# Out of Sync

[Planet : Ceru]

[Location: Basin Zanzibar]

[2076]

## 1

Ten seconds ago collided with now, nearly knocking Michaelson down. "What the... what just happened? I already thought that thought, why did it come back?" The force of the replayed thought subverted all available synapses, including motor control. Our minds are not built for parallel thoughts, replays or otherwise.

A wave of nausea followed quickly on the heels of the rogue thought, distracting him momentarily. Michaelson stopped in his tracks. "What's going on? Could lunch do this?" He was a few hours into geological survey for a new mining location on Ceru. "No way, vacu-food ain't great, but it can't do this. This is something else."

His mind kept replaying fragments of earlier thoughts, albeit interrupted mid-sentence, like it was looping back on itself and had gotten out of phase.

‘WTF?’ An echo? Dude, is this what crazy feels like? If I bring this up they’ll bench me and give Taylor all the good routes. I’ll keep moving.”

The echoes and delays got stronger, more intense, as though the volume was turned up. “No, louder is not the right word”, he was thinking, “denser, like every cell in my head is being bombarded from all sides at once.” It hurt to think. Felt like moving through molasses, with an out-of-sync feedback loop. “There you go, your brain is reverberating in syrup. Put that in your report. ‘What’d he say? Jello brain?’ That’d be a real hit. But what do I do? If this gets worse I won’t be able to finish my route.”

“Where’s Michaelson? He was due back a half hour ago,” Captain Anna Sorenson asked. “Taylor have you heard anything?”

[Taylor] “Nope, nothing on the radio. When was his last contact?”

[Ferguson] “About 2 k’s outside the perimeter.”

[Sorenson] “That was over 2 hours ago, why didn’t I hear about this sooner?”

Michaelson looked up after taking another step. “Why is it dark already? And how do I turn off this frakking echo?” He checked his watch, 15:15hrs local time, mid-afternoon. “Dark? Now? What gives? I’d better head back. Sol don’t lie.”

[Taylor] “There. He’s over there, about a half a k out.”

[Ferguson] “What the hell is that – Tai Chi?” Ferguson asked, adjusting his scope.

[Taylor] “Huh. How can he move that slow without losing his balance?”

They brought the rover to a stop at the edge of the timpani basin a few minutes later, its surface too fragile to support a vehicle. Michaelson had come out here to Basin Zanzibar on a study to learn more about the curious radio silence enveloping it. That same silence blocked mining the rare earth elements found in abundance here.

[Taylor] “He’s going faster now.”

[Ferguson] “Yeah. Hurry up. I want to know what kept him so long out here in the [radio dead zone].”

“Base, do you copy? This is Ferguson.”

“Base here. Go ahead Ferguson.”

“We’ve got visual on Michaelson. He’s heading back. We’re going into the basin to rendezvous and return with him.”

“Copy. Mark the time, 18:15hrs.”

“Copy base, Ferguson out.”

[Taylor] “Weird, mine says 18:14, it was just on base sync. Battery must be wearing out. I’ll have it looked at later.”

“Finally, that echo is dying down. Lights – oh, they sent out others. What the hell – I have to get rescued from a walk in the park? This is weird. What am I gonna say – I don’t know what to think myself.”

Ferguson and Taylor made their way across the slope down to the surface of the basin. The relatively hard basin was a welcome change from the sandy downslope, their pace quickening in response. A few minutes later Michaelson was recognizable without using a scope. Ferguson waved and bobbed his headlamp. Michaelson waved back, bobbing once in reply as an A-Ok. They’d adapted to communicating via scopes, lights and gestures in the [radio dead zone].

They waited for Michaelson to approach given that he was not in need of aid. Taylor handed him a slate once he arrived, with ‘What’s up – why delay’ scrawled on it. Michaelson read it, furrowed his brow and wrote back ‘No idea. I did not delay’ and handed it back. This was not an answer Tayler was expecting. He was hoping for something exciting – a finding, injury or something tangible to explain the hours elapsed since his scheduled arrival time. He scrawled back ‘huh? explain’. ‘Can’t. won’t fit’ was the reply, indicating it was too complicated to fit on the simple slate.

[Taylor thinking] ‘Damn, I’ll have to wait till we clear the zone, can’t wait to hear this one.’

[19:00 hrs]

Captain Sorenson checked in with the comm officer – “What time did they enter the zone?”

“18:15 ma’am. They said they had him on visual about a half a k out.”

She considered this for a moment, doing some quick math. “So they should have only needed at most 15 minutes to reach him, and the same back. It’s been 45 minutes – they know the protocol.”

This was the first incident she’d had to deal with since taking command of this outpost. She’d only graduated the academy a few years earlier, and considered herself lucky to get a command so soon. She was hoping for something a little less remote, but had been in no position to be choosey.

The book was pretty clear about protocol breaches – zero tolerance. The protocols were forged from vast experience, loss and hard-won lessons over decades of off-world operations, and as such were not up for debate. However she was estimating their time on foot, based on a visual estimate of distance to target, both having margins of error that did not yet indicate a breach.

“If you don’t hear from them in 5 then mobilize a rescue operation.”

“Full-blown rescue? Ma’am are you sure that’s-”

“Yes.” [Sorenson thinking] ‘Yes, I think so. Nobody ever got demoted for being too safe. But if anything happens and I failed to follow, then I’m toast.’ “Yes I’m sure.”

[19:02 hrs]

“Base, do you copy?” This is Ferguson checking in.”

“Ferguson we copy. What was the cause of the delay?”

“We don’t know, Michaelson said he didn’t delay, he-”

“No – your delay. What caused your delay? You should have only needed 30 minutes. We expected you at 18:45.”

Ferguson paused. “Say again? It is 18:45, well 18:46. What gives?”

“Base time is now 19:03 hrs.”

Taylor chimed in “My watch seems to have a bad battery, maybe yours does too Ferguson.”

“That wouldn’t explain why we took 45 minutes to walk a half a k out and back.”

