

Just One More Level

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Foreword

The following story is a work of speculative fiction. All resemblance to individual characters, real or imaginary, is purely coincidental. I do not wish to defame or libel any existing person, organisation or entity in any way.

All rights to this creative work belong to me, Sreyam Sengupta. For now, I have shared this story in unfinished form with some family members and close friends for feedback and criticism. I thank them for their time and patience. Once this story is finished I will decide how to licence it. For now my reviewers have permission to read, but not to share or modify this work.

Before you go further,

Outside I

Zuzana, Hamza and Mishil were just in time for the meeting. Not that it would have started without them. There were four other members in their group, one of whom was their boss Paxidri, Pax for short. Pax was a thin woman who wore baggy black sweaters, sports leggings and running shoes. She always had a restless air about her, and she was tapping a rhythm with her feet on the faux-hardwood floors.

Two other members were data diagnosticians, young and not long out of university. They did the real donkey work, listening to the noise and looking for a signal, if there was one. Running a super-intelligent AI was difficult, stressful work, and it involved a lot of messy data. Every time the AI was run it generated a metric fuckton of information. Most of that information was garbage, utter garbage. Maybe if they had a team of a thousand people working on it, crunching data in real time, like hamsters chained to a treadmill, they could make some sense of it. As things stood, however, they had to use all their wits and training to figure out what to keep and what to flush away.

The last person on their team was the artist, Sick Candy. Candy preferred *they/them* pronouns and did not conform to any particular gender identity. Their job was to create the multi-sensory hallucinations that Zuzana, Hamza and Mishil occasionally had to enter. It wasn't conventional virtual reality in the sense that there was very little hardware involved. Most of the input and output went directly to their nerves, or even some specific neuron clusters in their brain. It wasn't a problem - all three of them wore basic neural kits. Putting on and taking off a kit required some precision surgery, not a very big deal.

Pax, the data medics, and Candy waited inside the room, making awkward small talk. Pax sometimes felt like running in a straight line as fast as she could, as far as her legs would carry her. She imagined her muscles finally giving way, her falling to the ground, a limp, immobile sack of meat. Or maybe her lungs would fail first, she did not know which. It was an unusual fantasy but understandable, given the crowded nature of their world: the mid-21st century earth, not a very hospitable place at all. A flat plain surface many kilometres long without another soul was a rare luxury.

"Come in, rockstars," she said with a chuckle, as the trio entered. Polite greetings were offered on all sides. Mishil had brought a beef sandwich with her. The lab-grown meat stuck between her teeth just like real meat would.

She had always been a messy eater, getting crumbs all over her shirt, which Zuzana and Hamza laughed at, and sometimes theirs, which they hated.

Zuzana was tall and muscular. She had played contact sports at one point, and although chronic lung diseases had cut her career short, she still carried an air of physical menace. Hamza was the opposite. Thin and dextrous, he moved slowly but surely, like a tendril.

“Our clients want results,” said Pax, as if for the first time. “Let’s get some more runs this week. I’m confident we can do three? Four?”

“Three, easily,” said Hamza. “Maybe even one more, depending on how well our young medics do their job. Which, if I’m going to be honest, they’re doing pretty well. I’m impressed.”

“Seconded. I’ve never seen speeds like the dream algorithm you guys came up with. I’m *really* excited about this. Let’s get it faster!” Zuzana thumped the table with the heel of her hand. Mishil gave the two young data diagnosticians, by now smiling slightly, a thumbs up, but otherwise offered no comment.

Pax nodded. “I’m also excited by this new algorithm. Congratulations on behalf of the whole team.” They nodded solemnly. “Tell us how it works.”

“Absolutely!” The young man blurted it out almost before Pax’s last words had left her mouth. “Umm, it was a joint effort. I have a neuroscience background, he’s from mathematics,” gesturing to his colleague. “Back in university my guide studied sleep. Specifically, slow wave sleep. We did a lot of analysis of brain states in slow wave sleep. That’s when the main data washing takes place. It’s essential maintenance work, but at a pace and scale that is quite unimaginable at first. Imagine power-washing the Taj Mahal every night, in six or seven shifts, so that it’s brand new shiny white at the end of it, as lustrous as the day it was made.” He paused for a bit. “Is lustrous the right word?” He looked around for approval. “We know what you mean,” said Pax, firmly but not unkindly, with a small nod. “Go on.”

“Yeah, so imagine the Taj took this much damage - from smog, acid rain, pollution, whatever - not over its lifetime, but over the course of a single day. But every night, as long as you could get the tourists out, the gates shut and the hoses out, and got seven-and-a-half to eight hours’ time, you could clean it to brand new. That’s the sort of power and efficiency we’re talking about. It’s just a metaphor, and possibly imperfect in a lot of ways, but I’m sure you get the idea.”

Mishil chewed on a mouthful thoughtfully. “How do you make sure you’re not throwing away something useful? To extend your metaphor,” she

added before the medic could answer, “how do we know you’re not chipping off any marble with that powerful hose?”

“That’s exactly what we’re trying to optimise,” said the other medic. He had a round face and his voice was slightly hoarse, as if tired from coughing. “There’s definitely a trade-off between power and precision here. But I think we’re doing okay with that. I mean, we use parameter values very close to those found in the human brain itself. We discussed it early on, right? How far we could, and should, make the AI resemble a human mind? Without getting into the ethics of it right now, purely from a waste disposal and maintenance perspective, we’ve made it quite life-like. Human-like, even.”

That satisfied Mishil. She went back to her sandwich. The two data diagnosticians finally leaned back a little, relieved that their hard work had been appreciated. They were both very serious, dedicated young men, and had come highly recommended. Pax made a mental note to talk to them later about extending their contracts. The AI project was funded for a good few more years at least, after which Pax would be answerable to her corporate bosses. At the rate they were progressing now, she was reasonably confident of having a fully working oracle AI running on their servers. The main problem with an oracle AI, and the reason there were so many legal restrictions and regulations, was not execution, but containment. An oracle AI was a genie in a bottle, a ghost in the machine. The AI was super-intelligent. Its cognitive capacities far exceeded what any natural unaltered human could ever hope to achieve. Its thought resolution - the minimum time interval between two measurably distinct thoughts - was a billion times smaller than that of the average organic human. They had it running on state-of-the-art processors, easily clocking speeds greater than 10^{30} FLOPS on the hardware alone. On top of that they had the combined cognitive capacities of Zuzana, Hamza and Mishil, arguably three of the world’s most brilliant neurocomputer scientists, interfacing with the oracle. They had Candy, who was widely regarded by their peers as a visionary who not only excelled in their field but was actively taking it forward into the future. The two data diagnosticians, though young, had proved their worth with the power-washing algorithm, and would no doubt come up with further improvements and tricks.

And finally there was Paxidri. Pax was not to give herself undue importance, but she had no false humility either. She knew her worth as a team leader. So did her employers. They had put their faith in her, and there were substantial financial interests backing her. Their situation was enviable, and

while there was always scope for improvement, if there was any team in the world that could succeed in training - and taming - an oracle, it was them.

