The Hunger

Marco Frassetto

"Madam Zieli ski, we'd really appreciate it if you could embark for the Guyana Elevator at your earliest convenience. A helicopter has been sent to offer you passage."

You can tell I'm an old, respected engineer because when they give me orders, they're very polite about it these days.

"Do you realize it's three in the morning here?" I say, because the joy of a long, successful life is that people have to put up with me when I complain. "And I'm eighty-three. I haven't *been* to space in more than six years."

Plus, the doctor said I shouldn't leave Earth ever again. But the truth is, I'm excited to go to space. I was starting to feel like a fossil in a museum, stuck in Earth's gravity well.

"I'm sorry, madam," says the young voice on the other end of the neurolink, "but it's a matter of the maximum urgency, and your great expertise is needed."

At least the Directorate for Space is still good at training bootlickers. *My great expertise* usually means *something broke in space, and everyone is freaking out.*

"I graciously accept your passage," I say. "But where the hell am I going?"

A moment of pause.

"Please do not divulge the information externally," they say, "but you're headed for the ILO."

I'd make a small dance of happiness, except for my stupid hip replacement. The International Lagrangian Observatory is far enough from ground to feel *properly* in space, but not so far I'll need a substitute teacher for this semester.

And if they're taking the trouble to send me all the way from Earth when they have a legion of bright young engineers already at the observatory, this must be *really* interesting.

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By the time we reach the ILO, it's clear my body is too ancient to be in space and should stick to Earth like a good fossil. Every acceleration left me aching and light-headed, even though you barely go above two-gs these days. Nausea from microgravity makes my stomach roil—something that hadn't happened since I was in my twenties.

But I'll be damned if I let anyone see I'm not having the time of my life. When I look out of a viewport and see the endless black sky, my eyes tear up.

"Are you ready, Professor? We're cleared to dock," says the young ESA cadet paid to fuss over me.

"I was ready *far* before you were born. Why don't you tell me what is going on instead?" I

demand, and the cadet looks away in embarrassment.

Most likely she doesn't know. I spent the fifteen hours of travel sending increasingly aggressive requests for information to every higher-up contact I have, and still couldn't get more than *classified emergency* as a response.

I'd think India started a space war, except I doubt the Space Directorate would call on me for that. I'm an aerospace system engineer, and I've fixed quite a few emergencies with spacecrafts and stations, but don't know the first thing about fighting. On the other hand, if no one is shooting, why all this secrecy? If something broke down at the ILO, I could have started working from a telemetry.

We dock with agonizing slowness. I know it's faster and smoother than it was in my first decades of space travel, but I guess time feels more precious when you have less of it left. I look from the viewport, trying to get an early glimpse of whatever is wrong.

The ILO spreads above me—no, below me, I decide. It looks like a flower of six inflatable modules around a central hex-shaped core. Solar panels extend beyond the modules like a second set of petals.

It's beautiful.

And seriously damaged. Two of the six modules are deflated, hanging limply from the metal scaffold. One is painted blue—the ESA section—and the other has the Japanese flag, now stretched and creased.

Two damaged modules? And on different sides of the station, too. What kind of incident could've caused that? An extremely lucky meteor might've hit one, but not both at once.

Battle, or sabotage, my treacherous mind suggests.

But the capsules from all the other space agencies are docked, and had a real war started, I can't believe my ship could have departed safely. Also, the atmosphere would be burning in nuclear fire, and we'd all be very busy dying.

I rein in my impatience and wait for the hatch to open. On the other side, a NASA astronaut gives me a sharp salute from the docking section of the station. It's spacious enough that without the railings, you could float in midair and have nothing to push against—but they build space stations so vast you could fit a St. John's cathedral inside, these days.

"Professor Zieli ski, welcome to ILO," the astronaut says. "I believe you're already familiar with our protocols and the station's layout?"

I designed that layout and knew those protocols while you were in middle school, I think. But she seems exhausted, and I've played the insufferable old woman enough for the day. So I smile and give a gentle push against the wall, to float toward the corridor. My doctor is wrong as usual, microgravity feels *great* when you're old and frail. At least after I discretely took some nausea medication.

"I had the pleasure of visiting this beautiful station in the past," I say. "How can I be of help?"

She seems to grasp for words. "We had an . . . extremely unusual . . . accident yesterday. The joint mission commands have decided to consult a few expert scientists before making public announcements. If you could follow me, your colleague Dr. Liu is in the conference room already."

* * *

I'd never heard of Dr. Liu, but that's not that surprising, since they're painfully young, and promising young researchers blur together in my mind, these days. They're dark skinned, wearing a red suit, and look like they're about to be sick any moment. I check their neurolink presentation, and lines of text appear in my vision next to them.

DR. LIU FAN—CNSA TECHNICAL CORPS—THEY/THEM—RANK: MAJOR—RESEARCH FIELDS: VOID-DWELLING EXTREMOPHILES, EXOBIOLOGY

A *biologist?* Unusual, but it wouldn't be the first time I work with one. Some bacteria and molds are hardy enough to survive in space, and I hate them with a passion.

We barely have time to bow and shake hands before the NASA astronaut starts talking, a schematic representation of the station filling the screen behind her.

"The first incident happened yesterday, at seventeen UTC," the astronaut says. Her tone is

cool and professional, but her eyes have the haunted look you cultivate with stress and lack of sleep. Behind her, the screen zooms on a schematic of the ESA inflatable—an elongated balloon neatly partitioned into living quarters, labs, and storage.

"Alarms and diagnostics warned us of rapidly falling pressure in the ESA module. The personnel evacuated, drones were deployed to check from the exterior, and *two* different damage sites were found on the inflatable surface."

Two bright points appear on the screen. I immediately see they couldn't be from the same impactor, even assuming a ricochet. Then the image switches to pictures from the drones: plumes of escaping air from identical punctures, circular in shape and about five centimeters across.

It's not easy to puncture habitat fabric. It might look like burlap, but it's made of layer upon layer of woven nanostructures. A point-blank bullet wouldn't scratch it, and while micrometeors can tear it, they wouldn't make so clean a cut.

The only possible answer is bitter in my mouth.

"Sabotage?" I ask.

Dr. Liu looks at me as if I sprouted horns, and I understand them. The game of powers is played in space, too, but so far, we've managed to avoid bringing to heaven the violence of Earth.

"Of a sort," the NASA astronauts says. "On closer inspection, the damage turned out to be laser-induced. So sabotage was our first thought, too."

Her tone is grave, because she knows as well as I do that the moment the first shot is fired, the age of peaceful exploration will be over. With the resources from the asteroids, space habitats are hugely valuable, hugely costly, and hugely vulnerable.

I dearly hope they didn't call me here to advise them on how to win a war in space. But if it were so, why would I be speaking with CNSA *and* NASA? I doubt the three of us would be on the same side.

"While inspecting the damage, what we found was . . ." The astronaut stops, as if looking for a word. ". . . surprising. See for yourselves."

With great care, as if handling explosives, she extracts one of the storage trays set in the wall and takes a box from it—a transparent glove box, hermetically sealed, like those you use to handle highly toxic material.

Inside the box is a thin metal cylinder, perhaps three centimeters across and fifteen long. It's not perfectly straight; it's narrower in the middle and has three bulges, like a snake that ate eggs. And it's completely covered in . . . writing? Circuits?

