorientation in our microgravity training. She had even talked about not going on our voyage. "I don't think I can take it, not for a week. Can't you give us some fake gravity, Sam?" I had tried to explain that the method used in the high gee habs to change the apparent pull of gravity-acceleration wouldn't work in the confined volume of the ship, but she didn't understand. I didn't fully understand either (but I didn't tell Maddie that). Pseudo-gravity and force beams were very complicated, and only Lilliana and Phoebe fully knew how they worked.

Maddie repeated her complaints, this time about the "ten whole hours" spent, when we could have done it faster. I told her, "Neil Armstrong spent three days in free fall going from Earth to Luna. We're on the express train, and have a lot more space, with better food, than those guys did. You're just spoiled by translocation." I was getting tired of her complaints. Did she expect bathtubs and massages in space? We were pioneers. What we were doing was a lot faster and more comfortable than crossing the American prairie had been, back in the day. Kids these days, right?

In Lunar orbit again, I re-synced our on-board translocator with the one in the construction hab. Back home, with the walls not so close, Maddie buzzed off to take a shower and change her clothes. To Ian, I said, "I didn't think she'd be anything like that annoying. Is it that she's spoiled, or is it claustrophobia? In either case, I'm not sure I want her on the weeklong trip to Mars and back."

Ian answered, "I agree. Besides, I'd like to be alone with you on this expedition. I've got some things to talk to you about." He wouldn't say more. This was exciting.

I made up some story to tell Maddie about why she couldn't go. But she forestalled me. The next day, she started our conversation by saying, "I don't want to go to Mars, after all. I don't think I can take free fall for a week. The close quarters ... they give me the creeps sometimes. I'm sorry, Sam. I'll have to wait until you can give me some artificial gravity, and a little more space. You'll have to find someone else for that third bunk."

I said, "There isn't time. Ian and I will be the crew for this first trip. It'll be your turn someday, don't worry, Maddie. Maybe the next ship will be a cylinder, and we'll spin it to make the centrifugal force pinch hit for gravity. The problem with a decent sized cylinder is that it would have to be assembled on the surface or in space. The surface will have to wait, and space is just too difficult. Give me a few years. By then, we'll have spacesuits and can actually leave the ship."

She answered, "I can dream. Just you two going? I suppose it's romantic. But also a little weird. I can only tell you, be careful out there." I laughed at her. She was just jealous. I knew Ian had had a fling with her before he met me. I didn't ask what she meant by "weird".

Before Ian and I left for Mars, Ana Phoebe came to visit one more time. She said, "Mama and I want to remind you, Samaya, that the *Aleph Zero* is potentially a terrible weapon. Not just because it could destroy a continent, or worse. Your ship represents a next phase, a next step outwards.

Ruthless people always want to exploit frontiers. Come home intact and safe. Don't do anything I wouldn't do."

I smiled at her, but I didn't mean it — because I didn't really understand what she was saying. I answered, "It's only a week, eight days maximum. The safety systems will ensure our return. Unless we run into an antimatter blob out there." I gave a little fake laugh. That was the best joke I could think of, and as I said it I realized it was pretty stupid. Oh well.

We left Lunar orbit accelerating at half gee, since that had worked on the swing around Earth. Then I slowly ramped the acceleration upwards. Ian watched what I did closely. I could tell he was a little nervous, and he kept commenting. Statements like, "I don't feel anything yet." And he counted up the tenths of Earth acceleration, "zero point six ... zero point seven ... zero point eight", until I told him to stop.

I said, "Why should you feel anything just because we're accelerating faster than any other space vehicle in history? The physics is clear. If we felt anything, something would be terribly wrong. That's why I'm taking it slow, so if I *do* feel something, I can back off and we can limp home."

He said, "I never asked before. Is that why you limited the acceleration to two Earth gravities? Safety?"

I told him, "Pretty much. If something goes wrong with the uniform acceleration, we personally can stand two gees and the ship's structure won't tear itself apart. We won't like it, or like being jerked around, but it probably won't kill us. A partial boost malfunction at ten gees — we're dead, even if the ship itself holds together just fine. As I designed it to."

He asked, "So what's the upper limit of what you *could* do? Ten gees?"