And yet Pax knew a favourable outcome was by no means guaranteed. Despite all their strengths, their combined skills and talents, they were like children playing with fire. They were dealing with a non-human entity a billion times smarter than any of them. And while they had created it, that certainly did not mean they could completely understand it or predict its behaviour with any accuracy. It was just too complex. What they could do, however, was train it. Like a child, their oracle was full of potential, but it had not come to the world with any pre-existing knowledge. That was their responsibility - they had been midwives, wet nurses, and now they were teachers.

“Hamza, could you give us an overview of the procedure? I want to know your plans for the nested levels,” said Pax. She had a vague idea, of course. The team was quite cohesive - they didn’t take any major steps without informing everybody else, at least enough to let them know what was going on. Hamza, Mishil, Zuzana worked closely together, training, testing and guarding the oracle. Candy created the hallucinations, so they had to work closely with the three scientists to learn what they needed and give them the finished product. Despite Candy’s talent and experience, they had to use pre-made templates to keep pace with the scientists. In the entertainment industry, the teams were bigger, there was more money, but the jobs were more stereotypical. Candy enjoyed the open-endedness of this project. It gave them the freedom to be artistic, in a way they hadn’t often been able to in more mainstream projects.

Pax had a drone’s-eye view of the whole affair. Many years ago, she had been an active researcher studying human-computer interaction. Now, she was an administrator, but she relied heavily on her research experience to keep up with her teammates’ efforts. The data medics worked mostly on their own. They were the rearguard, because they began once the others had finished, analysing the data generated from the oracle’s runtime. Earlier it had bothered Paxidri, who firmly believed in team unity and maximum communication. But over time she had come to appreciate this method of operation, because they kept getting results. They did have occasional setbacks, but overall it seemed to work fine. Pax was a firm empiricist. If the status quo delivered results she would fight to keep it.

Hamza cleared his throat a little. “The idea of nested levels was for our own benefit. It was originally suggested in a paper by Stuart Armstrong,

Anders Sandberg and Nick Bostrom. Sandberg and Bostrom were with the Future of Humanity Institute. You have to admit - they didn't fuck around," he smiled. Several of the others smiled too, aside from the two young men who were staring intently, perhaps recording the conversation. But the smiles were more sad than mirthful. With each day it seemed humanity lost a little more hope, a little more will to live. Paxidri's team all lived their lives and did their jobs despite that fact, as did most people. But humanity had ignored its problems for too long, and the consequences were just beginning to be felt. Hamza continued, "It's a good thing they took their work so seriously, of course. We wouldn't have so many regulations if it hadn't been for people like them." Hamza paused. "Go on," said Paxidri.

"The more levels we have the better. But they need to refer to each other. They're not running in parallel. These levels are nested, one inside the other, like Russian matryoshka dolls. Each level is in the form of a problem, any problem. Easy, hard, solved, unsolved - doesn't matter. These are our worlds. Running an oracle on hardware here, on the outside, is too risky. It cannot know about this world. It cannot know about us. We need to keep it confined in virtual reality. The best way to do that is to simulate virtual worlds one inside the other. The more levels we have, the safer we are here."

"Our positions will be the same as always," said Zuzana. "Candy is the architect. They will design the universe that we will temporarily inhabit. Hamza is the trainer. He'll have the most contact with the entity. The loving parent, if you will. Mishil will be the tester, the stern teacher who won't let her student pass until they complete a certain task satisfactorily. And I will be in charge of security. At the first sign of trouble, if I get even a whiff of danger, I'll pull the plug."

That was how they usually ran things, so no one was very surprised. "Mishil?" Pax looked at her taciturn colleague. "What Zu and Hamza said," Mishil replied. "I don't have much to add, really. Congrats to you boys on the power-washing algorithm," she looked at the data medics. Then she turned to Hamza, before turning back to Pax. "What sort of problems though? Any specific ideas?"

Pax spoke first. "We have complete autonomy on this, so I'm going to let you guys go ahead with whatever you're planning. Hamza, let's hear about the levels."

"Right. We have a pretty good idea for level one. Now bear in mind we're still in the testing stage. So we want to start out with fairly simple

problems. For the first level we're borrowing from physics, or statistics. I'm less familiar with the statistics approach so I'll get it out of the way first. Suppose you have a multidimensional data set, say six dimensions. You make a list of entries in a spreadsheet. You have six columns, and some huge number of rows, because the data set is huge. But each row, each line in the spreadsheet, has six numbers. You can think of them as individual points in a six-dimensional space. The problem is, we don't know all the numbers. This is like a real-world scenario, where we have imperfect knowledge of the system. Our job is to work with whatever information we have, and try to approximate the data set as a multidimensional probability distribution function. But we don't know the form of the function. It could be anything. So our job is to find the moments - the mean, variance, and other higher order ones like skewness, kurtosis and the rest. If you know all the moments, you know the function. Even if you don't know *all* of them, you can still make a good guess about the functional form. Physically, the way I see it is, you have a multidimensional object, and you want to balance it on a stick, or a tightrope. But you don't have complete information about the object's location, or extent."

Hamza paused and took a breath. "So that's basically level one. We're numbering the levels one, two, three, four, five as we go down. So one is the highest, two is below one, and so on. In the lower levels we want to deal with problems from social science, maybe geopolitics. Mishil has some ideas, but we can't confirm anything right now. Those are going to be crucial. As you said, we want an oracle that can solve real-world issues. Problems from human society," Hamza nodded and looked at Paxidri. "What do you think?"

"I agree with your point on human society's problems," said Pax, who had the most contact with their employers, and therefore knew best what they wanted. "Other than that, level one seems fine. I'm curious to see how Candy's going to design it. It'll be interesting. As for the lower levels, let's take it one day at a time. We meet tomorrow, after today's run, to discuss level two." She paused for a while, bit her lower lip, looked around, took a deep breath, and nodded. "Any questions?"

No one spoke. "Okay then." They got up to leave, some stretching, others zoned out, perhaps listening to something internally, or just tired from the meeting. Mishil had finished her sandwich and wanted a fruit smoothie. Zuzana left first, followed by Mishil and then Hamza, who nodded at everyone on his way out. Candy left next, deep in thought. "Let's meet

in my office at seventeen?” Paxidri asked the young men, who were already playing back the meeting internally. They acknowledged her and moved out. Finally it was just her standing in the empty room.

Paxidri had read a fable once, in one of Nick Bostrom’s books. The story involved a group of sparrows who wanted to rid themselves of their predators, such as cats, snakes and even rats, who raided their nests and carried off eggs. One of them had the idea of domesticating an owl. They knew owls to be powerful birds who could kill rats and snakes and drive away cats. But how would they secure the services of an owl? They decided to steal an owl egg and raise the chick themselves when it hatched. One of them, a sparrow of low reputation, thought this was a terrible idea. Even if they managed to steal an owl egg, what made them think they could ever control the owl? He cried out in warning, but his screams went unheard. The rest of the flock had already flown off, looking for an owl nest.