"We found two objects like this inside the remnants of the European inflatable. Not much later, a section of the Chinese habitat lost pressure too, and we found another such . . . drone."

She says *drone* with a weird pause. And certainly, it's a strange drone. If I had to design a killer space drone—Christ forgive me, I *did* muse about this before—I'd almost certainly go for a spherical shape, for ease of maneuver and low detection profile.

"Was anyone hurt?" Liu asks, in a soft voice. I stifle a groan. That's biologists for you, always worried about trivialities. We already know no one died, and they definitely didn't call us to help in the infirmary.

"Thankfully not," the astronaut says, "we have systems in place to prevent too abrupt a decompression, and they worked. Astronauts evacuated habitats unhurt. But the most surprising part is what we found when we sent astronauts in EVA suits to assess the damage. The two drones in the European habitat had latched to the frame's metal, and were . . . removing material from it, and processing it."

I take a moment to parse the sentence.

"I beg your pardon?" I ask, my mind blank.

She nods, looking as confused as I feel, and shows a new slide. It clearly depicts that same cylindrical drone, lit by a portable torch, latched to the habitat's supporting frame via three pairs of clamps. One of its extremities is *sunk* into the metal.

"One of its ends is equipped with a high power, low range laser. The opposite one has diamond teeth and seems designed to burrow into metal, while the body . . . processes the material."

Impressively compact design, I think first. That thing must have, at the very minimum, a propulsion system, energy storage, a cutting laser, and a working diamond saw, packed into so little space. Even for me, it would be . . . challenging.

But that's not what I should be thinking about.

"What the *fuck?"* I ask, because one of the benefits of being a highly respected fossil is that no one reprimands you for language. "What's the point? What did it even *process* it for? What kind of attack is this?"

The astronaut nods, her face pale.

"You see those bulges? As the material slides through the drone's body, which is highly adaptable in shape, it transforms into this once it reaches the other end."

She opens a different tray, with another glove box. Her hands tremble as he holds out the object for me to inspect.

"This one has been . . . deactivated," she says, and I see there's a gleaming metal sphere inside the container, about the size of a peach.

"Five similar objects were found in the damaged sections. At first, we analyzed them non destructively," she says. "And see for yourself what happened."

He projects a sequence of pictures. A sphere, similar to the one in front of us. Then a deformed version of it, more oblong. A third one, more elongated, *almost* a cylinder.

The fourth is a small cylinder, its surface lined with grooves, thinner in the middle.

"This . . . secondary drone," the astronauts says, his voice shaking, "showed a remarkable ability to reshape itself. In the space of three hours, it became a smaller version of the original drone. It even latched to the metal container like the larger one did, and tried to consume it, before we deactivated it."

"That's impossible," I say, even if I've sworn to never become the kind of engineer who disbelieves things just because they're new. "This must be a hoax. The best technology in the world doesn't go *near* that self-organization capability. Let alone in so little space."

The astronaut nods.

"Our experts agree. The more we studied it, the more obvious this drone is beyond our technological capabilities. So this either isn't from our world, or it isn't technology at all."

"That's why I'm here, isn't it," says Liu, quietly. They have the incredulous look of a paleontologist who just met a very polite triceratops. "It's not about extremophiles. This is because of my papers on *exobiology,* isn't it?"

The astronaut nods.

"The two of you are here to understand what this thing is and how it works. And most importantly, whether it's alien technology, or an alien *lifeform."*

* * *

"This will change *everything,"* I say, looking at the latest muon scan results. We're getting more and more detailed maps of the machine—we're down to the micrometer scale, and each scan keeps revealing more complexity. I have no idea what 90 percent of its parts are for, so I can't *wait* to disassemble it and study everything piece by piece.

It was worth every sacrifice, every ungrateful politician, every undignified zero-g diaper, even the insult of aging, to become important enough to be called here. To be the one who gets to play with an alien machine.

"Alien life, or at least technology," Liu says, still sounding incredulous. "Proof that we're not alone in . . ."

"Yes, yes, that's nice," I say, "but think of the *applications.* A machine that autonomously collects resources and can entirely reconfigure itself. Even make copies of itself! And structured on a submicrometer scale! It has these microscopic repair drones crawling all over it, and they fix everything *perfectly.* I've never seen anything like this!"

"With the utmost respect, Professor, you *have* seen something like it," they say, sounding like contradicting me caused them physical pain, "every single time you've looked at a living being. This . . . entity is able to feed, move, grow and reproduce, and is highly structured on the micrometric, even nanometric, scale. But the same can be said of a fruit fly."

Their tone is so gentle and reverential I don't even get angry. They're young after all, and every scientist likes their own field, even the really silly ones like exobiology.

"So you think the drone is living? That's a fascinating idea," I say, which in many years of academia, has become my favorite way to tell someone their idea is stupid, "but even without discussing *how* life could form in the endless emptiness of space, consider its laser and propulsion system. Life created incredibly complex systems. But there's a reason it never built a rocket engine, or an industrial laser. Those things are completely worthless until they're complete."

Liu is quiet for a moment, looking at the scans. Then they laugh.

"You know that was a popular argument, in the last century, to argue against evolution? Life showing the marks of design. It was usually claimed by religious fringes and . . ."

I scoff, cutting them off. "I know, Doctor. The argument was still popular when I was young, even if it *did* die out in the end. They were idiots. But if animals on Earth were equipped with lasers, they might have had a point."

They seem taken aback, and stare at me, as if just realizing how old I am.

It's one of the small pains I've learned to live with: The incredulity of young people who realize you're *so old you remember that.*

"I'm sorry, Professor," they say, "I'd never suggest you were part of such fringe. Your wisdom is renowned, and working with you is the highest honor I could hope to attain."

Well, CNSA always had the best solid state engines *and* the best bootlickers.

"What I meant," they add, "is to point out the irony of it. What they made as an antiscientific point becomes a crucial consideration of our work. We have this machine with wonderful capabilities. How can we prove it has a maker and is not the result of evolution in conditions deeply different from those of a planet?"

* * *

Ten days later, I'm giving a lecture.

Unlike many colleagues, I love this part of the job. There's something magical in the moment you see a student fascinated by a new notion; it's the closest you can ever get to learning it again. That is, assuming you can get the students to pay attention to you instead of their hangovers and neurolink chat.

This time, the audience is small but challenging. We're in a claustrophobic, secure room. Six people are seated across from me and Liu, all of them high-level representatives of the six great powers. Liu, who's been a model of calm and professionality so far, looks green in the face, and I think they're going to vomit.

But to me, they're still just an audience. They might have the power to shake Earth with a word, but I built the wonders that took humankind to the sky. And it's *me* lecturing *them*.

"Professor Zieli ski, Dr. Liu, you can start at any time," the Indian representative says. She looks at Liu with obvious mistrust—the ever-swinging pendulum of the Sino-Indian relationship is in the bad part of its arc.

"Thank you, madam," I say. "First of all, it must be understood that these findings are preliminary, and based on severely limited observation. We had only three undamaged machines to observe, and none of those were . . . in the active state."