I said, "No. Calculate it yourself. We're being pushed by pretty much the same effect which transits you from Earth to Luna when you translocate. Four hundred thousand kilometers in four minutes. Figure it out."

He laughed, as I meant him to. "I'd have to take off my socks and count on my toes to do that kind of math. I guess it's pretty high, though."

I nodded. "But our transit time goes down only as the square root of acceleration. If we accelerated 100 times as much, we'd only get there 10 times as fast. At some point, it's just not worth the effort. At the two gees we've just reached, Mars in two days. Not so hard to take."

But there wasn't so much to do on our transit to Mars. With nearly unlimited thrust available, navigation was basically (1) make a rough course in the right direction, then (2) refine it as we got closer. No tricky orbital optimization needed, at least for a short jump like this. Going out further, say to Pluto or Eris, would require a little more complexity. I'd worry about that later.

Not so much to do? Being alone, we rearranged the bunks downstairs — I mean, on the lower deck — so we could be together. Not that 'lower' meant much in zero gee. Every so often I'd run diagnostics and check our progress. Other than that, Ian and I could do whatever we wanted. Which we did.

Ian was very interested in watching what I did when I used the controls. I commented on his observations, and he said, "Someday, I might be the pilot myself on such a ship. The *Aleph Two*, maybe? I'm trying to understand what you are doing, and why. Besides, what if you pass out or something? I'd like to get us back to Luna rather than just blast off at two gees into interstellar space forever."

I reassured him. “The system has a ‘save me’ feature. Just do *this* then *this*, and the navigation software will take the ship back to the Lunar orbit which we were assigned. You literally don’t have to do anything else. It will also activate if no one operates the controls at all for 24 hours. Even if we die out here, the ship will go home.”

He was very interested in that feature. “It’s a clever idea. But what if we leave the ship for longer than that?”

I punched him on the arm, which made him float away. Zero gee, remember. I said, “You know we don’t have spacesuits on this trip. We aren’t leaving the ship, until we get back to translocator range of Luna. It’s a shame that we won’t be walking on Mars, but standard vacuum gear requires too much training — we wouldn’t be leaving for another year, at least, if that had been part of the plan. Plus, you don’t realize that designing Qcoh powered suits would be much more difficult than designing this ship was. Someday, maybe we’ll be strolling around outside wearing form-fitting invisible force fields, keeping us alive. For this trip, we’re stuck inside with each other.”

By then he’d floated back. He kissed me on the cheek, and then said, “It’s not so bad, I guess.”

We touched down at several locations. Not just to brag, “We were the first people ever to land on Mars.” We were also gathering samples to take home for scientific analyses. Translocated directly into holding bins built into the middle region of our protective structure. Previous robot missions had returned only about a kilogram of soil and rock samples. We would be bringing back several hundred kilograms, from selected regions, and from selected depths — the translocator could easily reach underground to pull up rocks.

Just before our planned departure time, Ian said, “I’ve got a surprise for you.” I was all for surprises — nice ones, I mean. He didn’t disappoint. By some magic, he produced a bottle of sparkling wine. I lit up. I hadn’t had a drink in a month, but now was the best time for at least a sip. Ian pointed out that we had to drink it all before leaving Mars. It’s not easy to figure out how to drink sparkling wine with any panache, or at all, when you’re in free fall.

We laughed, we clinked glasses, we drank ... wash, rinse, repeat. The first people to get even a little drunk on Mars. Laughing more, we went to the lower deck and our cobbled together double bed.

I woke up in free fall. That was disorienting. After a second or two, frightening. We were in space, and *I* wasn’t at the controls? What the ...? My head felt woozy.

I managed to untangle myself from the sheets and float up the ladderway to the control deck. Ian was strapped into the control couch. He must have heard me, because he turned and said, “I didn’t expect you to be awake so soon.”

Ignoring his words, I said, “What the fuck are you doing? Driving my ship without me!?” I didn’t try to conceal my anger.

He said, quite peacefully, “Remember I said I had some things to tell you? Now would be a good time, if you can calm down.”

I didn’t. Calm down, that is. “*I* designed and built this ship. You provided some hands and some feedback, that’s all. This is *my* ship, and we go when and where *I* say. In the old days, mutineers walked the plank into an ocean of hungry sharks. You’re lucky I didn’t install a plank.”