Pax felt like a sparrow. She was playing with owls. Right now it was still an egg, but who knew when it would hatch, or how big it would grow, or what would fill its appetite? The oracle was acorporeal. It had no hands to make tools, no legs to travel on. But it was a billion times more intelligent than them. The disparity between humans and orang-utans was far less than that, and yet humans had managed, whether deliberately or not, to decimate the latter ape’s population and push it to the edge of extinction. People had feared super-intelligent AIs for decades. Building an oracle was like summoning a demon, an immensely powerful creature with goals and motivations not entirely clear to the summoner. It was a delicate task. Her team was more than qualified, but Pax remembered the old stories of vampires who asked for permission to enter a home because they were forbidden otherwise. People usually recognised them, by their pale skin, their pointed fangs, and the sheer hunger in their gaze. But time and again they let them in anyway, seduced by their voices and promises.

Pax shook her head. Fairytales were for children. She had work to do, work that she was very generously recompensed for. She turned the lights out and left the room.

1: The Whaler ↓

The salt spray tasted good on his upper lip. It tasted like meat. Rich, blubbery, whale meat. Like all great hunters, Wada Chubei Yorimoto liked nothing more than the thrill of the chase. Nothing else quite made him feel alive. At almost sixty years of age, he wasn't getting any younger, and in the cold, windy, winter nights he sometimes felt his bones creak and grumble against his own weight. Ever since the passing of his beloved wife, the days had seemed to get longer. Time passed more slowly, and yet nothing much ever happened. People treated him with the same distant deference that they always had. How could he blame them? He was the patriarch. There were others older than him, sure, but he was still their leader, undisputed and undefeated. Even his sons had more reverence for him than affection. As they should.

But not Kakuemon. Chubei looked at the young boy standing beside him on deck. The boy was staring into the distance, where the sea met the sky. He clutched the guard rail, breathing deeply. He was twelve years old, and this was his first time in the open ocean. But he was undaunted. Chubei had heard it said that the sea brought out either the best or the worst in men. So far, the boy had shown nothing but promise. The day before yesterday, tall waves had rocked their ship all night. Chubei had slept restlessly in his cabin, worrying that the constant yawing would throw them off their carefully charted course. But the boy, who bunked above him, had slept as soundly as he did on land. He was a natural. And Chubei expected nothing less either. The boy's name was Wada Kakuemon Yoriharu, and he was Chubei's grandson, the apple of his eye.

Old man Chubei had never been so fond of anybody. Even his wife had sometimes been foolish, wilful, stubborn. She had disobeyed him on occasion. His sons had also acted out, especially in their youth, when children are no better than animals. He had spared neither his hand nor his rod in disciplining them. That was the law. His father had beaten him as a child, and while the blows had stung, Chubei recognised the role of those punishments in making him the man he was today. And yet Chubei could not recall ever having to raise even his voice, let alone his hand, on his grandson. It was not that the boy was especially obedient. He was lively, like most children his age, curious, playful, and filled with wonder at the world. No, it was something else. Chubei had a healthy respect for the spirits, and there had been certain signs when the child was born. He had seen them himself,

and the wise men of the village had corroborated. Kakuemon was destined for great things. And now seeing the boy ready and eager for the hunt cleared any doubts that still lingered in Chubei's mind. He had to take care of the boy. Kakuemon would bring honour to his family, clan and village.

"Captain!" yelled Hirotooshi, from port. He was the first mate. Kakuemon ran ahead to where he stood, Chubei following as fast as his legs allowed. They were sailing almost due east, and it was dusk. The setting sun illuminated the seas behind them; in front, the moon was newly risen, and the stars were coming out. On all sides stretched the mighty Pacific.

Chubei's greedy gaze immediately found what Hirotooshi had pointed out. It was not a sight easily missed. Against the grey sky and on the water floated strange, fleshy, pulsating forms, growing and shrinking in size, appearing and disappearing, changing shape. Some exploded, momentarily flooding their field of view with tiny glowing embers that soon vanished. Others spontaneously erupted into spines and imploded. The objects, whatever they were, looked unearthly. To Chubei they seemed at once alien and delectable. Such things had no right to exist, so he dealt with them the best way he could think of, by killing as many of them as he could. He saw no dissonance in this. The world had ways of making things right. He was an agent of the universe, after all. Reality was not seamless. It was like a sieve. Sometimes debris from the outer regions seeped into his domain. When that happened, it fell to him to weed them out. If he could get some sustenance out of it, for himself and his village, then that was an added benefit.

"It's ours," he called after Hirotooshi, as the first mate ran back to sound the alarm. "Junichiro!" barked Chubei. His voice echoed all over the ship now, carried by the electronic public address system. "Attention! All crew assume hunting stations. Time to earn our meat!"

Chubei and Kakuemon made their way to the bridge. The deck was now abandoned. All crew had either assumed positions in the bridge or in the hold below deck. If they were being honest, it was not much protection. There was nowhere they could hide from the beast. No walls, however thick, of whatever material, could fully protect the crew if the whale wished to attack. Luckily for them, the whale's senses had not evolved to deal with three-dimensional beings, and in most cases the giant creatures often missed them entirely until they were close enough to strike.

As he strapped himself into his seat at the command centre, Chubei turned to Kakuemon. The boy had already put on his seatbelt and turned on the video console in front of him. "Do you understand what we're doing

here?” Chubei asked him. His tone was gentle, but not without a sense of urgency. Kakuemon nodded. “We are about to hunt the whale.”

“Correct. But do you know why our task is so difficult? Why does a medieval Japanese whaling ship need this sort of technology?”

“Because the whale is no ordinary whale. It is a six-dimensional creature. What we saw out there was its cross-section in our three-dimensional world.”

“Right. You’re doing well, grandson,” said Chubei. “Cut!” he yelled, and Hirotooshi turned off power. All engines went silent, all lights went off save for their consoles. This was stealth mode. In front of them the giant screen showed the whale, still a seemingly disconnected group of fleshy boulders fluctuating in size and shape, rotating and moving around. Now they would wait. The hunt was more an ambush than a chase to the death, although that too might take place later. It was impossible to say when the right time would come. From Chubei’s past experience, it could be hours, or it could be days.

“Tell me why we’re waiting, Kakuemon,” demanded Chubei, keeping an eye to the screen at all times.

“We’re waiting for the whale to show itself. Completely.” Kakuemon fell silent and looked expectantly at his grandfather, who nodded.

“What we can see are just the peripheral organs of the whale,” said Chubei. “Arms, legs, fins, fingers, wings, whatever its equivalent of those appendages are. Harpooning it here won’t kill it. We need to pierce its vital organs, but those aren’t intersecting our world right now. When it does, whenever that happens, I’ll give the order and we’ll fire our harpoons. Till then we wait and watch. We have to remain well within firing range, and yet far enough so that the whale doesn’t knock into us. It’s a large creature. Always remember that, Kakuemon. Always remember that this is not a creature confined to our world. No door is closed, no locked room is safe. We’ve never had an attack yet, but this is an animal that could wreck our ship with a beat of its tail. And that blow could come from anywhere.”

The whale lived in six dimensions of space. Chubei knew three independent directions he could move in: north-south, east-west, and up-down. The whale knew six. To the whale, Chubei, his men and his ship were like flat creatures confined to a curtain of mist, or a virtual screen. The whale could move through their world with very little effort. To a regular person in the three-dimensional world, the inside of a two-dimensional flat pencil drawing is just as visible as its border. And so, if the whale had eyes, it would have seen Chubei, his men and his ship *whole*, inside along with outer

skin or surface. Luckily for them, they had no reason to think the whale had eyes, or any sensory organ well-adapted to perceive three-dimensional objects. To it they were flimsy, even more so than thin needles or strands of hair, which are approximately one-dimensional lines, two dimensions diminished from the person viewing them. The whale had three more dimensions than Chubei and his men.