I have to correct myself from saying *living.* I'm still confident they're machines, but their behavior is lifelike enough that I think of them as *dead* and not just *inactive.*

I project an image on the screen. This would be much easier if we could use neurolinks and share 3D models, but apparently the facility is too secure for that. So we stick to crude 2D representations, the kind I grew up with and happily parted from.

I tried to make a scheme of the working parts of the machine, but there are so *many,* so complex, and often so confusing, it looks like I simply drew a lot of squiggles.

"The machine is of exceptional complexity," I begin, "well in excess of what any nation could currently manufacture . . ."

The U.S. representative, a slim man with black skin and a black suit, interrupts me. "How can you be so confident this isn't the result of classified military technology?"

I *hate* being interrupted with stupid questions that aren't really questions, but as it is with

students, getting angry doesn't help one bit. It's not their fault if they're stupid, after all.

"Because the technology required to make this—a fully integrated self-assembling system structured down to the nanoscale—is as far from our technology as ours is from, say, the first steam engines."

I let the words sink in, then start again.

"This machine has dozens of subsystems and is capable of reconfiguring them on the fly. A key role seems to be played by semiautonomous submachines, too small for the naked eye to see, that continuously repair the main drone. In turn, we believe a dedicated component builds new submachines. Unfortunately, all the drones available to us were too damaged to see those systems fully in action."

I feel a pang of loss when I think of what we destroyed when the station technicians decided to electrocute these wonders. We could learn so much from an active one, and there's no guarantee another one will ever pass through our system.

"What we are sure of," I continue, "is that it has several modes of propulsion. It has a very small hydrogen-oxygen rocket engine, highly directional, likely for fine maneuvers. It can also deploy an extremely thin solar collector, which probably doubles as a solar sail. Finally, its laser system can be used as a photon rocket to provide a very low acceleration. I believe this third mode of propulsion is what it used to travel between stars. Such propulsion systems would exert an extremely small force, but wouldn't require fuel."

I shiver at the very thought. This small machine was born under the light of an alien sun, maybe even saw *many* suns, and slowly, slowly traveled toward ours for centuries or millennia.

"Do we have confirmation it's extrasolar?" the European representative asks.

I know her, she's an aide to the commissioner for space, and she isn't stupid. But I guess this is hard to wrap your mind around.

"I certainly hope so," I say. "Because alien hands made them, hands much more skilled than our own. To think they traveled between the stars might seem incredible. But the alternative is that aliens came to the Solar System, built mining bots unnoticed, and left."

"I should add," Liu says, so quickly I barely understand their words, "that even if, uh, this was a living thing, which it might be, it can't have evolved here. We would have seen other creatures like it before, if they inhabited the Solar System."

"So it really could be an alien lifeform?" asks the Chinese representative, a man even older than me who has been silent so far.

Liu is looking more and more on edge, and I fear they'll just faint if they have to answer.

"The possibility can't be ruled out," I say. "It's extremely hard to understand how a branch of life could have originated in space, or how some subsystems could be the result of natural selection. But the Galaxy is vast, and we still know very little about it."

It's bullshit, as far as I'm concerned. But Liu is a brilliant researcher, and they and their team made a great contribution in understanding the creature, so I give some credit to their pet theory.

"What are they here for? Is this an attack?" the Japanese representative asks.

"I would rule that out," I say. "I'm not even going to speculate what kind of weapons could be made with this kind of technology, but that is beside the point. This machine might have caused accidental damage to our space habitats, but it made no resistance when it was . . . deactivated. It's too early to guess its intended purpose, but I think it's an autonomous mining drone, which probably missed its original target and drifted for millennia. Since there were three, there might be others—which I'd highly recommend capturing intact at any cost. But this isn't an attack; it's a confused resource-gathering system. I think of them as harvester drones."

I look at Liu, who looks as if they're trying to summon the energy to speak again.

"And *if* it is a living being," I add, "It clearly has a very simple mind, feeds on inanimate matter, and is not a predator. It would be akin to a rodent eating our harvest. It might inconvenience us, but it's far from dangerous."

"That's a relief," the American representative says, sarcasm oozing in his words, "because seven hours ago, a high orbit communication satellite went offline. When maintenance arrived, it

found two of those things happily chewing through it. And half a dozen of those . . . *eggs."*

* * *

"Treat it gently. It might be living," Liu says, "even if it's probably no smarter than an insect."

Personally, I think all insects should be eradicated by hunter drones, and might have even sketched a few designs for that purpose in my idle time, but the kid loves critters, so I nod to humor them.

We're both on the ground, but we're projecting ourselves to a low-orbit laboratory where the functioning drones are being kept. We've bred—it's hard to avoid the terminology—a dozen of the Harvesters, as we call them now. We use servos and high-resolution scanners to study them, both in the living—no, *active*—and inactive states.

Right now, I'm remotely handling through a metallic hand coated in plastic. The active Harvester has a luster that the inactive ones were lacking, and the pattern of grooves on its surface has the unique beauty of well-designed machines. The microscopic mites repair it continuously, keeping its surface a perfect mirror. Once dead, it quickly loses that perfect shine.

"It would be a really boring pet," I say, "but it's a *wonderful* machine."

"And a dangerous one," Liu answers, looking at the small, elongated thing.

The drone stays perfectly still as I handle it. It exhausted its propellant already, and the only other way it can move is to crawl on its magnetic clamps. Hardly a threat to humankind.

"Those things damaged a few satellites, that's no threat to civilization," I say. Kids these days lose their minds over a few damaged comsats. In my days, we nearly lost all access to orbit due to space debris, and that was while the Relocation crisis almost caused World War III on Earth.

"Forgive me, Professor, but you still think of them in terms of faulty mechanical components," they say. "These creatures, fascinating as they are, are parasites with no natural enemy. And our whole space infrastructure, to them, is a rich breeding ground."

I scoff. "And you have no appreciation of just how good distributed detector arrays are these days. As soon as we train them to look for these things, they'll be spotted within one million kilometers from any major outposts, even if they fly completely dark. And maintenance drones are more than able to take them down."

Personally, I hope we get a few more Harvesters. We can breed them now, but there are countless variations in each individual's subsystems, and every minor variant could be a new technological breakthrough. A new generation of lightweight, high efficiency solar collectors from reverse engineering their sails is *already* being developed by ESA labs.

"If we understand how they find our satellites, it might be easier to track them down," Liu says.

I put the small machine inside a plastic cage. Inside there's a small ingot of iron and a bowl of water. It can process both, for building material and for fuel.

It stays motionless for a moment, then its clamps unfold—it's hard not to think of them as legs, and it's impressive how they disappear seamlessly into the body when they retract. It crawls awkwardly toward the metal ingot. I almost want to nudge it forward to help.

But I'm here to study the drone, not bond with it. I check the recording of those first moments when I put it down. With a swipe of my hand I can watch the scene with infrared, ultraviolet, magnetic, or even gravitational lens. Virtual immersion technology gets better every day; my young self would have *killed* for this.

It doesn't take long to find what I'm looking for. While the small machine seems quiet in the visual spectrum, there's a flurry of magnetic field changes along its body. Those intricate grooves on its surface turned out to be superconductive, and probably play a role in its ability to find metal.

"Look, it flares up when we put it in the cage. I think it's exploring. It might be simply probing for ferromagnetic material, but it can find water too. I reckon it's doing a rough nuclear magnetic resonance scan," I say, once again in awe.