I hadn’t meant to be funny, but he laughed. Probably being nude didn’t give me an air of authority, either. But I wasn’t joking and I was in command. If necessary, I’d make that clear to him.

Ian said, "I just thought I'd get us started back a little early. Now that you are awake, let's have that talk."

I looked at the displays. We were more than halfway back to the Earth-Luna system. I'd slept for nearly 36 hours! Maybe more. I shook my head. My brain still was stuck on the "woozy" setting.

I glared at him. "Did you drug me? What the fuck is going on here? Do you want to be a solo farmer, or what?"

He said, "I have a proposition for you. A very profitable proposition. It's best if you wait until we get to Earth. But I can outline it for you if you're impatient."

I thought of screaming at him, but that didn't seem likely to get good results. At least my anger was de-woozying me. Adrenaline? Internally, I was saying, "Think, think, think. That's your specialty, isn't it Princess Ana?" After a moment, I choked out, semi-calmly, "Let me get dressed, then I'll hear whatever nonsense you have to say."

Down below, I took deep breaths and got myself into better shape. Anger changed to resolve. He wouldn't get away with this. Mutiny, kidnapping, piracy, no doubt a litany of other crimes. I took stock of myself — I really had to pee, and I needed something to eat. Then, collecting my thoughts, I focused and calmed myself using the same techniques as I used to get ready for programming the Next Physics. Fixing the details of Kami's security system in the front of my brain, I floated back up. I carefully positioned myself at the center of the deck, where there was a small stanchion and handhold. There were several of those around the deck and the inner hull, for grabbing onto with hands or feet in zero gee. Just floating around was sometimes pretty annoying.

Ian said, "That took a while. Look, we've passed the peak velocity and are braking to slow us down to the orbital speed of Earth. More than halfway home — home to riches, that is."

Keeping myself steady, I tried to sound interested. Maybe I *was* interested, a little. "Go on, Ian. What do you mean?"

He went on, "I wish you'd slept until we were on Earth. Erez could explain it all to you better. You'd get to see the benefits, not just hear about them." He paused.

I said, "Well, I'm not asleep now. And you shouldn't have drugged me. I don't know if I can ever forgive that. Right now, I'm angry with you. But tell me the rest. Who is Erez?" My tone was calmness incarnate, despite my underlying outrage. I even avoided adding "the fuck" before "is Erez" in my question.

"The whole thing is simple. Erez wants to do to Mars what is being done to Luna — colonize and terraform it. It's been a dream of his for decades. *You*, Samaya, are the key. Your ship is the prototype for a fleet. More crucially, your mind and his resources can make it happen. You will be the Ana Lilli of Mars. Except that the society there won't be wedded to this 'no rich, no poor' nonsense. You will be wealthy. Don't tell me you haven't seen how the super-rich live on Earth. That will be your life, starting a day from now when we arrive."

He added, "Erez wanted to be the one to talk to you. He's got all the detailed ideas and plans, and he is very persuasive."

I admit I was tempted, for a second. I *had* seen how the rich lived on Earth, when I was down in Hawai'i, and sometimes it attracted me. A dwelling unit in a Lunar hab was comfortable, much better than most people had on Earth. But luxury only came in occasional dribs and drabs. The idea of servants seemed attractive, in an abstract sense. People to do the ordinary stuff of living for me.

But when I actually thought of ordering people around just for my own enjoyment or convenience, I got pretty uncomfortable. It wouldn't be like when I'd made the engineers do what I wanted — that was not for me, but for everybody.

After those thoughts passed through my mind, I said to myself, "Nah. I'll just stay me, the lowliest of the Anas. I don't really want to be a princess." So how to say "no" and make it stick?

I had the feeling that yelling at Ian probably wouldn't help. Another thing that wouldn't help would be saying, "Let's go to Luna and talk it over" — he was too far into whatever plot was hatching. So I had to temporize. I asked, "But who is this Erez guy?"

Ian was forceful. "He's one of the richest men on Earth. He has power and influence, as well as money. He's getting old, and wants Mars to be his legacy. He'll give you whatever you need and want. A palace and servants while working on Earth? Sure, no problem. Sign a billion dollars over to you the day you agree to his plan? Sure, no problem. He's buying a chip factory which is already producing Lunar-style Ana tech chips. With you in charge, he can utilize them for the Mars project. Build spaceships, terraforming machines, and so on. You know all about these things. All he needs is your help to fulfill his dream. He'll do anything you want."