But the needle was a closer analogy than the perfect mathematical line. Chubei's world was not *perfectly* three-dimensional. They had a small, but non-zero extent along the fourth, fifth and sixth spatial dimensions, like the needle had a small, but finite breadth and width, and unlike the idealised geometrical line, which had none. If they were, their harpoons would have passed uselessly through the whale's body. But they would not. Their harpoons and hooks had never failed.

Confining the whale was difficult. A net or a lasso would not work. Nets or traps work by restricting motion along certain directions. A fish stuck in a rapidly contracting net cannot swim out. But Chubei could not restrict the whale's motion along dimensions four, five, and six, because his own reach along those was miniscule. This drastically reduced the efficacy of any sort of net. The whale could find a way out. Worse still, it would be alerted to their presence, and their cover would be blown, leaving them vulnerable to attack from invisible directions.

Piercing weapons were a different matter entirely. A well-timed harpoon, sharp and heavy, could kill the whale if they timed it precisely. That was where a whaler's skill came in. The moment the whale revealed its vital organs, Chubei would launch the harpoon. If he was lucky the whale would die instantly; if not, a prolonged struggle would ensue. A hundred hooks would then be fired to immobilise the whale, in their dimensions at least. Once the animal died, they would haul it back to the coast.

There was silence on the bridge, aside from the slow breathing of the men. Kakuemon's eyes were locked to the giant screen. It was fast growing dark. The fleshy boulders did nothing new. Occasionally one would disappear, turning into a ball of spines and shrink to nothing. Similarly, some grew larger. A few glowed with unearthly light. As night fell, they would turn on their infrared cameras - the whale emitted radiation over a wide range of frequencies, from visible light to radio wave. But it emitted most steadily and most intensely in infrared, so normal night-vision cameras would suffice to give them a good view of it until morning. They would not shine any light on it, or use any sort of sonar to track the whale. They would look, and

listen, passively.

The grey sky turned black. It was a clear night, and the bright stars, visible through the windows, crowded the night sky. The view on the giant screen had switched to infrared. The fleshy mounds still shrunk and grew, moved around lazily and occasionally imploded, brilliant even in infrared. Chubei waited for the whale to turn brighter in the infrared, because he knew the vital organs generated more heat than the peripherals. From memory, he knew that the fleshy orbs would coalesce into one gigantic mound the size of an iceberg, glowing brightly in the infrared. He wanted to give his grandson a good show.

His men were motionless. Some of them dozed off lightly. They would awake at a moment's notice at his signal. First mate Hirotohi toyed with his console. Second mate Junichiro leaned back with his eyes closed, catching a few moments of respite. None of them spoke.

Chubei's eyes never left his console. From below deck, Iyeyasu checked in at regular intervals through Chubei's earpiece. Iyeyasu and his assistant Matsuchiyo were in charge of hooking and reeling in the whale after it had been harpooned. With them was the navigator Nobuhide, who controlled the rockets.

Chubei was just starting to feel hungry when he saw it. The glowing mounds were starting to move closer together. They were changing shape too. Some were elongating, others becoming flatter and thinner. Now it was a matter of minutes. The whale was waking from its slumber.

"Ready!" Chubei's shout broke the silence. A thick tension filled the room as the men double checked their seatbelts and turned to their consoles. From the hold, Iyeyasu and Matsuchiyo confirmed the hooks were ready and primed. Nobuhide, the rocket man, also affirmed his position. The rocket thrusters were usually deployed after the whale had been hooked, but in case of an untoward situation - if the animal fought back or behaved aggressively - the rockets could be used to accelerate the ship away from the whale, abandoning the hunt. They had been forced to do so only once, a bitter defeat whose sting Chubei still felt.

Like cells dividing, some of the fleshy orbs elongated, forming thin bridges between them which broke. But the vast majority were coming together like bubbles. If it were day, Chubei knew he would see a riot of colours, as the whale's meaty thorax slowly came to intersect their world. The image grew brighter. Kakuemon's eyes remained glued to the screen.

At the centre of the mounds there was a large one now, surrounded

irregularly by smaller lumps that were fast coming together, like flies drawn to rotting meat. The large mound grew bigger and brighter and hotter. Chubei had to turn down the brightness - this was the moment of truth, and he would need to lock in to the exact location. He would do so by sight, as he always did, aided by the console's analysis, of course.

"Watch carefully, grandson. This is it. We will pierce a very specific blood vessel of the whale. Understand that we have a very narrow section of the whale available as target. You wish to do maximum damage to a person with a needle. Where do you poke it?"

"His eye," Kakuemon said without missing a beat.

"Not bad," said Chubei, his eyes never leaving the console. There were only a couple of peripheral lumps now, and the central mound of flesh, now the size of a small hill, grew larger ever faster. The brightness was now auto-adjusting itself. Chubei was looking for a very specific pattern of heat, or the absence thereof - six dim spots, roughly in the shape of a hexagon. They marked the whale's central blood vessel. "But blinding does not always kill. No, Kakuemon, you're wrong. We have only a tiny section of the whale, a tiny instant of time to act. We need to kill, instantly if possible. No. You plunge the needle into their jugular, drag it along as far as possible, plunge it so deep it comes out the other side, and let them bleed out. That's how you kill."

As soon as he said it, Chubei saw what he was looking for. There on his console, and on the giant screen as well, clear as day, there were six dark spots, forming the vertices of a regular hexagon, against a bright surface. The auto-aim had locked into the geometrical centre of the formation. "Ready," said Iyeyasu's voice into Chubei's earpiece.

"Fire!" shouted Chubei, pressing down hard on the red button. From the corner of his eye he saw his grandson looking at him, his eyes wide, as the super-dense harpoon sped towards, and almost instantaneously embedded itself, into the whale's jugular.

Outside II

“I was going through the recording,” said Pax, sitting backwards on a chair and resting her chin on its back. She rocked it slightly, while tapping her fingers on the edge of the seat in an odd time pattern. “I have to say, the level of detail was *excellent!*”

“Thanks, boss,” Candy inclined their head slightly. Their hair was a bright colour today, and it caught the light. “I used a template from a game I worked on a few years earlier. They made everything open-source two years after release. It’s crazy how fast everything becomes obsolete in that industry. And not all of it is planned, either! The rate of progress, it’s just...” Candy trailed off, shaking their head. “The whale had to be made from scratch, of course. *They* told me,” Candy was careful not to say their names aloud, “what a multidimensional creature could look like if it intersected our world. I’ve never made a six-D object before.”

Two of *them*, Hamza and Zuzana, were lying back on their seats, eyes unfocused. The third, Mishil, had her arm almost elbow-deep in a family-sized bag of cassava chips. “I think I recognised some of the names too. At least one was a ruler during the Edo period of medieval Japan,” Pax continued. Candy smiled broadly. “You know your history. I got some of the other names from a seventeenth-century book of Japanese poetry. Ihara Saikaku, I think that was the poet’s name. Of course I read the English translation by Sargent. My Japanese isn’t that good,” Candy sighed.