Liu wasn't convinced the grooves work as detectors, and I suppress a laugh looking at their frown. It's a system *very* difficult to believe evolved naturally.

"It seems your hypothesis was correct," they say, amiable as ever. "But may I point at something else of interest?"

I nod, and they move their fingers, rewinding time once again—back to the moment I put down the small machine, but seen from the wider angle. They point at the other two critters we keep in the same room.

A few nanoseconds after the first one's magnetic field flares, theirs do, too, a smaller fluctuation, but definitely not a coincidence. Liu projects a signal analysis in midair—they're much smoother than I am with immersion technology, damn their youth.

The three machines emitted three identical signals, on a low-energy wavelength.

"They communicate," they say, smiling.

"They emit and receive signals. So do the chips in our head," I point out, "that doesn't make them conscious. But it's a great observation. And we have to report this as soon as possible. It will help a lot with finding them."

* * *

I always loved looking at the sky.

I have a vivid memory of myself as a girl, lying on the grass and looking up, when a blackout hit Krackow. The sky had filled with stars, and I truly understood for the first time that I wasn't looking at gleaming flecks on a black ceiling, but at an abyss deeper than any ocean, with wonders beyond imagination just outside our reach.

I spent my whole life reaching, in the most literal way, for the stars. I cried tears of joy the day my laser-driven probe showed us a glimpse of Centauri Prime. I remember my first time to space much better than the first time I had sex. Sometimes I fumble my daughter's date of birth, but I could never forget the day the Guangzhou space elevator opened.

I always laughed at those who were scared of space. Of the emptiness, of the unknown, of the things that might be there.

Maybe I was wrong.

I watch the Solar System from above, like a goddess would, if one were to believe in such silly things. The neural simulation is so beautiful I could think I'm really floating in the endless sky, planets and asteroids wandering below me, their orbits traced in thin white lines.

Bright white lights dot the system in clusters. I know them all very well. I dreamt of them, I made some of them. The station and habitats we built in the heavens.

Five major settlements, three orbiting Earth, one the Moon, and one on the Moon's surface. Twenty-seven smaller ones, mostly mining stations in the Asteroid Belt, plus a smattering of large stations in the Jovian and Saturnian systems.

Fifty-eight small stations with human presence—half of them scientific stations like ILO, the rest manning remote parts of the asteroid economy.

One hundred and twenty-five thousand people living in space, in these wonders we built. The promise of a future free from Earth's gravity, of one day reaching the stars.

Two hundred and fifty-seven red dots scattered across the system. Each is an identified source, transmitting in the seventeen centimeters wavelength the Harvesters use. More and more pop into existence as telescopes keep scanning the sky.

Paths in red are being computed and marked out as I watch.

"Clever things," I think, forcing myself to say *things*.

They have little fuel to burn, so they use low energy orbits, drifting past planets and moons in a convoluted dance, to get across the system by barely expending any energy. Most are in the outer system, some past the orbit of Pluto.

The orbits get drawn with more and more precision as the telescopes tighten their tracking on the things.

A few go for the asteroids. A few will just shoot past the system, if they don't change bearing.

Two hundred and thirty-two are aiming toward orbits occupied by human structures.

"You think . . . this is an attack?" Liu asks, their voice low. I see them as a glowing outline, a fellow god looking down from above the system.

I shake my head.

"It wouldn't make sense," I say. "They're using slow, energy-efficient orbits. It'll be at least three years before they reach any human station. I'm no expert on war, but that doesn't sound

like an attack plan."

"So what is this? They can hardly be going toward our habitats by coincidence," they say, their tone confused. They're trying to understand if this is a real danger, or just one more curious scientific behavior.

They haven't thought this through. Ironic, given it's their theory that works best here.

"I think they're pack feeding," I say, "though it's just a rough simile, since they're machines. But it's clear they systematically target human space infrastructure. Probably by tracking our communications. After all, where there are communications, there's probably something made of already-refined metal."

Were these things mining drones, once? Why make them able to track communications?

"So, how much should we worry? Forgive my impertinence, Professor, but you seem deeply upset. And yet, as you predicted, sensor arrays proved perfectly capable of spotting these creatures from great distance."

"You don't see it, do you?" I say, because I can't resist taunting them a bit.

They shake their head.

"These things are extrasolar," I say, "and probably tracked our signals from a long, long distance. Two hundred of them, or even a thousand, in five years, aren't dangerous—we could easily design maintenance drones to get rid of those pesky things. But where do they come from?"

I point at a red spot. Annotations appear below it as I look.

"See? This one is beyond the Kuiper Belt. Much farther than the others."

They look at me with a blank expression. I sigh. Their ignorance is ruining my dramatic presentation.

"We have good telescopes, but they can't perform miracles. They managed to spot these things within the orbit of Pluto. But this signal is one hundred times farther. We're only able to see it because it's stronger."

Their eyes widen.

I usually love the moment a student understands. Now I pity them.

"It's a group. Like a fleet."

I nod.

"The signal is three-hundred-thousand times larger in intensity than that of a single drone. And the vast majority of the ones we met so far fly dark at any given time. *That* is what worries me."

* * *

It's a wonder, what inspiring feats of science and engineering can be done when humankind is scared shitless.

I spoke to politicians, and they didn't understand. I spoke to the media, and while they didn't understand, either, they were more than happy to fill the neurosphere with confused headlines of alien invasion, rogue machines, ruin coming from space. People didn't understand, but got scared, and decided *something had to be done.* Politicians kept not understanding, but threw money around in buckets, so they could claim to be doing *something.*

And so, in just under two months, the Lightrider project—designed to send interstellar probes to different systems at a decent fraction of *c*—was hijacked, adapted, and upgraded. Lightrider probes usually weigh three grams once the sail burns and are made to capture and send a single snapshot back to Earth.

Now we're sending heavier, slower probes, one kilogram in mass and accelerated at 1 percent of the speed of light.

I helped design them, of course. They put me in charge of the whole thing on the engineering side.

For the first time in my life, I didn't enjoy the responsibility. Failure won't just mean a few billions wasted, or even risking few lives.

If we can't stop those drones, it will mean the end of human presence in space. The erasure of every single thing I did in my life. The knowledge that my daughter won't ever set foot on another world.

"LIDAR data expected in thirty seconds. Pre-pulse telemetry nominal," a young woman says,

her eyes closed and her fingers moving frantically in midair.

Once inside the drone fleet, our probes will emit powerful pulses of light, staggered in time, and then watch where they bounce. From that data, we'll be able to get the distance, position, and number of the Harvesters.

We pointed our best telescopes at them, but they're very small and far from the Sun. The one thing we detect from Earth is the stars behind the fleet are getting a little fainter—astronomers had been tracking the fleet for years, I found out, assuming it was a cloud of anomalous dust, proving once again scientists are useless and should be replaced by more efficient engineers.

There must be a huge number of them. Billions, even at the lowest estimate. A fleet of tiny drones, still beyond the Kuiper belt, but so numerous they blot—ever so slightly—the stars.

How long have they been traveling toward us? They aren't traveling at a meaningful fraction of the speed of light. Did our very first radio broadcasts attract them, the Devil knows where from? Or did they leave even before that? That seems more likely, unless they come from one of the very closest stars.