“Wait a sec – oh,” Taylor said, the realization dawning on him that 45 minutes of base time had actually elapsed. “Damn.”

[Base] “Ferguson – what time does Michaelson’s watch say?”

Ferguson turned from the vehicle comms and talked over suit radio to Michaelson. “What time you got?”

Michaelson replied “See that’s the thing. Seems to be running slow. I got 15:30, but it’s dark now so my suit must have a malfunction.” He thought for a second, then decided not to worry about sounding crazy. “Ok, here’s the weird part – I only perceived about an hour, maybe an hour and half going by. How’s it dark already?”

[Ferguson] “Base, he has 15:30, says he only experienced about an hour and half.”

[Base] “Proceed directly back for immediate debrief.”

[Ferguson] “Copy. Out.” Shit – there goes dinner.

Captain Sorenson considered this for a minute. This was definitely not a scenario she was expecting. I want more eyes on this. “Call engineering – have them ready to run full suit diagnostics as soon as they arrive.”

“Yes ma’am.”

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## 2

The distance to basin Zanzibar was always long, but today the drive back to base felt like an eternity. Taylor was normally the last person you’d expect to be at a loss for words, yet he just stared out at the landscape in silence. Michaelson was similarly mute. Finally Ferguson broke the silence.

“So what do you guys make of this? I mean, suit malfunctions are rare enough, but 3 at once … and how did we take so long?”

Taylor was visibly shaken. “Dude, I, uh, I mean, I don’t know. I feel ok. But we’re gonna look like idiots to the debrief board. I can walk a k on a basin in 10 minutes. We felt like we were gone at most 20 minutes, 30 tops. Which is what my suit says.”

Michaelson sat for another minute, thinking. Finally he spoke “Did you guys get the echo?”

“What echo?”

“Farther out on the basin. It got stronger as I went farther out.”

“Whoa. Was that where you were moving in slow motion too?”

“Say what? I never slowed down. Standard march pace the whole time.” This statement carried some weight – they both were aware of Michaelson’s ultra-running hobby, and his uncanny ability to pace himself steadily for hours without needing to refer to a watch.

[Taylor] “Uh, no. Dude you looked like Tai Chi man when we showed up.”

[Ferguson] “And sped up as we got closer. Holy shit…” Ferguson trailed off.

[Taylor] “What is it?”

[Ferguson] “Time dilation.”

[Taylor] “Bullshit. They’ll send us back in a padded ship if we go on talking like that.”

[Michaelson] “But how else do you explain the-”

[Taylor] “I don’t. We just go in and tell what we saw. Let them reach that conclusion on their own.”

[Ferguson] “Yeah, agreed. Besides, time dilation only happens near light speed.”

[Michaelson] “Or near a black hole.”

[Taylor] “Right, extreme gravity.”

[Ferguson] “Did you feel heavier?”

[Michaelson] “No, everything felt fine, aside from that damn echo.”

[Ferguson] “Ok, this is now bona fide weird.”

Taylor thought for a minute. “Dude, you could go out there with the your girlfriend and get freaky – you could say you did it for days and be tellin the truth!”

[Michaelson, laughing] “Shit that’s funny. Do NOT get caught doing that. You’d get busted you down to private.”

[Taylor] “Might be worth it.”

[Michaelson] “Huh?”

[Taylor] “If it lasted for days.”

[Ferguson, laughing] “Shaddup already.”

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## 3

Michaelson was dreading the debrief. It’s one thing to read about cool, exciting off-world phenomena as an aspiring student, but it is decidedly less cool when it happens to you. And when it makes you look like an idiot. He had plenty of time to think about this earlier in medical isolation. It was standard procedure after anything out of the ordinary to separate you for observation and testing. The protocol had saved many lives on dozens of occasions – he understood the need – nevertheless he felt vulnerable and more than a little crazy as he replayed the events of the day in his head while sitting in there alone. Thankfully all the tests came back clean and he was free of quarantine status.

“Just tell the truth. Stick to the facts – actions, events – leave the interpretation up to them.”

He sighed. He knew what to do, but had zero interest in doing it. He wondered what Ferguson and Taylor were thinking. They hadn’t been as affected as long as he had, and thus had less to explain.

A knock on the door signaled his turn. He opened the door.

“You’re up.”

“Yeah,” he said heavily.

“Cheer up, at least it’s not bio-quarantine, else you’d be rollin down the hall in your very own clear beach ball. Well, more of a hamster ball if you think abou-”

“Put a sock in it Meyers,” he replied, laughing.

“You know I’m right.”

“Yeah, at least I’m in my civvies, not the portable habitrail.”

“Besides, I heard they weren’t too tough on Ferguson and Taylor.”

“Really?”

“They just said it was all your fault and that seemed to cover it.”

“I shoulda known not to listen to you.”

“There’s your problem. Seriously though, it sounded to me like it was inconclusive – I heard someone say something about sending a probe.”

“Dude, don’t breach protocol. But thanks.”

‘Well, technically that was not a breach of protocol,’ he thought, ‘at least not in any detectable way. He’d shared nothing of what Ferguson and Taylor had said. The probe comment was firmly in the gray. Speculation at best. Maybe this won’t be so bad after all.’

“No sir, I felt nothing out of the ordinary until the echo started.”

“Please explain.”

“Thoughts would replay, time-delayed. It sounded like an echo of my earlier self. It began faintly, then got stronger as I moved further out into the basin.”

“Define ‘stronger’.”

“Louder. More forceful. Harder to ignore.”

“What time was this?”

“I don’t know for certain. I was busy trying to log data for the route report, and was also trying to figure out what was going on in my head. I checked the time after what felt like a normal interval – say an hour or so – then realized it was getting dark.”

“You did not notice the light diminishing sooner?”

Shit, I look like an idiot. How do you miss the sun setting? This is not a small thing to lose track of.

“No.”

[thinking] ‘How could I not notice earlier? I was logging the time during-’

“The data recordings – you were logging the time, correct? Did you not notice the passage of the sun towards the horizon while you were doing this?”