I wanted him to go on. What did he expect to get out of this deal for himself? And had he somehow gotten rid of Maddie, maybe slipping her drugs to make her uncomfortable in the ship and in zero gee? Or was that just lucky for his plan?

On the other hand, there was no point in carrying on the conversation. I knew what I wanted, and it wasn't to go see Erez. Once on Earth, I'd be helpless. In my own ship, I was not.

Ian had unbuckled from the control couch, so he could face me while we talked. He'd drifted away from the control panels, and had grabbed a handhold on the inner hull. That was a good place for him. From my point of view, I mean.

I asked him, "What if I don't want to go to Earth just now? We can go back to Luna and talk about it there." While I was doing this, I was re-calming myself down, getting ready for the next step.

Ian answered, "That's not an option now. We'll be at Earth in less than 12 hours. Let's land at Erez's Colorado retreat, and discuss it with him. I think you'll like what he has to show you."

No doubt I would "like" it. That didn't mean I would *want* it. Or that I would betray my whole life up to now for it. I thought of Phoebe, my mentor and ally. I thought of Kamaria, almost my sister. I thought of my parents and brothers. What would all of them think if I went along with this scheme? What would *I* think of myself?

I had to take the first step. Which did not require any physical effort. On the contrary, what I had to do was be still and calm, even cool. I closed my eyes and silently spoke the mantra *roam home, roam home, roam home*. Then I glanced over at the controls. My interior mantra had worked. Voicelessly, I added, "Thanks, Kami." Her mind reading software was crude, but its pattern matching was good enough for simple things.

Ian caught my glance, and realized something on the control displays had changed, and that the external display had vanished. He said, "What just happened? Did you do something?"

I said, trying to sound so innocent, "I think the ship somehow started its emergency return home program. It's autopiloting us back to Lunar orbit, and sending a message to the Council of Anas. You must have done something, but I can't tell what from here."

He stared at the displays, and propelled himself to look at them closer. He looked back at me with a strange expression. A mixture of surprise and anger, maybe. He said suspiciously, "It says we're accelerating again, at eight gee. I don't feel anything different."

And I'd thought he was smart. He tried to change the controls, but of course that didn't work. "Emergency return home" means exactly that. It couldn't be interfered with easily, especially by anyone not me.

Anger for sure now. "Change it back, and head to Earth. How did you do that?" As if I'd tell him. He repeated himself, louder. "Change it back, Samaya. We're not going back to Luna."

I fibbed a little, "It's started, I don't know how, and there's no way to turn it off. We'll be back at Luna in five or six hours, I estimate. Now that the emergency acceleration has been invoked, we'll be moving faster." Could I wait him out, keep him talking for all that time? Didn't seem likely.

The probability of keeping him quiescent for hours dropped quickly to zero. He glared at me. Had I loved this man? Then he said, "Stop it now, take us to Earth, or I'll make you." Then he calmed himself, and said a little pleadingly, "Samaya, Sam. Give Erez a chance to tell you his dream, to tell you the benefits. Not just to you and me, although those are huge, but to every single person. Mars is a better long term habitat for humans than Luna."

I ignored his plea, and lied again, "I can't change it, Ian. The emergency return program isn't built to be turned off. Some bug or weird combination of circumstances might have started it. Now we'll have to live with it." This moment was the point where it started to get more serious.

Ian backed from the controls to his handhold. Holding on with his left, he pulled something out of his shirt with the right hand. Was that a ... gun? What was the word, pistol? He said, "Fix it, Samaya. Take us to Earth. I know you can do it."

I stared at his hand. He didn't point his weapon at me, but his face said that was the next step. I didn't have a lot of options. I tried to think two ways at once. Not so easy, but it wasn't that different than when I'd learned to think in a "calmly furious trance" about several math/physics topics at once. This task wasn't so complicated.