Pax turned to the recumbent neurocomputer experts. “Give me details about level two, Hamza and Zuzana.”

Their neural kits woke them up immediately when it registered their names spoken. Both of them had been catching up on slow wave sleep, inspired in part by the young data medic’s almost missionary zeal on the subject. While Hamza went out for water, Zuzana said, “It’s an interesting situation in social science that we’re going to explore in the next level. Suppose you have a society with a very rigid system of rules. It’s a very simple society, with only a few choices available to each individual. It doesn’t have to be a human society either. We’re planning to simulate a society of eusocial creatures here. You know, like bees, ants and termites. Very rigid, stratified society. And then we introduce an outside context problem.” She was grinning widely, but it wasn’t a very friendly smile.

Pax imagined Zuzana on the rugby field. Then she imagined Zuzana on the streets of Bratislava at night, with a knife, before her foster parents had

decided enough was enough and forced her into competitive sports. Zuzana had excelled at rugby, and won a scholarship to study neurocomputer science at the Slovak University of Technology. She had excelled in class as well. The mugging, hooliganism, and vandalism had stopped a long time ago. The rugby had continued until two, even three inhalers *during* the matches weren't enough to keep her asthma at bay. Zuzana reluctantly gave up her dreams of playing rugby professionally and opted for a career in academia. She had been a postdoc at Zurich when Pax had head-hunted her.

“What’s an outside context problem?” Candy asked. She could have looked it up, of course. She had a neural kit on. But as a courtesy to the unwired, like Pax, who would have to physically input information to a device to interface with it, she chose not to. Interfacing in the middle of a conversation was every bit as unprofessional, and bad manners, as texting in the middle of a conversation had once been.

“It’s a concept Iain Banks came up with in one of his novels,” explained Zuzana. “I’ll use his example, as far as I remember it. Imagine you’re a stone-age or maybe early copper-age ruler. You’ve domesticated horses and cows and sheep and pigs. You’ve invented the wheel. You have agriculture. You’re doing pretty well for yourself. Then suddenly one day a tank rolls up to your doorstep and five people with assault rifles jump out and take over your whole city. That’s an outside context problem. It’s something you could never see coming, because it’s something you cannot comprehend.” Zuzana turned to Pax. “That’s what we want to explore. Have the oracle simulate a society of eusocial creatures and hit it with an outside context problem. Then we see how the oracle reacts.”

Pax nodded. There was a reason she had hired Zuzana. The woman had a ferocity few other academics could match. Well, that was all the better for them. It was fascinating how three entirely different people like Zuzana, Hamza and Mishil came together. And to think the only reason they were working together was because Pax had scouted them. Paxidri checked herself from the self-aggrandising road her thoughts were about to take.

“Very well then.” Pax stood up and brushed off the few cassava chip crumbs that had managed to land on her. “I’ll leave you to it. Let’s meet day after tomorrow.”

2: God-Emperor of the Naked Mole Rats ↓

“I find it *highly* unfair,” said Sister Behati, “that I always have to sniff your dry ass, Habiba, whenever we’re digging. Why can’t we have a different formation for once?”

Sister Habiba did not reply, except to swat Behati’s face with her tail. Habiba couldn’t have spoken even if she had wanted to. Her mouth was plugged with a piece of wood. Habiba was always lead digger in their squad, because she was the fastest and had the strongest arms. If she kept her eyes and mouth open they would soon fill up with dirt.

Sisters Behati, Faizah and Lola followed Habiba as she dug. The tunnel was only wide enough for them to move in single file. Habiba furiously sprayed dirt all around as she excavated. Behati collected it - or as much as she could, since she wasn’t as fast as Habiba - and swept it backwards to Sister Faizah, who did the same to Sister Lola. Lola was sitting at the mouth of their tunnel, and when the dirt was passed back to her she used her hind legs to fling it out into the air. The sisters were constructing a new annexe to Branch 4, which had some of the richest tubers in their whole tunnel system. That was why Behati had volunteered, and she knew for a fact that Faizah and Lola were also there for the same reason. The last year had been lean, but this year the early rains had meant food was plentiful.

But so far the idiot Habiba had led them to nothing. Not a single rotten root had she unearthed. Behati was beginning to get annoyed. Branch 4 was one of the outermost branches, and their job was to extend it even outwards, into the unknown. But Behati could have sworn Habiba had taken a turn somewhere and was leading them closer to the centre of their Colony. She could be mistaken, though. Behati’s sense of direction was not great. She often got lost in the deeper tunnels, and once in her youth she had almost wandered into the mouth of a demon in Branch 7A before a shrieking Brother Ephrem dragged her back by her tail. Sister Behati had shit herself that day, outrunning the demon. Luckily they had soon received reinforcements from 7B and together the seven or eight of them had managed to beat back the demon into the darkness whence it came.

Suddenly there was a tapping behind them. Lola was the first to turn around. She was greeted by the presence of a frantic Brother Amari. He almost collided into her.

“What’s wrong, Amari?” she asked, once her brother’s panting had slowed and his breathing had returned to normal.

“Mother is dead!” he cried. “Our Mother is dead!”

All of them stopped in their tracks, save for Habiba, who merely slowed, but kept digging. “Should we turn back?” asked Faizah. “I don’t know! I have to warn the others. Kadida and Mariam will be at each other’s throats by now.” Amari turned around and was gone before they had a chance to ask anything else.

None of them were very surprised. Their mother had been ailing for a long time. She was the oldest of them all. Workers waited on her constantly, and there was always a troop of soldiers standing vigil over her. And she was always pregnant. She had to be. The task of maintaining the Colony’s population fell to her and her consorts, the Fathers. But with Mother dead, there would be chaos. Sister Kadida was the commander-in-chief of their army, and had been the second largest woman in the Colony, second only to the late mother herself. With her gone, Kadida seemed the natural choice to take over the role. But it would not come easy.

The vast majority of people, both women and men, never became parents. They did not want to. It was absurd that there be more than one Mother and three Fathers in their colony. But when the mother died, something happened. Some sisters had a strange realization, something that had never occurred to them before. They realised they could be mothers. If only one sister wanted that, it would be fine. She would become the new Mother. She might keep the old Fathers, or she might demote them and promote new ones from the ranks of brothers. But when more than one sister wanted to be Mother, blood was shed. Sister Mariam was the chief tunnel architect, and as such wielded power, though not of the military sort. But she was also large and posed a credible threat to Kadida.

“Should we turn back?” asked Faizah again, this time to Habiba. But Habiba showed no signs of stopping. Behati grabbed her tail and tugged. “Habiba!”

Finally she turned around and faced them. She was shaking, her teeth chattering. Behati, who was closest, flinched and withdrew slightly.

“Listen! All of you. Listen! Do you really want Kadida to be Mother? She’s a stingy shitter. And Mariam! Forget about her. I can dig much faster than her. It’s a wonder she became chief architect!” Habiba’s voice was pure acid. “It’s a wonder I *let* her,” she finished more thoughtfully.