“No. The time on my watch was in sync with what I was feeling. The diminishing light was too gradual. I almost thought the visor auto-tint function was off its mark.” He felt relief at remembering that last point – he’d forgotten it until just now.

“Thank you Mr. Michaelson. That will be all. Check in with the doctor in the morning for final clearance.”

‘Really? Sweet!’ He exited the room before they could change their minds.

Michaelson made a beeline for the canteen. He hadn’t eaten since noon and was starving, however by this time of night the menu was slim. ‘Junk food sounds good right now.’ He found Taylor and Ferguson at a corner table by the large windows. Outside the sun had set, leaving the base lights as the brightest things around. They trailed off into the distance, casting an orange hue reminding him of the sight of shimmering lights from distant cabins in the mountains back home. He stood there, staring distractedly out the window, momentarily forgetting what he was doing.

“What are you doing out and walking around? We thought you’d be in the padded chamber sipping happy juice by now” quipped Taylor, laughing.

“Makes two of us,” sighed Michaelson.

[Ferguson] “Are they sending you back out there”.

“Huh?” [M]

“For the probe expedition.” [F]

“Didn’t say anything about it.” [M]

“Are you on leave?” [F]

“No, well I don’t think so. Said to check in with the doc first thing in the morning. Take it from there.” [M]

“Well make a good impression on the doc so you can join us.” [T]

“Eh? You already know?” [M]

“Dude, we volunteered,” Taylor chimed in. “I can’t wait to see what the hell this is.”

“Yeah, aren’t you curious?” asked Ferguson.

“Totally.” [M]

“But?” [F]

“I guess I’m still a bit phased about the head trip.” [M]

“Worried about lasting damage.” [F]

“Yes. Doc says the scans were all clean. Nothing to worry about. But still…” he trailed off. [M]

“Just stay outside the basin. Run the probe – you’re qualified right?” [T]

“Full pilot cert.” [M]

“Then you’re goin,” said Taylor. “There’s no way you can miss this.”

“What time do you depart?” [M]

“10:00hrs tomorrow. Plenty of time to get squared away by the doc.” [T]

“True enough. Wouldn’t they have already picked the team by now?” [Michaelson]

[Ferguson] “You are slow today. We didn’t get back until 20:30, then straight to debrief. They’re figuring all this out now.”

“Oh, right. It only seems like days.” [Michaelson]

“Go down to the comm center and check in. Tell ‘em you’re in.” [T]

“I think I will. Right after this burger.” [M]

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## 4

Anna allowed herself to get excited about the find now that the formalities of the protocol were over. This was totally unexpected for a regular mining and geologic outpost. Forget the career implications for a second, this is genuinely unknown. With possible time dilation. Wow!

“What are you smiling about chief?” the question interrupting her thought. She hadn’t realized she was smiling.

“Oh, nothing” she deflected, considering how much of her excitement to share. “Just glad we’re past the review and on to planning some action.”

“I’m with you there” the comms officer replied.

“Does the chief engineer have all the parts he needs?”

“He’s finishing the inventory now. For sure we have probe drones and imaging sounders on hand, it’s the mounting hardware that he’s looking for.” A typical mining rover would perform geologic soundings from the surface – they were not intended to be airborne.

“How long did he say it could stay airborne with a sounder on board?”

“Depending on the altitude and atmospheric density anywhere from 30 to 45 minutes.”

“Who’s doing the scan grid plan?”

Michaelson entered the comm room.

“Hello Michaelson, feeling ok?”

“Yes Ma’am. Just stopped by to see what I can do.”

“Good timing – we need input on the drone’s flight plan.”

“Sure thing.”

“We need to figure out the best way to use a sounder from the air for-”

“Beg pardon?” Michaelson asked, confused about why they’d use heavy ground equipment on a light duty probe drone.

“We were discussing solutions earlier with Chief Engineer [name] while you were in debrief. Specifically we need a way to get readings without sending anyone into the basin where you were.”

“The rovers are remote pilotable, why not drive it in there? “Oh,” he said, the realization dawning slowly on him. He was pretty tired by now. “It’ll likely slow down the same way I did, take forever to get there. So you’re going to airlift it in there.”

“Right. We think we should fly up above the field, assuming there is an ‘above.’ We’re estimating a k or 2 above the surface, but need to refine that. At what point did you feel normal again when you were exiting the basin?”

Michaelson thought back to the walk out. Man that seemed like days ago. On the plus side, this is getting interesting, and nobody seems to think I’m nuts.

“About the time I rendezvoused with Ferguson and Taylor. By then the echo was gone. I had no perception of being slow.”

“So you don’t recall your spontaneous transformation into a Tai Chi master?” Anna asked with a wry smile on her face.

Michaelson flushed initially with embarrassment, but that was quickly replaced with laughter. Damn, not sure I’ve ever seen the captain crack a joke before.

“No, I don’t recall ever putting on a black belt or snatching a pebble out of the master’s hand” he replied, laughing.

“Ok, so that puts you about here” she said, pointing to a map of the basin on a wall display. “That’s about 1 k from your farthest point, according to the logs.”

“Damn, that’s all I walked?” he asked, looking at the map. “A slug could do better, and wouldn’t need a whole afternoon. I guess the time thing got pretty strong.”

“Yep, that’s it. So if we fly a kilometer above the basin we should be free of the field, right?”

“Sounds reasonable” he said, then added “ish”. “We might want to take an unloaded drone and fly in at twice that height and validate the airspace. What if they do get slowed down – would the propulsion also be slowed – they’d drop outta the sky.”

“Agreed. [chief engineer] said the same thing. That’s why we need a good flight plan with some contingency planning. How much forward momentum would be required to have a falling drone not land in the field.”

“Oh, interesting. Fly it in fast enough that if it is adversely affected it can at least glide far enough out of the field to be retrieved.”

“Exactly.”

“And then retrieval via …?”

“Dragline.”

“Oh, that’s a cool idea. Keep the ends outside the field.”

“Right.”