I bought time by talking. Inanely, I started with, "Is that a gun, Ian? Where did you get it?" I made myself calm again, silently saying inside a new mantra. *Spin to win. Spin to win. Spin to win.*

He said something, but whatever it was, it was irrelevant. All I had to do was keep thinking clearly. *Spin to win. Spin to win.* And keep talking, to distract Ian from what was about to happen. I said aloud, "Are you going to shoot it? If you kill me, literally nothing can stop you from returning to Luna."

He started to speak, "It's an electric stunner, like I just said. It can't kill you. But it will hurt. Do you want a sample?" He started to adjust it, but then said in a more strained voice, "What is happening? Is the ship going crazy?" He sounded scared. Good. He should be.

The ship was spinning around its axis. The axis on which I was located. Faster and faster we spun, and the centrifugal "force" pressed him back against the half-spherical wall of the control deck. He tried to raise and point the pistol, but he wasn't used to the "gravity" he was feeling. Already well above Lunar strength, the force kept going up as I mentally chanted my mantra.

The ship quickly spun up to the rate at which he was pressed outwards at two gees — double his Earth weight, and twelve times his Lunar weight. His attempt to point the pistol at me ended in it spinning out of his hand and getting itself pinned to the wall a meter away. Of course, from his point of

view, the wall was now the floor. I doubted he was comfortable. He was lying in a slightly contorted position. He managed to adjust himself slowly and with difficulty.

I held my grip at the center. The force on me was much smaller, since I was very close to the spin axis and he was four meters away. This was enough, I thought. Then added, to myself, “Thank you again, Kami.”

I held on firmly, and also had to hold my head pretty still. The spinning caused weird sensations if I rotated my head quickly. If I let go, I’d be thrown “down”, like falling off a short cliff ending in hitting the metal hull. Since everything I could see was also spinning at the same rate, there were no visible signs of our rotation.

I watched him closely, to see if he’d try something. Like trying to get his stun gun. Or pull something else out of his pocket. Two gees is heavy, but shouldn’t really glue him down. Then I spoke aloud. “Would you like to be dropped off on Earth? Or return to Luna?”

He non-answered, “How did you do that? And why aren’t you affected?”

I thought of telling him. No, there was no reason to explain. I had to remain calm, and not give anything away. If he couldn’t figure it out, too bad for him. I didn’t have so many other tools to use if he had other weapons, or got hold of his stunner. Tools which wouldn’t hurt me also, I mean.

Reducing the oxygen level wasn’t a good plan, not since we were in the same compartment. The security plan wasn’t flexible enough to deal with this situation. About all I could do would be to further increase the spin, say to three gees at his radius. That would pin him down pretty good — triple his Earth weight. I’d have to hold on pretty tightly, though.

I answered him, “The answer to both your questions is ‘That’s a secret’. You know we Anas, we have lots of secrets spinning around in our heads. Changing the subject, I’m not that impressed with your Erez. How did he get rich, being so stupid? If he thinks that kidnapping me is a good idea — well, I wouldn’t want to be him when Ana Lilli and Ana Phoebe get done with him. He’s a shit kicking moron. He should have asked, politely.”

Meanwhile, I was thinking hard. What’s the end game? How do I get out of this? We would be back in Lunar orbit in a few hours, and I could hold on that long. Even if I’d have to pee my pants. But when we arrived?

I ran through the security options in my mind several times, trying to find a clean way out. Meanwhile, I listened to Ian trying to justify himself and his Erez. There’s an idea in literature, the “subtext”, the unstated background to the actual writing, the invisible framework of assumptions on which the whole narrative hangs. As he went on, I came to realize Ian’s subtext was, “I’m tired of Luna, and this is my opportunity to return to Earth and get rich.” Some immigrants didn’t like living in the Concord and went downwards to the Earth. Fine. Kami’s father had done that (the jerk). But the leavers usually didn’t resort to hijacking and kidnapping along the way.

It was just in time that I noticed he was trying to inch over towards the pain gun. That was good, in a way. His action indicated to me that he probably didn’t have any other weapons to turn on me. I broke my silence to say, “That’s not nice, Ian. Do you want me to turn up the gravity holding you down? It won’t be pleasant.” It wasn’t gravity, of course, but he didn’t need to know that.

He stopped moving, and snapped out, “Fuck you, bitch.” The swearing shocked me. He’d never sworn in my presence before. I’d even commented on it to him. It’s funny how little things are

the ones which leave the big impressions. His gun, a much bigger threat than the word “bitch”, had less of an impact on me than his outburst.