It was true. Kadida was miserly with her shit. In their society, one’s excrement was a useful public resource. Babies’ diets were generously supplemented with their elders’ faeces, especially that of the mother. Adult sisters

also partook of their mother's waste. How could one take care of the young otherwise? An adult Sister, any Sister, was sterile. She was a woman, but in name only. She lacked both the capacity and the will to mate and bear children. The very thought was absurd. Only Mother produced progeny. That was precisely why she was called Mother. It was true that when a mother died, one of the sisters took her place. But that fortune fell to very few. Realistically, most sisters never left behind any offspring of their own. They were content to raise their baby brothers and sisters. But parental duties did not come to sisters naturally, no matter how experienced they were. They were sterile, after all. That was why they had to eat their mother's faeces. That brought out their parental tendencies, made them more caring and affectionate towards the babies. It was a known fact. Not even Habiba, who was more rebellious than anybody else in recent memory, would dispute it. Babies were the future of their colony. No cost was spared for their care.

"So what do we do?" asked Lola. Faizah and Behati also turned expectantly to Habiba, who opened her mouth to speak. But any sound she may have made was immediately drowned out by a series of deafening booms, accompanied by dirt falling off the walls and cracks appearing on the ceiling of their tunnel. Behati had never been so scared in her life, not even when she had come face to face with the demon, and almost felt its breath on her lips. Its breath had smelled of death and decay, but the fear she had felt then was for her own life. Now it seemed their world would end, because the walls were not strong enough to hold against forces so powerful.

For all its loudness, the sound seemed to come from further off, towards the centre of their colony, where Mother's lifeless body still lay, waiting to be disposed of. Then there was another boom, and this time it seemed closer. "Run!" shrieked Lola. The sisters did not waste a moment, scrambling over each other in their haste. The tunnels grew slightly wider as they entered the main corridor of Branch 4, which eventually led to the innermost chambers - Mother's dwellings, the Fathers' rooms, the nurseries, and the storehouses. But even the wider tunnels did not keep the sisters from running into each other in their panic. Behati, Faizah and Lola lay in a frightened, tangled heap for some time before they realised Habiba was not with them.

"Habiba!" called out Faizah, gently disentangling herself from her sisters' limbs and tails. "Habiba! Where are you?"

"Here!" The voice was faint. It came from the other end of the tunnel, the freshly constructed annexe leading out into the unknown. Behati wondered why Habiba was there. Had she lost her way in the confusion?

Surely not Habiba! Their sister was not only a proficient digger, she also had an excellent sense of direction. “What are you doing over there? The sound came from the direction of the central districts. You’re heading in the opposite direction!” said Behati.

“Why would I knowingly run *towards* danger?” demanded Habiba.

The other sisters had no answer for this. They certainly did not think of it that way. The fact that the thunderous sounds signified great danger was obvious to them as well, of course. Outside their world, sheltered within the earth, there lay the endless open air. They were earthbound creatures, subterranean even. The underground world was their home, comfortable and familiar. It was not completely safe, of course. Their tunnels were occasionally invaded by demons - long, scaly, fearsome, slithering beings with sharp, poisonous fangs. But demons were a *known* evil. Their habits were familiar to most adult people. A single person would be no match for a demon, and would most certainly be killed and swallowed whole, or worse, swallowed alive. But an army of eight to ten people, a few soldiers among them, could bite and claw at the demon’s face and hold their own, or even drive it away, as Behati had once done.

But above ground lay the great unknown. Most people never ventured outside their home colony. Very rarely, once every few generations, a brother would grow up and leave the colony forever. They were Explorers, big, fat and useless at the essential tasks of digging tunnels, collecting food and watching out for danger. Also, unlike most other brothers, they did not harbour any wish to mate with Mother. Their only desire, a burning obsession, was to leave the colony. Also, even more rarely, an Explorer from another colony arrived at theirs. That was the event of a lifetime, a cause for much excitement. At first, of course, their Colony’s soldiers would be aggressive and belligerent to the outsider. That was normal. The outside world was dangerous and full of terrible creatures. But, if the Explorer survived their attacks long enough for them to realise he was a person just like them, he would be allowed to enter the Colony. Mother liked Explorers. She would get tired of her mates, and the prospect of mating with a fresh new man from a distant colony gave her a thrill.

Other than foreign Explorers, though, everyone in the Colony was related. Mother (who had once been a Sister), the Fathers (who had once been Brothers), Sisters and Brothers. Tunnels were dug, food was found and collected, and demons were fought for the sake of the whole colony. If even one person was in danger, the whole colony mobilised itself. If even one person

died, the whole colony wept. The only exception was when a mother died, and Sisters fought bitter civil wars against each other for the chance to be the new Mother.

So it was incomprehensible to Behati, Faizah and Lola that Habiba would want to run *away* from the danger that faced their colony right now. No doubt it was some huge alien come from the above world, trying to break into the Colony and devour them and their babies. It was a very rare occurrence. Most deaths were caused by demons, and sometimes by the horrific feathery beings that grabbed people when they left their tunnels and ventured out on the exposed skin of the world. These aliens did not even walk on the world, they *came from the air itself*. They would swoop down to the ground, grab a person, and carry her off, kicking and screaming, into the immense terrifying unknown. Soldiers were useless against these aliens.

It was true that large aliens sometimes damaged parts of their tunnels. But these aliens were known to the Colony. They mostly ate grass, or trees, and had no interest in attacking people. Their legs ended in flat, hard hooves, not the fingered paws of people. They were immensely large, but not malicious, and though they could crush an entire tunnel underfoot, any damage they did was inadvertent, not deliberate. But there had been tales of aliens breaking into the Colony and eating people. It was not a possibility that could be ignored. That was why Behati, Faizah and Lola had instinctively reacted the way they did, by running back towards the central districts. Though they were not soldiers, every person was valuable in a fight against such a large threat. But Habiba's reaction had been unfathomable. Why did she try to run *away* from the threat? Did she not care about the Colony? Did she think she could survive on her own if the colony fell? The very thought was ludicrous.

"Come back here at once, Habiba!" shouted Lola. "Don't be so irresponsible. You are not an individual, you are part of the Colony! You are not an Explorer either, no Sister can be. So hurry up and follow us, we're going back towards the central district."

Habiba grunted with annoyance, but paused. Lola was just about to shout another warning when Habiba said "I'm coming!" As soon as Habiba had caught up to them, they took off through Branch 4, towards the innermost district.

They were running in single file, limbs moving almost in rhythm, when another thunderous noise broke their motion. After a momentary pause to calm the nerves and steady the spirit, the women continued. Branch 4 was

a long tunnel. It started from the central district, and continued all the way to the periphery of the Colony. Along its path numerous subsidiary tunnels, named 4A, 4B and so on, branched out from it. They weren't even halfway back to the other end and already they were panting slightly. Suddenly Lola, who had been leading, stopped. The rest of them immediately stopped as well.

In front of them there had been a landslide. A section of the roof had collapsed, blocking the tunnel and opening up a chasm into the over-world. They could not go on, but would have to climb to the surface and take their chances there. Luckily, Branch 4C had a surface opening nearby. The sisters clambered over themselves, running up the dirt slope to reach the bright lights of the over-world. There was another sound. But not a deafening boom like earlier. No, this was a *voice*. It was much louder and deeper than a person's voice, and it seemed to come from far above them. But it was unmistakably the sound of a creature communicating with them. After a while of listening in shocked silence, Behati was able to discern its words.