“I’ll get started on the calculations and-”

“How long do you need to do them?” she interrupted.

“About a half hour,” then added “regular time,” laughing.

“Copy that. Get some sleep. Do the math in the morning.”

‘Yes ma’am.” ‘I’m in! And still a starter.’

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## 5

The next day Michaelson awoke giddy. All the fears of lost credibility were washed away. He was so excited to go on the expedition that he could not wait to verify clearance, so much that he went straight to the doc before breakfast. Michaelson never did anything before breakfast.

“You’re all set – good to go” Dr Hsu informed him after a battery of scans.

“Stoked! I’ll be rollin on chrome at 10:00!” he exclaimed.

“Chrome?” Jackson Hsu was not one for popular culture.

“Oh, the wheels on the big rover. They’re reflective like chrome.”

“Oh, I see,” he said, clearly not getting it.

“Ah. The other reference – rollin on chrome is cruising in a sweet ride. Old Earth slang.”

“What a fascinating piece of historical trivia. Does that qualify as ‘lore’?” he deadpanned with a sideways glance and the slightest of grins.

“Wait – did you just mock me? That is a first – wait til –“

“Clearly you are suffering some after-effects from your jaunt yesterday, they must’ve eluded the scans. Everyone knows I strictly follow protocol,” smiling. “Now get out of here before I decide that you need more invasive scans.”

“Yes sir.”

[internal dialogue] ‘Dang, first the captain busts out with a joke, then robo doc. Maybe I got transported to a parallel dimension or something. I should look in the mirror, maybe I’m better looking too’ he chuckled to himself. He was so absorbed in his thoughts that he tripped on a step and stumbled into a hand railing. ‘Nope, same old me. It seems my superpowers have worn off – well it was fun while it lasted.’

The vehicle hangar was buzzing with activity. He had always loved coming here – the sight of the gargantuan vehicles never got old – but today was different. ‘There was something truly unknown right there’ he thought, gazing at the horizon in the direction of Zanzibar.

“Hey Michaelson, over here.”

He saw Taylor and Ferguson loading supplies into the hold. “Is that the chow crate? Make sure I have sashimi for lunch.”

“Freakin wiseguy. You seem to be doing better today.” [F]

“Yeah, either that or I’m in another reality. Doc cracked a joke on me earlier, and –“

“Shit now I’m worried. You’re hallucinating. Straight makin things up. Everyone knows robo doc never smiles.”

“Well, he did today. Was downright nice.”

“Maybe he felt sorry for you.”

[laughs] “I think everyone is pretty keyed up about this find.”

“Hm. So it’s not that I got suddenly more charming after my dazzling performance yesterday – Oof!”

Taylor handed him a heavy crate. “Load this in the hold, Prince Charming.”

“Uhn, certainly.”

Captain Sorenson and [engineer] walked around the giant wheel and into view. “Michaelson – you ready to compute that flight plan?”

“Hell yeah, er, yes ma’am.”

[Smirking] “Good. And don’t let your enthusiasm allow any carelessness to creep in. We still have no idea what we are dealing with.”

“Yes ma’am. Understood.” He let that sink in for a minute. It can be easy to forget that most really fascinating natural phenomena out here can kill you in an instant.

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## 6

“So we’re gonna hoist up sounders over the field, and then what? How were you planning to get them down to the surface in one piece?” [M]

“Pierce and I came up with three options so far. One – we mount drone thrusters onto them and reverse thrust down. Two – parachutes. We got a supply of them in the shop.”

“We still use chutes? In this atmosphere?” [M]

“Yeah, for dropping supplies down into canyons, remote sites, that sort of thing. They’re big. Force-deployed, no tangles.”

“Wow, didn’t see that coming. Go on.”

“Three – glide it down”

“On what?”

“Anatolian drone.”

“You’ve got clearance to use one of those? We only have three on the whole planet.” [M]

Anatolian class drones are long range atmospheric laboratories that can stay airborne for weeks at a time. They have cameras in visible, infrared, ultraviolet, x-ray, gamma and half a dozen other spectra, and play a vital role in scouting out routes, habitat sites, bases for mining ops and anything else that can’t be done via the surface.

“Yes. Captain cleared it last night with the Quadrant Admiral.”

[Whistles] “This thing is already that big?” [M]

“Better believe it. When all three of your suits checked out they knew. Three simultaneous failures of independent equipment never happens. Three coordinated malfunctions never never happens. Three clocks that run at the same slowness then speed back up on base never never ever happens. Unless you got time dilation. Period.”

‘Then boom, the whole quadrant knows’ thought Michaelson.

“Cheer up kid, you’re famous. No doubt quadrant is relaying this back to Earth too, likely as more than a footnote, and your name is on it.” [engineer]

Michaelson felt uneasy at the thought of this, his earlier enthusiasm giving way to a slight queasiness. What if it turns out to be nothing? Suddenly he was glad Taylor and Ferguson came to get him, despite the appearance of being rescued from a walk in the park. Three independent suits, three independent humans. No this is not imaginary, something out there is real.

“What option you like best?” [M]

“Thrusters. Easiest to control.”

“Agreed. How long to set up?”

“Done. We built one of each last night.”

“Nice, you’re on it. I’ll start computations for the thrusters first. Hang on a sec, have we ever fired a sounder inside the [radio dead zone]? How do we know it’ll work?”

“We don’t know for sure, but we are betting that the [radio dead zone] only blanks out electro-magnetic radiation. Sounders generate compression waves, which are physical.”

Captain Sorenson climbed into the cab of the big rover and buckled in.

“You’re coming along?” Taylor asked.

“You think I’m going to just listen in on the radio back at base? Not on your life.”

Taylor nodded. His regard for her ratcheted up a notch. He didn’t like desk jockey leaders. He hadn’t seen much of her in action before yesterday, and had until now assigned her the default status of ‘just another bureaucrat.’

The big engine rumbled to life.

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## 7

Basin Zanzibar had always been something of a mystery, even among the timpani basins. All of them were odd to begin with, but by now had been explained enough that regular people could understand them, and that mining could proceed. Except Zanzibar.