But *how?* Before the twentieth century, humanity left no electromagnetic fingerprint.

I have a terrible flash of a theory, of a probe like the ones we made, taking a snapshot of Earth, centuries or millennia ago. Predicting that soon, we'd be a spacefaring civilization.

Deciding, for unfathomable reasons, we should not be one.

"Incoming signal. Number of hits . . ."

The very calm, very professional young woman trails off, shaking her head.

"That can't be correct. Waiting for a better estimate," she says, sounding dazed.

Data feeds are appearing on the large screens, though. One is a sky map, quickly filling with red points, like an illness.

"Data is of doubtful reliability," the girl says.

Whispers rise all over the room.

"Please report. What is the current estimate?" I ask.

"Spatial resolution of sensors is overloaded for the probes inside the fleet," she says, her tone incredulous.

And I can't believe it myself. We loaded some good cameras on that probe. If there are so many drones they're crowding its pixels . . .

"Give a lower bound estimate," I say.

"Assuming the whole fleet is this dense," the girl says, "that would mean at least ten to the power of twenty drones are heading for the Solar System."

Voices rise from all around. Questions, curses, reassurances that *it can't be.*

Ten to the power of twenty. One hundred billion billion drones. Far more than the total mass of our space infrastructure. Enough to cover every square centimeter of our planet in drones. My head spins.

"There are . . . structures inside. Like tighter clusters," another analyst says—one who is good at keeping his cool, or can't understand numbers that large.

I've solved a lot of impossible problems in my life. That's what engineers are for.

But we can't stop that many drones any more than we can switch off the Sun. They'll consume everything we put in space and not even notice. They'll probably devour asteroids and moons.

They are so many, even if a small fraction burns up in the atmosphere, they could end life on Earth as collateral damage.

"Still think those things are critters, Dr. Liu?" I ask, in a fit of childish bitterness. "Tell me, what animal gathers in devouring fleets billions strong?"

They look at me, thinking. Then they nod.

"The locust, of course. It's not a fleet, it's a *swarm*."

* * *

"Professor, you should really check this cluster behavior," Liu says. Their hands shake as they make a gesture, and new data pings into my neurolink. I never became that natural with kinesthetic interface. I guess I'm just too old.

I really feel old, today. For eighty years I felt like a young woman, even if my body had the gall to disagree in recent decades.

It's different now. I'm tired; I keep wondering if I still have the energy to lead this project, if I'm still sharp enough to be the right person.

If I'll be still alive when most of the swarm will arrive, in seven years. If I *want* to.

But these are idle thoughts. You can't trust young people with saving the world. And I'll live seven more years out of spite if necessary, because I *will* see that swarm destroyed.

I open Liu's new file, to see what got them so upset.

Pictures and metrics from a locust cluster—that's how everyone calls them now, no matter how much I protest. The barest vanguard of the swarm has reached the Solar System, just a few million drones, and already we need our full resources to deal with them.

And the damn locusts keep showing new behaviors. Like this cluster of thirty thousand locusts that have latched onto a ferrous asteroid.

I look at the sequence of pictures—resolution got better as our quick response probe approached. At first, the locusts landed on the asteroid in a random pattern. They look like specks of glitter on its dark surface.

Then they crawled together, with their slow, shuffling steps, and formed an amorphous ball.

The following pictures are taken close enough to clearly see single locusts, and the way they're arranged—linking legs and forming new ones, as they've shown they can do, arranging themselves in a hollow cylinder.

Then they started firing. You can see flashes caught in the pictures, the asteroid's stone gradually becoming red-hot and then boiling away.

"They were boring through it," I say, looking at the data. There's a chart of heat signatures from each individual locust. They fired their lasers in a staggered pattern, so that they could fire continuously and yet have time to recharge from solar light.

In the last pictures, they had dug a sizable hole into the crust, and were rearranging again.

They had found what they were looking for. A metallic vein—nickel, I guess—had been exposed. After that, the telemetry ended. The officer in charge decided to detonate the probe's nuke as if flew past the asteroid.

A pity all the fissile elements in the world won't be enough to bomb the swarm out of the sky.

I checked. The Americans *really* liked that plan.

"So they can feed from naturally occurring asteroids," I say, hating the exhaustion in my voice "I bet they use those laser pulses to study the emission spectra, too."

The locusts like processed metal the most, but apparently aren't that picky when they are in large enough groups.

"That is . . . not what worries me the most," Liu says. They're usually calm when contemplating the doom of mankind, for having lived barely more than thirty years, but now their voice shakes, and they ball their fists.

"What is *more* worrying than the fact the swarm could strip the Solar System of every gram of metal, blocking space not only from us, but from anyone in the future?" I ask.

"Their ability to coordinate is impressive. The swarming behavior is nothing unseen in nature. But that they can coordinate to make a laser boring machine . . ."

I can't stop myself from laughing, even if they look hurt.

"*Now* you start to question whether they are naturally evolved things? You were starting to convince *me*."

Their communication system is what made me seriously think. After much frustrating research to understand what drove their actions, it turned out the conductive grooves etched in the locusts' sides are *both* their brains and their sensory organs. Electrical pulses going across the groves control their movements and growth.

But they also emit radio waves in the process and receive the aforementioned waves from other locusts as well. Basically, they're always thinking aloud, each influencing the ones around it. That's how they coordinate.

It's fascinating, messy, and unpredictable—the grooves are slightly different in every locust, making the locusts' exact behavior surprisingly difficult to predict.

I wouldn't presume to understand alien engineering. But this *does* look like the drunk, visionary designer evolution tends to be.

"I liked to think of them as living beings," Liu says. "Both back when they looked harmless, and now that they're coming in force. A swarm of locusts, dangerous as it is, has no evil intent. You can fight it in many ways, because it doesn't even understand it is a fight. But if this is really a fleet . . ." They shrug, and their hands are still shaking. "What if they rearrange themselves into laser *cannons,* Professor? What if they *fight* us?"

The truth is I don't think it really matters. They are *so many,* nothing we can send against them matters. Liu, like many others, doesn't yet fully realize this.

"I wouldn't worry too much about that, Doctor," I say. "If they *are* designed, I still think they're supposed to be mining drones. The fact they're able to mine asteroids even if the metal isn't exposed supports that. If they're programmed for something else, I doubt it's for fighting."

"But *why* would anyone send a swarm of mining drones to a random system? What's the *point?*" they ask, their voice getting shrill.

I usually try not to voice my darkest fears outside of my mind. But today I'm old and tired, and I'd like to drink something strong. "Pray they're lost mining drones, or your almost-mindless metal locusts. Because the alternative is that they are an extermination fleet."

* * *

"FOR YOUR EYES ONLY—PRELIMINARY REPORT ABOUT THE INCIDENT BEFALLING CNSA VECTOR WANG WEI"

The report flashes red in my neurolink, like a monster crouching at the corner of my eye. I've been expecting it. I need to see it, and yet I dread opening it.

The vanguard of the swarm, counting trillions of locusts, trickles toward the inner System. The Titan observatory had to be evacuated, and one of the evac ships was too slow. CNSA announced loss of contact, and we'd been waiting for a report about the events.