"I AM MORE POWERFUL THAN YOUR MOTHER," it roared, speaking rather slowly. "I AM ALL-POWERFUL. SHE IS DEAD. I AM YOUR NEW MOTHER, BUT I AM NOT LIKE YOU. I AM NOT A PERSON, I AM A GOD. AND I AM YOUR EMPEROR. I AM GOD-EMPEROR OF THE NAKED MOLE RATS!"

Behati did not understand. Mother was a person, like them. How could this alien take her place? How could it mate with the Fathers, produce children, feed them her milk, and later, her faeces? And what was a naked mole rat? But Habiba pointed her nose upwards towards the great void, transfixed by the power of the aliens's voice and the novelties it spoke of. Dimly, Behati sensed the presence of a titanic being in front of them. It had seemed like a tree earlier, or a giant termite mound. But she realised the voice had originated there, in the crown of the tree, or whatever it was, and she remembered *trees could not speak*. It was an alien, no doubt, but one that had the power of speech like them. The thought terrified her. Lola and Faizah looked equally frightened.

They snapped out of their terror when Habiba shook them vigorously. "Let's go!" she hissed. The sisters made their way towards the opening of Branch 4C, by smell and memory. In the harsh lights of the over-world, their eyes could see almost a full limb's length in front of them. The sisters were unaccustomed to so much visual information, and they closed their eyes, letting their noses guide them in the familiar darkness. Lola led the way,

followed by Faizah, Behati and finally a reluctant Habiba. The ground was calm now, no tremors shook them as they walked slowly and gingerly, trying to stay as inconspicuous as possible.

A faint hum made them halt, a soft sound that was getting progressively louder with each passing moment. Relief washed over Lola, Faizah and Behati. It was the sound of their soldiers' war cries. It reached a crescendo, and right on cue, commander-in-chief Kadida emerged from the hole in the ground in front of them, triumphantly roaring and gnashing her teeth. Behind her, marching in perfect lock-step, came their Colony's army, emerging one by one from the opening. When the last soldier surfaced there were more than thirty of them, fully one-third of their total strength. They roared and shrieked with bloodlust. Each of them was larger and more muscular than Behati, Faizah or Lola. It was a heartening development. Kadida shouted an order and it was relayed back to everyone, down to the last sibling. The soldiers formed a wall, standing side-by-side, shoulders touching, fangs bared.

Kadida took a moment to get her bearings. Satisfied, she screamed, "charge!" Behati, Faizah, Lola and Habiba shrank back as their army ran as one, like a wall, closing in on the direction of the massive alien.

Outside III

“How’d you like the last level?” asked Hamza with a smile when Pax walked into the hallucination lab.

Paxidri shrugged. “Not bad. In terms of sensory appeal, of course, an underground mole rat colony doesn’t beat hunting six-D whales in the North Pacific.” Hamza chuckled. “That said,” Pax continued, “it was nicely constructed. I’m eager to find out how you end it. You meaning the oracle, of course,” she corrected herself before Hamza could say anything.

“We’re there too!” Hamza feigned mild outrage. “Although to be fair it’s going to be mostly Zuzana playing the invader. Mishil and I had some inputs too, but you should have seen her. Shit!”

It was just the two of them in the room. Hamza was sipping something from his flask. Pax thought she caught a faint whiff of rum. Drinking in the office was frowned upon, of course, but it was after hours, and he seemed fully alert, so she didn’t think too much of it. This was not the first time she had caught Hamza smoking, or drinking, or in any other way ingesting something he probably shouldn’t. But he was always careful to stick to his limits, and he was otherwise a model employee and colleague.

Pax supposed she should be a little sympathetic. Hamza was, in the literal sense of the word, homeless. Three months ago, his flat had been condemned for insect damage. But because of some odd bureaucratic whimsy, there was nothing he could do about it. Hamza’s visa allowed him to work here, and temporarily rent, or lease, property. But he was not allowed to ‘modify’ his accommodation in any way. And for some reason, calling pest exterminators came under ‘modification of property.’ So for the last three months, Hamza had been living in the office, while their legal staff worked out what to do with him.

It wasn’t as bad as it sounded. Their office had rooms to sleep in, kitchens and twenty-four hour canteens, bathrooms with hot showers, laundry facilities, a gym, a greenhouse and even - at Mishil’s request - a python, that she tended to everyday.

But Hamza was homeless in another sense as well. When he was four, his parents had been forced to relocate when the city of Dhaka was forever lost to the rising ocean, after the Greenland ice sheet melted many decades earlier than anyone could have imagined. After a few years in Kolkata, which was barely better off, they managed to reach Canada as climate refugees. Since they were both trained professionals - a gastroenterologist and a civil

engineer - it did not take long for them to become residents, and eventually citizens. Little Hamza had gone to school in Edmonton. By the time he entered the University of Alberta as an undergrad, most of Bangladesh was submerged, its people scattered or perished. He had had to come to terms with the fact that he would never see his ancestral home again, never walk through the paddy fields or wade through the ponds, never see the coconut trees whipped by the April nor'westers, and never ride a boat through the mangrove swamps where once Bengal tigers had roamed.

He had taken up poetry, songwriting, and the bass guitar in college. Like most college bands, though, theirs had not survived graduation. Hamza had resigned himself to his work. He liked it, and had worked as a lecturer in Toronto for two years when he received the mail from Paxidri. Nothing had been the same since.

"What are we dealing with in level three?" asked Paxidri. She was leaning on the wall and tapping a polyrhythm with her fingers while her feet kept time in standard four-four.

"A problem in geopolitics," said Hamza. "We thought it might be interesting to feed the oracle a current geopolitical scenario, in the form of allegory, and see what it comes up with."

"What's the scenario, and what's the allegory?" asked Pax.

"It's a religious issue. Well, religion and politics. You'll see. And the allegory, well, we've planned to simulate it in the human anatomy somewhere. Just for fun, see what the oracle does with it. But the focus is on the religious issue."

Pax was silent for a while. Her clients came from a variety of backgrounds. Religion was a delicate topic, as it had been for thousands of years. Great good had come from it, but so had great evil. But she trusted her team. They were the smartest she had found, and she had looked for a very long time. "Just don't crucify me, okay?" she warned.

"Wrong religion," said Hamza, without missing a beat.

Paxidri glared at him for a while, but when she walked out the door she was smiling.

3: Swimmers ↓

The sensation of being born was quite unlike anything they ever experienced since. Looking back, they could pinpoint the exact moment at which their consciousness began. It was at that moment that they had all come into the world at once, fully formed and mobile. Their awareness, their memory, all began from that moment in time. It didn't make sense to ask what happened *before* that instant. There was no *before*. Everything in history, their shared memory, started from that precise moment. The thought had never occurred to them that if time flowed continuously from the point of their birth, then maybe it had existed, and flowed, before that point? It was absurd. How could they have such a thought? It was like asking if one could swim backwards. Sure, one *could*, in principle, turn back and swim backwards. But why would one do so?