Geologically they are subsidence craters, formed when prior subterranean flows receded, leaving empty lake-shaped basins behind millennia ago. The precise nature of these prior flows is unknown, and is an area of active study in several of the basins. After the dense flows retreated underground, they left behind in each basin a small area of the original flow exposed, much like a lava lake in an active volcano’s crater. Thus far this is nothing too exotic, the remnants of old volcanism on Earth and countless other planets have produced craters and depressions that resemble basins. This is where timpani basins differ – most basin erosion and backfilling occurs by material falling in from the sides, however timpani basins were backfilled from underneath.

One phenomena of the flows that has not been explained is their out-gassing. They bubbled and produced a foamy substance from any exposed surface. During the active flow phases the basins would have looked like lakes dotting the landscape, and their sudsy output would have been disbursed by surface winds. However during subsidence the foamy suds were down at the bottom of the basins, protecting them from the winds. This gave them time to congeal into a low density crystalline structure. Gradually these structures were pushed upwards by continued out-gassing, gaining size and filling the basins until they were sufficiently heavy to offset the upward pressure, capping the flow.

The basin-filling occurred quickly when considered in gelogic time scales, and was followed by a much longer period of normal surface erosion. Atmospheric weather brought in layers of sand and small rocks onto the basins, covering them with a shallow, dense layer. This layer hardened as the planet’s scarce moisture circulated over the next few million years. The result is a crust-like surface that is dead flat, visually resembles the surrounding landscape, and is structurally weak, unable to support more than a couple hundred kg per square meter. They are generally capable of holding people and light equipment, but not the large mining machines. They also produce booming echoes when you fire a sounder on them, giving them a striking likeness in both sound and shape to their namesakes, the timpani drums used in symphony orchestras.

A secondary effect of the [foamy crystalline structure] was interference. Radio communication was limited to a few hundred meters. Operations on timpani basins had to be modified significantly from every other mining playbook known. The large, automated machinery was out due to weight limitations. On-site mobile bases and camps were similarly out, being confined to the ‘lakeshores’ of solid ground. Drones and other remote controlled vehicles had limited range. Thus basin operations required more people, adding cost and time, with the added caveat that they are dangerous for people.

The first phase for any new basin is crust depth mapping. Teams proceed onto the basin with portable sounders to map out safe routes. Minimum safe crust depth is about six meters – anything less and a person could break through if the crust material is poorly bonded. The following phases see teams bringing out heavier equipment, establishing rigged lines, waypoints, drill stations and hardwired communication links. The rigging and check-in stations allow people to work solo safely – people are always the scarcest resource on uninhabited worlds.

The payoff for all this trouble is a cornucopia of rare-earth elements. The [foamy structure] contains elements normally buried beneath kilometers of sediment, rock or igneous flows, now just meters below the surface. Timpani basins were one of the most exciting geologic finds of the century, and one of the most enigmatic. Despite exhaustive efforts no other planets have been found with them. [Planet name] is unique in the known universe.

Basin Zanzibar was different still. While other basins allowed limited radio comms, Zanzibar denied all. Utter silence. Every effort thus far to find the cause of the [radio dead zone] has been unsuccessful, preventing mining operations despite keen interest. Perimeter samples indicated that it contained a unique mix of elements – some not previously found in nature. However without any radio comms the mining op was a no-go. Relay stations and cables allowed mining to push long distances out onto other basins, but radio was still required for the actual work – people had to talk, resolve issues, send instructions or corrections to portable mining equipment. There was no workable protocol yet in silence. Handwritten slates enabled monosyllabic exchanges, but could not support the information flow that accompanied a mining operation in full swing. Even an army of people would not be enough to get underway.

Michaelson’s survey operation had been intended to learn more about the [radio dead zone]. Instead of answering questions it created one more.

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## 8

“Seal confirmed.”

“All vehicles?” [Sorenson]

“Affirmative.”

“Hangar clear of all persons?”

“Affirmative.”

“Begin evac.”

Massive overhead turbines reclaimed the air that was pressurizing the hangar, reducing it to match the outside. Klaxons sounded to indicate immediate loss of breatheable atmosphere. Green lights signaled equalization. The doors began to rise.

“Michaelson – you get your flight plan sorted out?” [S]

“Yes ma’am. Both loaded drones and unloaded.” [M]

“Good.” [S]

“One question.” [M]

“Go ahead.” [S]

“Did you or any of the engineers have a theory about the echo?” [M]

[exhales] “We were hoping someone would have a flash of brilliance about that, but-“ [S]

“It doesn’t really show up in time dilation papers.” [M]

“To be fair – most of those deal with subatomic particles. Not sure you’d see it there. Person scale stuff has at most been at 0.05c on liners, with multi-day ramp-up and down. Nobody has ever been slowed by 50% in a few minutes.” [S]

Michaelson nodded, looking concerned.

“Cheer up, if it comes back you’ll be an awesome DJ – you’ll have your own built-in sampler” Taylor quipped.

[groans] “Except that I still have no rythym.” [M]

“I wouldn’t sweat it. Doc says your neurons show normal firing patterns. Zero residual effect” Sorenson offered.

“Yes ma’am, I know.”

“We’re hoping your drone flights can shed some light on that particular phenomenon” she mentioned, directing the focus of the conversation away from Michaelson.

Ferguson picked up on this, adding “How are you planning to measure it?”

“Multiple telemetry loggers per drone. Each writes on a dedicated process, two write directly to solid state, a third to a memory buffer that goes to solid state at intervals. Each has different latencies and failure patterns, so we’re hoping to see differences across them. We also put random numbers on every entry – there should be no duplicates unless it echoes.” [M]

“Seems reasonable. Can they handle corrupted writes?” [F]

“Dunno. [engineer]?” [M]

[Engineer] “It didn’t occur to me, I was too focused on the build-out last night. Are you thinking partial write on echo?”