There was only one solution to my problem. Wait until we were close enough to Luna for a near realtime chat, and call for help. I couldn't move from my spot, so Ian would have to overhear everything.

Hours went by, slowly. I held myself centered and motionless as much as possible, to reduce the force I had to apply not to fall. One hand holding for a while, then switching to the other. Carefully. Watching Ian and his pain gun all the time.

After a long while, Ian spoke again. “I'd rather be left off at Earth. You asked, remember?”

I shook my head (which was a mistake), “That's not an option now. I'd have to turn off the force holding you to the wall, and then ... well, I don't know what happens then. And I don't want to find out. We'll return to Lunar orbit.”

He said, “How will you get off the ship yourself, then, if you don't turn off the force? I can tell if you move from where you are, you'll fall down also and be pressed to this hull.”

I said with more bravado than was warranted, “You'll find out. It won't be long before it becomes obvious.”

More silence. I resisted, again, the urge to chat. There was nothing to say which wasn't inane or enraged. The situation didn't call for inane. I thought of screaming at him. Something like, “I *loved* you.” Then I mentally dropped that one into the inane bucket.

Finally, I judged we were close enough. About a million kilometers out, braking hard. Round trip speed of light lag of 6 seconds, and shrinking. I spoke aloud, “*Ya Pulingina*. Emergency call for Ana Phoebe. Override Zeta Omicron Gamma.”

Ana Phoebe

I listened to Samaya's description of her plight. In the background, I heard Ian yelling something, but Samaya told him sharply to “shut up, you wombat fucker”. As it was clear Ian would hear everything, I just said, “I understand what you need, Samaya. You don't have to explain any further. Stand ready. We'll just be a few moments.”

I contacted Mama and Blanca, and they met me at Security headquarters. Blanca had thought to bring Emily. “In case of any medical need.” I'd forgotten my own wife in the rush! The other mother of my son.

The Security chief, Guardian Rojina, was surprised to see three Anas and a physician suddenly show up without notice. Mama explained the situation tersely, and she commandeered a translocator in the holding area. She turned to me, and said, “Phoebe sweetie, will you do the programming?”

It wasn't hard. By this time, the *Aleph Zero* was in Lunar orbit. I synchronized with the computer systems on board, and programmed our local translocator for “pull”. Luckily, the two of them were still wearing their ID rings. Combined with the ship's video feed, which made it relatively easy to localize them. However, locking into Ian's velocity and location was a little tricky, since he was rotating pretty quickly.

Then I spoke again to the ship. "Ready at our end. Ian first." I waited two seconds to see if she objected, but didn't expect her to. One ... Two ... Ian appeared in our translocator, along with a tiny section of the ship's hull, and was immediately grabbed by a security team.

Then I told Samaya, "I'd like to wait one orbit to bring you in, about two hours. You are moving out of the safest range."

She answered quickly, "No need. I will take the spin off the ship. Then you can bring the entire ship, including me, back to the construction hab on my next pass over it."

Mama leaned in and said, "No to both of you! After you spin down, you personally will translocate down normally, using your on-board locus. Then you or I or Phoebe can bring your ship back down. Pull translocation of people is only for crises. You are not in the middle of an emergency any more, Samaya dear." She paused, then added, "Welcome home."