I flinch and consider asking an aide for a written summary—but I didn't reach my position by hiding from the truth. I open the report and select the visual feed first. The quality is great, it's taken from the Wang Wei's own escort drones.

It looks like the stars are moving at first. But they aren't stars, of course. They are locusts, so many the sky glimmers with them.

The evac ship is an old Chinese model, a fat sphere with a rotating ring for pseudogravity, rated to carry twenty people for months-long travels. It was carrying five more than it should have, because not enough ships could reach Saturn in time.

Most locusts can't match velocity. They bounce, broken, from the ship, leaving a crater on the meteor shielding when they hit too fast. The most dangerous are marked by the escort drones and vaporized with laser beams.

I know how this ends. I know it's all over already. And yet I cheer for every locust swatted from the sky, and my heart beats faster, wishing the ship to be safe, to survive.

But the locusts are so *many.* The escort drones start going offline, out of energy, out of delta-v, one hit by a locust. Clusters of locusts form on the drifting drones, eager to devour them.

Then they start clinging to the ship's hull. Just a few at first, then more and more. Communications from the ship are logged—calm, professional voices ordering damage control, describing the situation in a clinical tone.

Impact damage to forward-facing meteor shield. Maneuver jets 34 to 38 offline. Escort drone 5 out of propellant. Concentrate fire on dense locust clusters.

More escort drones go offline. They try to fire the maneuver jets in a jerky pattern to dislodge some locusts, but while some detach, more cling to the hull with every passing second.

Then the locusts start rearranging, until they form those cylindrical structures they use for digging.

The visual feed cuts as the last escort drone fails. We're left with only communications and telemetry.

Abnormal temperature reading. Widespread hull damage.

They're firing on the hull! We must get them out! Override engine safeties, point the jets at them!

Pressure loss in fuel tanks.

Fuck, they're… The voice trails to static.

Damage to voice communication system. Falling back to redundant systems.

Pressure drop in atmospheric sections.

Pressure loss in oxidizer tanks.

A flurry of red damage report lines.

Contact lost.

* * *

Speaking in front of horrified world leaders becomes an annoying routine these days.

At first, I had to struggle to make them grasp the danger. I had to evoke the Relocation Crisis and the Superbug Plague, and all the horrors that now-reviled politicians had dismissed in the past. They put in the trillions, they gave the speeches, but I could see they didn't really consider the locusts an existential threat.

No longer.

The whole planet has seen the Wang Wei disaster now. Half the world's leaders tried to get me removed and put someone more important—*politically* important—as the technical lead of the Extrasolar Threat Assessment Project. Or the Locust Watch, as we call it these days. But it turned out, as it often does, that I was the world's leading expert on the matter, so I'm still here.

And I'm the one who needs to tell them how to win an impossible war.

We designed new drones, new systems—laser grids and long-range detectors and low energy weapons. We considered other tactics: interfering with their comms, deorbiting asteroids to gravitationally alter the swarm's path, even building *our own* swarm of semiautonomous drones.

The problem is always the same. We are like a child trying to stop the tide. It doesn't matter how clever our toys are. The sea is just too vast.

But I can't say that. We still have five years until most of the swarm hits. We *must* contain the vanguard group, and then we *must* find a solution for the main swarm. It seems unthinkable only because we haven't thought it, yet. Or so I must believe.

"As most of you know," I say, even if don't trust politicians to know anything at all, "the vanguard swarm, counting approximately two trillion locusts—that is, two-thousand billions—has split in three large sub-groups, accounting for 99 percent of the locusts currently in the Solar System. As previously hypothesized, locusts are drawn to sources of electromagnetic communications and availability of metal."

I call up a map they'll see in their neurolinks. It shows three red lines flowing through the Solar System, cleverly using gravitational slingshots both to change direction and lose some of their momentum.

"One group aims for the Chinese Belt Refinery Complex, near Ceres. Probably attracted by the large amount of communication and raw metal flowing through the hub. Despite the economical importance of the hub, it can be evacuated. A second group is directed toward the Jovian System, possibly because of the favorable orbital conjunction. It will be the last to arrive, so the eventual evacuation can be assessed later. And finally, the largest group aims for Earth."

Whispers of worry.

"Can they attack the planet?" one Indian minister asks.

And here things get tricky. Be too optimist, and they underestimate the danger. Be too realistic, and they refuse to believe you.

"The locusts don't seem interested in *attacking,* per se," I say, "they are . . . feeding." It's still difficult to refer to them as living beings. But there's mounting evidence they evolved in separate strains, and I'm not going to disbelieve reality.

"It's unclear *if* they even have any interest with Earth," I say. "A single locust would burn entering the atmosphere, and even if it didn't, it would have no way to return to space after feeding. So, one could assume they'd be uninterested in planets and only target stations."

More whispers, but the leaders seem immediately reassured. *Yeah, who cares about space, it's just the future of our race out there.*

"*But,*" I say, "they've shown remarkable ability to assemble in complex patterns within the swarm. For obvious reasons, we haven't tried releasing a large amount of locusts on the planet's surface to see what they do. But we found their eggs capable of producing a number of adult forms, and have managed to artificially trigger the development of some of those. One develops ventral sacs and slowly fills them with hydrogen. This form might be part of a structure used to carry locusts back into space, reaching high atmosphere via aerostatic lift."

Futurists have been predicting a return of airships since before I was born. Turns out they were right, they just didn't factor in the alien locusts.

"Even if the swarm made no attempt to land, a large number of locusts would deorbit and burn in the atmosphere due to their limited maneuver capability. While single drones would burn harmlessly, falling clusters might cause a meteor shower."

I look at them and take a deep breath. *Now* the really essential part comes.

"But that's not the main problem. If we fall back to Earth and lose access to orbit, we'll lose all of our space infrastructures. We won't be able to respond when the *real* swarm comes. And that one is so large it *must* be stopped at any cost. We *definitely* wouldn't survive its passage near Earth. It is so vast, even just a small fraction of its drones deorbiting would make molten metal rain from the sky."

Not really sure it would kill us all in a way as cool as molten metal. Different models yield different apocalypses. But I might as well go with the most striking one.

"Thanks for the . . . sobering briefing," the U.S. representative says, looking dazed. They should know all this already, of course. But an old woman yelling at you still outperforms written text for persuasion. "So . . . what can we do? We know several plans were under feasibility study. We have just eight months before the sub-swarm reaches Earth. Do you have a plan, Professor?"

Ah, the good old politician's instinct to imply someone else is at fault.

"I have several," I say. "We need a full orbital laser grid, able to adequately protect *all* low orbits. We need fast response, high-burn drones equipped with energy and kinetic weapons to take over when static defenses are overwhelmed. And we need a substantial fraction of the world's quantum computation resources to decode and understand the swarm's communication in real time, if we are to act effectively against it."

"This will cost a lot," the E.U. high commissioner points out.

"Anything less, and we risk losing it all. How much would the end of the world cost?" I ask.

Silence. This might sound empty to the younger representatives. But those who are as old as I am remember the tail end of the Relocation Crisis. We *know* how much the end of the world cost, in money and lives and horror.

"So, if we manage to do all this, can the defenses be scaled up to deal with the larger swarm?" the Japanese Defense Minister asks.

I shake my head.