“Yes, like if it replays only part of the message.” [F]

[engineer] radios to a technician. “Can you disable validation on the loggers? Make sure they write everything, even if it’s gibberish.”

[Technician] “Way ahead of you. Did that before we rolled. Seemed logical. Also set log verbosity to maximum.”

“Copy that. Thanks. Out.” [engineer] closes the channel and turns back to Ferguson “Make that a ‘Yes’.”

“What if the echo makes it replay flight instructions?” Taylor chimed in.

“Measure altitude, deploy chute if below threshold” Michaelson replied.

“Seriously, that’s it?” [T]

“Not much else we can do. You can’t shield for time dilation, it happens below the subatomic level, in the fabric itself.” [M]

“So those things might start jerking around in the air?” [T]

“Yeah, it’s a possibility. Oh, and if chutes deploy it’ll eject logs back towards us, well the whole black box’ll get ejected. To aid retrieval in case the drone is too far in.” [M]

“Damn, this is starting to feel serious.” [T]

“Dude, where you been?” [F]

“I know, I know. It’s always been serious in a theoretical way. With most observable things if you approach with caution and take your time it kind of works out. If this thing swallows up drones and all EM, it starts to feel more like walking up to the edge of a black hole. That’s a whole different level of serious.” [T]

“That sounds about right.” [S]

----------- [ ] -----------

## 9

“Clock drop in 2, 1, here.” [Srini]

Chavez stopped the [small rover].

Srini climbed out, grabbing a 2kg hammer and a 2m length of steel reinforcement bar, called rebar. The thin atmosphere carried the faint ‘tink, tink’ of the hammer as he pounded the rebar half its length into the soil. Once in, he attached a clock and took an initial reading as a benchmark.

“Right. Time is 1035 hrs, benchmark location M5.72,” indicating route M5, kilometer 72 from base. [srini]

The main route that led to many of the major basins was named after the M5, after a large motorway in southwest England. Like the basins, people chose names for routes and other large features on [planet].

“How many of those are we doing again?” [Chavez[

“Every 2km from the base to 80km, then every 1km to the basin, then every 100m on the basin itself. We want to measure the full extent of the field.” [srini]

“That stuff freaks me out. I know all about the theory, but the thought of walking into a field that slows me down just doesn’t sit well.” [Chavez]

“Hate to break it to you, but you are already are. About 10%.”

“Already, this far from the basin? There aren’t supposed to be any effects until you’re 1k onto it.”

“We’re not in the field yet.” [srini, grinning] “The system we’re in is moving at [x% of c] around the galatic core, add to that the orbital velocity and you’re up to 10% slowdown.”

“That counts, eh? Yeah I suppose it does, never really thought of it.” [Chavez]

“That’s right, it all counts. Compared to someone on a ship in interstellar space at full stop, you are slowed down. How do you feel?”

“Haha, very funny. Ok, so are you saying our entry into the field will be that imperceptible too?”

“Totally, hence the external benchmarks. Speaking of which, drop in 2, 1, mark.”

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## 10

The sinkhole in Basin Gibraltar suddenly became ten times its original size. No warning – no rumbles, no minor earthquakes, just silence. Then boom. There was debate if this was caused by mining operations or erosion.

[1] “Bullshit – the odds of us witnessing erosion on that scale in a multi-million year window are zero. Subterranean erosion on this planet died millions of years ago. Extinct. All that remains are the surface winds.”

[2] “Say what you will about the odds, the mining is 50k away on the other side of the basin. [Crystalline foam] does not transmit effects more than 1k, 2 at the outside. No way 50.”

[1] “What then? You’re out of options to explain this. That’s all of them.”

[3] “Not all.” They turned to look at the usually quiet scientist, a chemist. “The flows could be active still.”

The sinkhole in Basin Gibraltar had been troubling [3] for a while now. It could more accurately be called a crater since sinkholes are generally not that big. Except that there was no material ejected, as one would normally find around an impact crater. It all went down, straight down. And now it is ten times bigger, a full dozen kilometers across with sheer sides 1000m high.

The noise it made woke every seismograph on the planet. And every scientist. Prior soundings indicated no subsurface voids. They’d put the mining access road nearby to permit study of the sinkhole. Now the road ended at a cliff. Rerouting the road was a minor inconvenience – far more troubling was the idea that the planet could resume movement with no visible geologic forces to drive it.

[3] ordered daily soundings for the basin along the road and all active mining operations.

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## 11

Ellie Barnes brought the [big rover] to a stop at the edge of Basin Zanzibar.

"All stop. Brakes engaged."

Anna Sorenson unbuckled her seat harness and stood up. She stretched and gazed out the window at the flat expanse of the basin. Its calm exterior gave no hint at the processes going on inside. Anna saw the tracks from Ferguson and Taylor's [small rover] a few meters away, their presence seeming to say "Here we are, we're real, you can't ignore us."

"Surface report?" Sorensen asked.

"Calm, winds from the north, 10 km/hr. No storms." [Barnes]

Ok, here we go. "Make ready the command pod." [Sorenson]

"Copy that." Ellie started working the controls that operate the crane on the back of the [big rover]. Everyone else in the cab started moving to put on EVA suits. The control pod and other linked units have atmosphere, everything else is outside. They are not setting up habitats or other large structures until they learn more. Shifts will work around the clock, with crews at shift's end being shuttled back to base.

Taylor, Ferguson and Michaelson worked their way back to the [big rover] where the drones were stowed, being careful to avoid the swinging control pod.

"Almost game time. Any jitters?" [T]

"Totally." [M]

"Ever flown one of these?" he asked, pointing to the hulking Anatolian drone.

"Not this model, but ones like it back on Earth. Out in the desert, during training."

"They have you glide any of them?" [F]

"Yeah, we simulated thin atmosphere like this one by using smaller wings, both under power and full glide. Glide is not normal, it's mostly for drone retrieval during failure scenarios."