Appendix - Timeline

2007	Twins Penni and Phoebe Tarella are born in Alabama
2028	Infant Lilliana Buckeye is found abandoned at an Ohio fire station She is placed for fostering (and possible adoption) with an evangelical family
2030	Lilliana teaches herself to read and do arithmetic
2031	Foster parents return her to state custody, as the child refuses to go to church
2032	Lilliana fostered by Blanca Ortega
2034	Lilliana starts teaching herself calculus, begins first grade
2038	Lilliana starts her machine learning research and development
2039-42	<u>The Asian wars</u> [†] (see below)
2040	Lilliana applies for a patent on her machine learning method
2042	Patent is granted; Marketing to NSA succeeds; Creation of STELA
2042-3	Lilliana instructs NSA data analysis team on her machine learning methods Lilliana starts to study cutting edge quantum mechanics Her frustration mounts as her progress is slow
2045	Begins collaboration with Edward Mitsui
2046	Fires her first attorney William Gorman Hires Richard Clifton and Cydney Fredholm Organizes STELA hedge fund Hires Edward Mitsui to start Qcoh chip design
2048	First working chips; Begin redesign
2049	Second generation chips with high output power Engineering for practical power boxes Initial breakthroughs for translocation, etc
2050	Beginning of personal relationship with Edward Mitsui Construction of underground station beneath Mt Sneffels (the first “hab”)
2051	Acquisition of smaller power companies, secret rollout of power in USA Establishment of Lunar station and what will become Habitat A Marriage to Edward Mitsui
2053	Pregnancy with the future “twin Anas” Meeting with Secretaries of Defense and Energy in new Sanchez administration Return of William Gorman; FBI investigation of STELA; Legal troubles Kidnapping and rescue of Lilliana, death of Blanca Ortega; Battle of Sneffels Ranch

	Birth of the twin Anas Blanca and Phoebe on Luna
2054	Rapid expansion of Lunar station Close relation with President Sanchez
2055	Death of President Sanchez, replaced by House Speaker Riley Battle of Lunar Habitat A Creation of Lunar Republic
2056	Lilliana steps down as First Presider of Luna
2057	Cydney Fredholm becomes first elected Presider of Lunar Concord
2058	Lilliana gives speech to United Nations, meets with world leaders Atmosphere projects begin on Earth and Luna
2060	Kathleen Turnbull elected American President
2062-5	Gigantic Qcoh “negative entropy” coolers to preserve ocean species affected by warming
2063-6	Construction of Luna’s first chip foundry Generation 3 (gen3) Qcoh chips are designed and created
2063	Kamaria is born somewhere in northern Afghanistan
2065	Dominic Newman’s run for Presider-ship is cut short by scandal Cydney Fredholm elected to her second term as Presider Dominic Newman is “extracted” from his refuge on Earth Two year old orphaned Kamaria is adopted by the Parvin family Kamaria is singled out for Ana training after the Parvin’s arrival on Luna Samaya Regas is born in Tasmania First generation identity rings introduced on Luna
2069	Regas family emigrates from Tasmania to Luna Samaya is selected for Ana training
2071-3	Ana Blanca attends medical school on Earth Ana Phoebe begins her reformulation of the Next Physics and the Deep Physics
2072	Kamaria’s father leaves Luna to return to Persia
2074	Founding of the Vesalius Institute of Medicine, including a medical school
2076	Ana Blanca graduates from VIM, begins developing micro-translocation surgery Marriage of Ana Phoebe and Dr Emily Williams
2077	gen4 Qcoh chips developed Adoption of third generation Lunar identity rings, including tiny gen2 Qcoh chips
2079	Suicide of Kamaria’s adoptive mother; Kamaria “runs away” to Shaft City Aariz
2080	Abortive war between the Israeli and Sh’ia Ali theocracies

	VIM develops highly refined neural implants Phoebe Tarella's vision is restored using the Next Medicine
2081	The Yunnan Republic becomes the first Earth nation to adopt a Luna-style Concord Luna pledges to defend Concord nations on Earth from external violence
2082	Luna begins aiding Earth nations in dealing with natural disasters when practicable Hawai'i becomes the first American state to secede and form a Concord Design of gen5 Qcoh chip begins
2083	Birth of Phobos, son of Ana Phoebe and Dr Emily Williams
2085	First voyage to Mars

†The “Asian Wars” (2039-42)

- Second Korean War
 - Much of the Korean peninsula is devastated after the war starts almost accidentally
 - War spills over the border into China, with catastrophic consequences
- Second Chinese Civil War: aftermath
 - China splits into several independent southern republics (e.g., Yunnan and Guangdong) and the northern Great Unity China (a rigidly hierarchical mix of Confucian and Maoist governance)
- South Asian nuclear exchange
 - Clashes between Indian and Chinese forces in the Himalaya regions bordering Tibet cause Pakistan to “aid” China by an impromptu (and unsolicited) nuclear attack on Indian forces
 - Retaliation by India, then tit-for-tat by Pakistan, escalates the disaster: destroyed cities, downwind radioactive contamination zones, spreading to neighboring countries