"No. This is enough to deal with this smaller swarm, and can be scaled up to deal with the second wave, expected in three years. But the main swarm is larger by more than one-hundred millions times—the laser grid can't collect enough energy to deal with them. There *isn't* enough energy. And if by some miracle we could vaporize it, all that plasma would be enough to destroy Earth anyway."

Silence falls again.

That was *definitely* too much truth at once.

"But this will at least buy us *years,*" I say brightly. "I don't know *yet* how to deal with the main swarm. But we *will* do it, as long as we're not swept away by this vanguard."

* * *

"Grid overwhelmed in sector C-31-Z. Scrambling two Angels to provide support. Activating transporter to bring in replacements from the Heavenly Citadel."

My reports these days read like those of a strange holy war. I never thought I'd design

weapons and defense systems—I actually thought I'd refuse, if asked—but I do little else now.

"Will we hold?" Liu asks. They always look awkward when they try to understand what is happening in orbit. They're brilliant at studying the locusts and understanding their behavior, but they don't really get orbital mechanics, nor the complexities of the layered defense system we put in orbit.

"Yes. The sub-swarm peak will be in fifteen days, but I actually think the worst is over," I say. "We risked collapse three days ago, but now we understand our weak points, and we're producing more Angel drones than we lose. We have contingency plans and redundancies. Plus, the locusts don't change strategy."

"That's a great relief," they say, their gaze distant. "I was thinking . . . well, it didn't happen."

"What were you thinking?" I ask, alarmed.

They shrug.

"A group of locusts obviously has greater computational power than a single drone. They can link to solve more complex problem; their sensors work better; their astrogation becomes more precise. And well, there are more locusts in that swarm than neurons in my brain."

"You thought it might have been *intelligent?"* I ask, a chill going down my spine. The idea seems outrageous—the cognitive abilities of a locust are comparable to those of their insect counterpart.

"Would you easily rule that out?" they answer. "Maybe not as intelligent as a human, but enough intelligence to change strategy. Their ability to coordinate seems to max out at about one hundred thousand. Not unlike bees in a hive."

"In a way, I *wish* they were smarter," I say. "Maybe we could reason with them. Or at least they'd understand we haven't enough resources in space to even *remotely* feed the swarm. We'll probably take more of them down in our defense than they'll gain by consuming all of our space infrastructure *and* ferrous asteroids. But they don't seem to have any self-preservation instincts."

Liu nods. "That's possibly the thing about them most unlike life. They don't seem to care about living."

Their tone sounds musing, again. I don't think I'd ever be that calm about the impending apocalypse, if I were as young as they are. Hell, old as I am, I'm *angry* all the time at the idea of dying because of these things. If I think about young people, about my daughter and nephew, even about Liu, I want to punch God in the face.

"I still think, more likely than not, that they evolved," they continue. "But what did they evolve *for?* They seem to work best at consuming artificial structures—already refined metal. One could think they usually eat civilizations more advanced than ours, with more space infrastructure. But would a spacefaring civilization vast enough to feed this swarm be vulnerable to it? As you say, the swarm will *lose* significant numbers even if it manages to consume us. So how did it grow so much?"

"It's obvious they *can* feed on asteroids by now. And have you seen those aerodynamic clusters? I bet they can land on planets, too," I say, trying not to think of the sky going dark with countless trillions of locusts. "My guess is, they devour everything. They just attack the space infrastructure *first.* Maybe it's a strategy they evolved with time. Who knows how many civilizations they've destroyed already."

"Maybe they don't search for signs of spacefaring civilization because they're good food," they say, an incongruous smile on their lips. "Maybe they're squashing them before they become a danger. Who knows how many swarms are out there? Maybe the galaxy is crawling with these things, and they're the reason we never found traces of life."

Like every space lover, I wondered many times about aliens.

Is the Galaxy a graveyard, patrolled by mindless swarms? That's a scenario so bleak my mind recoils.

"Well, if they exterminated everyone else, let's make sure not to join those losers. Those other species didn't have me and you," I say. "How is your communication study going? I'm more and more convinced that disrupting the swarm is the only way to survive this. Destroying or deflecting it is simply beyond us. We must trick it."

Liu nods, grave.

"I concur. Unfortunately, while we understand more and more about their communication system . . . as you say, it would be *easier* if they were smarter. While there's actual processing and data exchange within smaller clusters, up to one hundred thousand, above that it's just . . . like a consensus. A chorus. Endless repetition of a simple navigation directive. It was the *easiest* part of their communication to crack, and yet there isn't much we can do about it."

"Can't we jam the signal? Plant a false one?"

"That's what we've been working on. Technically, we can," they say, "but like any other kind of attack, it gets swamped by their *scale.* We can overwhelm or jam the signal, but only at a distance so short we might as well just detonate a bomb, or fry them with an EMP. We could tell part of the swarm to change direction, but as soon as they move beyond the range of our transmitters . . . they'd hear one billion billions voices telling them to go back on track. In this sense, they're similar to their biological counterparts. The swarm doesn't have much of a structure, or organization. They just need one thing—to all go the same way. Sheer numbers do the rest."

"A pity we can't spray pesticides on them," I say. While I'm wary of overextending metaphors, I *did* check how biological locusts are contained. "How did it even work before that? What stopped locust swarms from devouring every green plant on Earth?"

I ask it as an idle thought, but Liu smiles and starts talking. I forgot they *never* take a biology question as idle.

"A lot of factors. To begin with, remember that biological insects, unlike the locust drones, are mortal—they'll die if they can't feed anymore, while the ones plaguing us can hibernate for centuries, possibly millennia, and their mites can repair any damage caused by time. So, food availability was probably the insect locust's main limit. Persistent swarm behavior just wouldn't be a stable solution—if food is consistently available, scattered individuals could exploit it just as well, and be less exposed to predators and parasites."

"So, in a way . . . it's predators and parasites limiting them," I say, my mind running.

They raise their hands. "Forgive me, Professor, but the largest limit is *resources,* and we can hardly hide all the metal in our system. As for parasites and predators, I must point out both possibilities have been extensively investigated. You'll remember Plan Gamma—the possibility of creating autonomous drones, patterned on the Angels, that feed on the locusts and use them to recharge reaction mass and energy.

"But as you well know, we can't make enough of them. And we briefly considered parasites, too, but software ones are not viable—reprogramming them would require altering their groove pattern, and that can't be done with a signal. And a physical parasite machine would have no way to spread. The only solution would be a *self-replicating* predator, similar to the locust themselves, but . . ."

"We won't master that self-replicating tech in time to design a complex machine that uses it," I say. "But maybe we don't need it."

I consider just dropping the conversation and running to my design team. But I owe them at least *a bit* of an explanation.

"Why have a parasite or a predator, when you can have *both?"*

* * *

My artificial hip aches, as it does every time humidity is on the rise. I've strained my eyes so much I everything is blurry, and the only way I can read is bypassing my own body and reading via neurolink. I've worked basically nonstop the last month, as I often did when I was thirty, but since I'm not thirty, it feels like a tank ran me over and then shot me.

It doesn't matter one bit. I feel young and full of energy.

The locust threat is still huge, my plan is still shaky and vague, and two-thirds of my advisors say it's fundamentally flawed.

Those are details. I'm the one who sees the big picture; that was always my talent. And I *see* this will work. We can save everything. We can still have the stars.