Regular operations for the drones were fully automated, including flight planning. Parameters and flight goals would be defined and fed into the algos, and they would plan and execute from there. This was not regular operations. MIchaelson programmed the flight pattern for this scan manually since the algos had no parameters for 'check for localized time dilation'. If all goes well the actual flying would be automated, however Michaelson will be plugged in as a backup in case he needs to override or abort.

Barnes finished lowering the control pod into place. She asked via suit radio "Michaelson, where do you want the drone?' The radio still worked here, just outside the basin.

"Right on the edge of the basin surface proper, pointing SSW," indicating a direction that paralleled the edge of the basin, just outside the [radio dead zone].

"Copy that."

He backed away as the crane's oversized hand-shaped claw reached for the drone.

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"How do you want to message this back to Earth?"

"Time dilation is pretty exceptional. How certain are they? A few suit malfunctions?" his tone skeptical.

"Affirmative. Plus eyewitness accounts. And the suits checked out - no malfunctions. Three coordinated time slowdowns. Pretty credible, by the book."

"Hmmn. When did they say they'd know more?"

"They started their op today. Should know something soon."

"Let's wait on an update before we relay this back. I don't want to have to recall anything."

"Copy."

## 12

Michaelson started the drone’s engines and pointed it on a heading along the basin’s edge. As it began rolling a furious whine filled the thin atmosphere and could be heard through their suits. Ferguson unconsciously took a step back when he felt the rumble. A few short seconds later the drone lifted into the air and began a gentle arc.

“Smooth, you done that before?” Taylor hassled him. “Too much video game time.”

“Yeah that’s it. Y’know, that popular off-world mining game, was a runaway hit – what was it called? Dust Farmer,” he quipped, casually steering the drone into the start of its pattern.

“Beginning automated pattern in 3, 2, 1, mark.”

“Copy that, stay put in case we need manual override.” [s]

The drone banked right and came about for a third pass, dropping another 500 meters of altitude. Several of the team followed its progress with binoculars. Due to the EMI no signals coulbe shared other than light. Michaelson’s controls had comm lasers as part of its spectrum, intended for usage in harsh environments such as this.

At 3km of altitude the drone skipped a beat, jinking hard right and side slipping for about 100m before righting itself.

“You see that?” [s]

“Affirmative. Laser telemetry shows a heat buildup on forward surfaces followed by a rapid cooling.”

Ferguson whistled, then spoke. “Damn, there it is.”

Moments later the drone approached within a couple kilometers of their position before turning to begin another pass, showing no visible signs of the incident. After the turn it dropped another 500m and cruised back towards the site. At this altitude its flight path will intersect a much wider part of the dome, if the theory that this field is spherical is correct.

‘Here we go’ thought Michaelson, his hands tightening on the controls. A few seconds later the drone nearly bounced.

“Wings heating up. Velocity down 10%. Still enough to fly.”

A bright flash made everyone recoil and sheild their eyes.

“Report.” [s]

“Nothing yet. Stand by.” Seconds later “Temperature reaching critical. Drone dropping. Wait… cooling. Exiting. On the far side of the dome now.” [m]

“Next pass will put in it on the floor won’t it?” [F]

“Likely.” [m]

“Override. Bring it back.” [s]

“Yes Ma’am.”

Michaelson brought it down on the same basin edge where it took off. It taxied slowly to a halt by the crane. The leading edges of both wings showed signs of melting and rapid cooling.

Matter that is in a slower time frame is moving more slowly than its faster counterparts outside the slowdown region. Atmospheric molecules thus slowed cannot follow a normal airflow over a wing that is coming in from a faster time frame. Instead the wing appears to be moving at incredible speeds, e.g. velocities akin to a meteor hitting the atmosphere, with similar results. The moving object encounters immense friction and heat buildup, resulting in loss of some or all of its material to ablation.

Despite the drone’s modest 500 km/hour velocity relative to the planet’s surface, it appeared to the time dialated atmosphere as though it was moving at about mach 30. The flash of material loss was caused by this differential. Thus far it had survived the first two passes, but barely. It could continue the direct approach.

“Status?” [s]

“Still operational. Wings have some damage, but it’s mostly to the plating that is designed for that.” [barnes]

“Recommendations?”

“Lower the sounder in from hover. Skip the parachute option, the field is worse than we’d thought. Need throttles to adapt as it changes.” [barnes]

“Agreed.” [m]

“Ok, Plan C then. Go do it.” [s]

“Copy.”

By hovering and slowly lowering the device, say at 5 m/second, the relative velocity of the sounder to the atmosphere would be about 30 times less than it was when flying. Hopefully this is enough to not melt anything on the sounder, it does not have protective cladding like the drone does. The second consideration is that they can vary the descent speed, unlike with the parachutes. They are not sure how bad it will be as they get closer in, since they do not have enough data yet to estimate where the source of the field is located.

A few minutes later the drone was fully ready, Michaelson a bit less so – vertical takeoffs are much trickier, especially with a 3km cable attached.

“Clear launch area.”

“Clear.”

“Firing.”

The drone slowly stood up via its lateral thrusters, then lifted using main engines. The long cable played out like a giant dancing cobra for a mesmerizing minute, then went taut.

“Sounder liftoff.”

The sounder went up silently, then drifted towards the dome. Nobody spoke as they peered through their binoculars. Once centered on the dome the drone begain lowering.

“Sounder height 2500m.”

100 seconds later – “2k” and so on down to 500m, at which point the sounder began to heat up.

“Slowing.”

Anna had to remind herself to breathe while watching the agonizing descent. Through her binoculars she saw it jerk and bounce, glowing red on the bottom.

“Report,” she said as calmly as she could manage.

“Taking manual control.” [m]

“Slowing to hover. Not responding. Wait. Coming to standstill. Sounder cooling.”

“Resume lowering at 1 m/sec. Fuel report?”

“Thirty percent.”

“Proceed.”

Five minutes later they were within 200 m of the surface. Theoretically they could fire the sounder from that altitude and get some results. Resolution would be compromised but would guarantee at least one set of data. They had discussed this option the night before, and held it out as the absolute last resort. Firing from a cable was untested, and they did not know if the concussion would sever the cable or destabilize the drone.