"Dr. Liu, please, come in," I say.

They enter my office, a coffee cup and a brioche in their hands, wariness in their eyes.

"I brought you breakfast, Professor Zielinsky. May I inquire whether waking up so early . . ."

I cut them off. "Don't worry, I didn't get up early, I just didn't go to sleep. Doesn't matter. Doesn't matter. Look!"

I share via neurolink a rough design. Barely more than a 3D sketch with a few notes. Specifics, constraints.

It's a cylinder, thinner in the middle, covered in thin grooves. A locust, in the standard space-faring configuration—no eggs, folded legs, no weird morphs. Except for its extremities—a thin metal tendril is connected to each, thin as a hair and twenty meters long.

"See the groove pattern? It's modified. One of your designs, actually! Elegant, really elegant, making them *avoid* refined metal and electromagnetic emissions, instead of *seeking* them."

I take the coffee and slurp it. How many did I already have today? My doctor will be *furious*. She insists I'm old. But if I listened to her, I'd be crotcheting on a beach or something, and humankind would be doomed.

"Yes, we explored that design, but . . ." Liu starts, their voice thin.

"But!" I say, pointing a finger at them, "but you young people don't have *vision*. You had it too easy, with specialized machines for everything. In my days, you had to jury-rig stuff all the time. You know, with the collapsing civilization and all."

"Professor, with due respect, you might want to . . ."

I scoff. "Yes, yes, something silly like *eat* or *sleep*. I'll get to it. But I'm not quite senile yet—you were going to say there's no practical way to change the groove pattern on a locust, right?"

They nod, looking unhappy, like a kid who'll soon have to go to the presidents of pretty much everything and tell them *I think the fossil you tasked with saving humanity should retire to a nursing home, and we're all fucked.*

"The locusts themselves can change the grooves, or grow them, but it's a slow process," they say, "and it's maintained by their repairing mites. You can't affect those with a signal."

I nod.

"Stop thinking about *signals*. These are living beings. Sort of. Those self-repair mites are *symbionts*. You *infect* them. You even did that in the lab, right? Drop in a few modified repairer mites, and they'll modify their own production instructions. You can make them dance to your tune."

They seem sadder and sadder, as if they see where I'm going, and that I have no chance with this mad plan of mine. But of course, I read about their work. And I'm brilliant.

"The idea is valid in principle, Professor, but all the microfabrication plants in the world wouldn't be able to produce enough of the repair mites to infect a sizable part of the swarm. And even if we managed, there would be no way to deliver them. Like many other plans, it works on *a few drones*, but nowhere on the scale required."

"That's where you are wrong," I say. "Why use our factories? We have the greatest automated production system we could ever imagine right there. *The swarm.*"

They blink.

"Wait, what?" they ask, the courteous smile fading from their face.

"I worked on a further groove modification. It has to be tested, of course. But I'm sure your people you can make it work. You see that section highlighted in red? It instructs the infected locust to enter a brand-new morph. The one you see, with nanostructured wires at every extremity. They seek nearby locusts, latch onto them, and inject the modified symbionts."

Slowly, they nod.

"And the new symbiont changes the grooves . . ."

I smile. "And the grooves cause the infected locust to morph, start producing the modified symbiont, form the tendrils, and start infecting nearby uninfected locusts. But they won't change route until a majority is infected! As you say, it's a chorus. Only when most of them are infected will they change course. I did some modeling, and reckon we can get the vast majority of the swarm. And if sizable sub-swarms detach and stay uninfected, we can send a few drones to infect *those.*"

They look like they may fall down.

"This . . . this might work," they say, because unlike many older colleagues, they're actually quite smart. "It's . . . a bit like horizontal gene transfer. With a touch of parasite wasps. And possibly those weird fungi that . . ."

They shake their head, as if overloaded.

"Eat the brioche, you look like you need it," I say. "I think I'll go to sleep. Get everyone to work."

* * *

"The last swarm of meaningful size has deviated from its original course. It's likely it will slingshot by Jupiter and then Neptune, and leave the Solar System," Liu says. They still sound incredulous.

"Well, I'd say our work is done," I say. "Time to remind world leaders we saved them all, collect every possible honor on the planet, take petty revenge on old enemies, and party."

"I . . . was thinking more about using my newfound importance to advocate for international cooperation and benevolent causes," they say, with a guilty smile.

"Yes, that too, very important. Do you think we could get a statue in front of the United Nations?"

They look at me, as if trying to see if I'm serious, and I burst into laughter.

They do, too. We've worked together nearly every day for five years, and this might be the first time we laugh together. We laugh for a long time, getting a bit hysterical in the end.

It is really over.

"So, do you still think they were artificial things, Professor? Your great plan had, you will admit, a pretty biological approach."

Said by anyone else, I'd take it as a jab. But I know them by now, and they're actually asking in curiosity.

"What about you?" I counter. "Are you still convinced they evolved naturally? With those lasers, the mining configurations?"

"I thought a lot about it," they say. "I think . . . we might have been framing the question incorrectly."

"Tell me about it," I say. I'm pretty sure they reached the same conclusions as I did. But I'll let them take this small victory; their self-esteem took a hit when I beat them to the winning move, no matter how crucial their role in it.

"We thought of *designed* and *evolved* as two radically different things. But I wonder, now. Maybe they were really born as mining drones, with the innate ability to self-replicate. And the randomness in the grooves pattern . . . maybe it was just a mistake, something unintended that gave them the ability to evolve. I doubt they were *meant* to roam the Galaxy and grow indefinitely."

I nod. "It's a very realistic possibility. Consider the reverse, too. While I still think it's incredibly difficult for complex life to spontaneously arise in space . . . think about what we just did. We changed them, with purpose and design. Maybe they *were* a natural species before. Are they still? What if this isn't the first time this has happened? Maybe long ago, some remote species found these weird, asteroid-feeding creatures, and thought *what if they had lasers? What if they actively sought young spacefaring species?"*

They seem troubled. "And have you thought, in that light, about what we just caused?"

"We saved ourselves, and possibly countless other species. At the bare minimum, that swarm will avoid technologically advanced planets."

They incline their head. "As an immediate consequence, yes. But we did much more. So far, their evolution, if there was any, had to be very slow. Random changes in the eggs, possibly mediated by cosmic rays, leading to new grooves pattern. But no recombination like you get with sexual reproduction. And no horizontal transfer . . . until now."

This, I hadn't considered.

"So, now new strains, possibly more effective ones, might spread much more easily, thanks to our infection system."

"Not just that," they add. "Remember that most random mutations, for the locust as for us,

are harmful. A harmful mutation capable of spreading might destroy the swarm . . . or ensure only those individuals who can avoid infection survive."

"We might have introduced something like a prey-predator cycle. *And* faster evolution."

They nod. "Well, we saved our species. And I think the single most likely outcome of spreading random mutations would be to destroy the swarm. But who knows what else they might become. And who knows what *other* swarms have been changed already, by other species, much like we did."

"We know two things about life in the Galaxy, so far," I say. "There's enough of it that the locusts evolved, or were designed, to feed on processed metal. And yet we can't detect any other civilization. What does that tell us?"

As usual, they love answering rhetorical questions. "If these were locusts, maybe we should worry about the wolves."