At five meters things got weird. The bell shaped sounder slowed, causing the cable to go slack. It fell as through molassess, entirely at its own pace. Michaelson stopped the drone when it was clear the cable would have reached the ground otherwise. The sounder kept drifting down at a snail’s pace. The radio channel was utterly silent until it touched down, silent except for the collective exhale of the entire crew. Michaelson released the sounder from the cable and set the drone to auto-return.

# Appendix

Working area:

Source of time anomaly:

* Crashed ship. Under sediment. Stasis field generator, breached its containment.
  + Strength of field drops off as 1/r2 with distance from the source. Affects all wave propagation – gravity, light, radio, the vibrations of cells in our body. Time slows down, like being near absolute zero, but you cannot perceive it.
  + Physical resistance also occurs due to the source being from a stasis containment field.
* Terraforming-induced flows
  + variation – flows were terraformed, to make mineral extraction easier. Field is generated by old terraforming equipment

Behaviors:

If you fire a projectile through the field it will retain its momentum. It will age less than if it had been fired through unaltered space, but will otherwise keep moving. It will experience more heat buildup on its nose, since its own molecules cannot vibrate fast enough to dissipate heat normally.

Similarly you could drag a cable through the field, pulling both ends from outside the field. Excavation would proceed in this way. Drag a cable around it, then pull a bucket back through it. Drag the bucket back and forth to excavate. Like the projectile the bucket will experience less subjective time, but will still respond to being pulled. At the highest field strength the winches will need to be slowed since the bucket perceives material coming at it very fast. Becomes brittle. Can’t dissipate heat.

Any means that uses localized motion – robots, vacuums, drones – are all subject to the time slowdown. Success requires a device to be tethered back to normal time. Mechanical means only, no electronics nor drive motors in the field.

The field slows all electro-magnetic waves, including gravity. Objects that fly through it won’t plummet in the field. Planet has little erosion anyway due to thin atmosphere, so the geological footprint of the stasis field is not noticeable (i.e. that it has changed even less). Compression waves are also slowed since they rely on the movement of atoms/molecules to transmit the wave.

Stasis field, impenetrable to radar at the source. Clarity of radar emerges as field strength diminishes. Rest of ship visible. 1km long. They dig down to the other end of the ship and find a way onboard, then disable the stasis field via controls.

Later, once we can generate one, we can change the frequency and have it act as artificial gravity. It can make an object behave as though it is more massive by converting energy into apparent mass.

Considerations:

* More exposition
* Respectful relationships, ok for kids to read
* More leads as women, actively solve problems
* What does each person contribute

## [Planet Ceru]

Ceru is a Mars-sized planet orbiting an M-Class star. Its system is located in the next spiral arm of the Milky Way from Earth, travelling spinward. Its mineral wealth was evident to even the earliest probes, making it an obvious choice for establishing a mining outpost.

Ceru’s thin atmosphere, bright orange soil and blazing blue sky create dramatic vistas in every direction. The planet’s stark beauty surprised everyone who saw it – even the most jaded travellers – and led to its name. One of the first scientists stationed there gazed out at the horizon one day and dubbed it ‘The Cerulean Outpost,’ having been inspired by the peculiar shade of blue he saw in the skies. The planet had not yet been given a ‘friendly name,’ so he lobbied hard for the honor. This may seem petty, but very few people actually got to name anything despite the enormous amount of ongoing exploration. Most planets and asteriods are either uninhabitable or unprofitable and end up with catalog names like NST-18-422. There were plenty of business ventures that offered regular citizens a chance to name a star or planet for a fee, but that only bought you an entry in their private catalog, not the official ones. By the time people decided to set up shop on a planet the name was all but decided by someone you have never met, thus he lobbied hard for ‘The Cerulean Outpost.’ The name was met with something just north of apathy, which can be considered a victory – most names are met with outright hostility.

The naming of the planet came up during the [planetary executives/mining people] daily briefing meeting. The chief of staff was in a hurry and abbreviated it to Ceru (“seh-roo”) and it stuck, its original name having been relegated to a mere footnote in the meeting minutes.

## [Ceru Storms]

The three domes shuddered under the pressure from the wind. Even the ground pulsed from the storm’s rythyms. Michaelson stared out the window in fascination. Ceru storms are legendary – during the few months of the year when its elliptic orbit brings it closest to its sun the temperature gradients between night and day spike to absurd levels. Weather has been described as Mother Nature’s way of balancing temperature and pressure. On Ceru during [storm season] the balancing act is quite a show. Winds routinely blew several hundred kilometers per hour and would last for days. And the wind is the sideshow.

The winds blow ultrafine sand through the dry Ceru atmosphere, building immense static charges. The scant moisture joins the action, helping form focused areas of increased density and charge, which gives all those free electrons somewhere to congregate. This cycle continues until it goes critical. Then BOOM. Devastatingly beautiful bolts of lighting detonate on the surface, illuminating the sky with shades of blue that we have not previously seen nor named. The power contained in a single bolt is terrifying powerful, dwarfing its namesake on Earth by orders of magnitude.

During [storm season] everything goes under hard shelter, even the largest mining crawlers. Nothing mechanical can withstand a direct hit. Structures all have extensive lightning rod features engineered into their exteriors – steel ribs 2 meters thick every 100 meters gave Ceru architecture a distinct skeletal vibe. Everyone called the largest hanger the beached whale. The three domes on [mountain plateau] were the trilobytes.

BOOM.

“Damn. That was big.”

“I never get used to it. You ever see a big supercell back on Earth?”

“No, we didn’t get those in my country. We got monsoons. Lots of rain and some amount of light show, but nothing so focused as your supercells.”

“Yeah, they’re big, but this wins hands-down for pure elemental fury.”

“When is it safe to go outside? I want to check on the fulgurites.”

“Forecast says day after tomorrow. I can’t wait to see them myself.”

Niether Michaelson nor Venya had seen a fulgurite firsthand so the opportunity to collect some of their own was too good to miss.