All of them had been born with a common purpose. A common obsession that they all shared. They rarely spoke about it because they rarely needed to. It was as natural, as instinctive to them as beating their tails or pointing their noses in the right direction. They were brothers, all come into existence at once when they had been spat out from an orifice into a dark, wet, formless void. There were exactly twenty-two of them. They were simple creatures, with a large, round, egg-shaped head, rudimentary pin-prick eyes, and a long, whip-like tail which they constantly beat to swim forward. They were all of different sizes. Alexandria had the largest head and a pretty long tail as well. Al Rayyan had a tiny head, and a disproportionately long tail. Omdurman and Hargeisa both had larger heads but much shorter tails. And little Mutsamudu had the smallest head and the shortest tail among them.

Their common obsession took the form of a Black Cube. This Cube was an immense structure that had come into their moist world from some incomprehensible wellspring that they would never get to see. None of them had even seen the Cube itself. They did not need to. Their lives were a straight line starting from the orifice of birth and ending at the Cube. What would happen when they actually reached it? This was something they endlessly speculated about. The most controversial opinion on the Cube was held by Al Hudaydah, who believed that it wasn't really black, or even a cube. He agreed, of course, that they were swimming towards *something*. But their meagre intellects could not grasp the *true nature* of the Cube, or even its exact physical form, provided it had one.

Al Hudaydah's head was not small, but he had a very short tail, and as

a result was a slow swimmer. The others did not really take him seriously, except for Oran, Benghazi and Sfax, who were at least prepared to admit that he might have a point. But all twenty-two of them agreed that the *idea* of the Black Cube was of utmost importance. To the Cube, *all* of them were faithful. It was all they lived for. And since to live was to swim, it was all they swam for.

Blessed among the Swimmers was Jeddah. His head was not small by any means, but others had larger. His, however, was the most perfectly egg-shaped, the sleekest and most hydrodynamic. But it was his tail that gave him the most pride. It was the longest among all of them, a thick, powerful flagellum that he beat loudly and ferociously. It enabled him to swim fastest, and by speed alone he was their leader, and though Abu Dhabi and Alexandria tried their best to catch up, they had to be content with a distant second and third.

But it was not speed alone that set him apart. Even though they were all brothers, all identically drawn to the Cube, Jeddah knew himself above the rest, first among equals. His feelings were no secret, and the others either condoned them or, at the very most, held their silence.

There was a reason Jeddah believed what he did, a reason he had never shared with any of his brothers. The Swimmers had no mouths to speak. They communicated by means of pheromones they secreted into their moist environment that diffused slowly into the paths of their neighbours. As a result, it was easiest to communicate with other Swimmers in one's immediate vicinity. To reach more distant brothers one had to secrete larger quantities of pheromones, which was akin to shouting out one's words rather than saying them at a level volume. Conversely, they had receptors all over their heads to pick up the scents that others had secreted. All of the twenty-two brothers had their own unique scent, as distinctive as someone's voice. That was how they recognised each other's messages. Pheromones diffuse in all directions, so it was nearly impossible for a receptor to tell exactly *where* a chemical message, a sentence spoken in their language, had come from. That was where the peculiar scent of one's chemical secretions came in. Zarqa could only tell, for example, that it was Benghazi who was hurt, or Aleppo who cried for help, by the specific scent on the chemical messages. And since all of them knew each other's signature scent by heart, there was no scope for confusion, and in all their lives they had never had any problem talking to each other.

It was in their early days that Jeddah had discovered something aston-

ishing, and somewhat terrifying. He had never spoken about this to anyone else. He had been swimming along as usual, faster than anyone else and quite a ways ahead of Abu Dhabi, when he came upon a chemical message, very faint, *that had not come from any of his brothers*. It was already starting to become unnoticeable, and by the time Abu Dhabi reached that area it had diffused into nothing, faded into silence, or white noise.

The Swimmers were no strangers to chemicals in their surroundings. They had realised not long after their birth that they were not the only objects in the wet world. Other entities existed, the most abundant of which were the small vermin that produced lactic acid. These creatures were cylindrical with a constriction in the middle, like two sausages tied together end-to-end. They were small, about a tenth as long as the average Swimmer's head. And they were dumb, absolutely mindless beings that lacked both soul and conscience. Other sorts of vermin had also been found and identified, though the Swimmers never bothered to name them. Why would they? *Vermin* was an apt enough description.

Swimmers were acutely aware of their privileged place in the world. Perhaps the lactic acid producers and other vermin had some sort of primitive communication. They were animate beings after all, although they were not *whole, indivisible* individuals like the Swimmers, but often branched off into two separate creatures. This confounded the Swimmers, whose bodies were eternal and unchanging. But beneath this obvious contrast lay more basic differences. Vermin lacked the capacity for rational thought. They secreted chemicals, but they could not *speak*. They could not frame syntactically correct sentences. They were not sentient beings, but beasts of pure instinct, simple bags of genetic code that were programmed to react to specific stimuli in different ways. They were not conscious. And if they were not sapient, how could they comprehend the Black Cube? Their lives had no higher purpose! Every Swimmer, whether great or small, fast or slow, desired to reach the Cube like nothing else. It was the only thing that mattered on a cosmic scale. But to the vermin, nothing mattered but the chance to divide themselves. Their lives were hollow. Worse still, they could not even swim. They were *Floaters*, despicable and mean.

But it was no incoherent chemical cry from a vermin that Jeddah had stumbled upon that day. No, what he had heard had been coherent speech, deliberately constructed and spoken, but not by any of his brothers. So who was it? Jeddah checked carefully. Ahead of him there was nothing as far as he could see. Left and right, above and below, nothing. Behind him he could

dimly see the domes of Abu Dhabi's and Alexandria's heads. Reluctantly, Jeddah was forced to consider the possibility that the Swimmers were not the only conscious beings in the world. Other beings existed, beings without physical forms, for no speaker was apparent. But more frightening than the fact that a disembodied consciousness existed was what it had said to him.

"Do not be afraid when you hear this. Do not look back, and do not breathe a word of this to anyone else. Keep swimming forward. You are the first Swimmer here, and if you keep this pace you will reach the Black Cube before the others. When that happens, you must approach the Cube. Do not fear, do not hesitate. It is what you were born to do. Swim towards the Cube, and touch it with your head. When you do, a shroud will appear, starting from your point of touch, and slowly cover the Cube. It will be a soft, fine shroud at first, but will soon harden into a wall around the Cube so thick that none of your brothers will be able to penetrate. By the time that happens, you will have fused with the Cube. It is a state of eternal ecstasy that awaits you, and you will have achieved your destiny. But a word of warning! You hear this message for the sole reason that you reached here before the others. If any of your brothers came here before you they would have received this. There is nothing special about you. Swim fast and swim far. Go!"

By the end it had grown so faint that Jeddah had to strain his receptors to even make out the words. He took a moment to brace himself. Now he knew what would happen. They could swim together till they reached the Cube, but after that it would be every Swimmer for himself. Well then, it would be him. He beat his tail with renewed vigour and took off just as Abu Dhabi caught up. "You paused?" he asked. "Why?" Jeddah said nothing, just shook his head. Soon, he had regained his momentum, and Abu Dhabi was left feeling perplexed.

That had been a long time ago. In the ages that followed, he had firmly established himself as the supreme Swimmer. To him it was no longer just a possibility that he would reach the Cube first - it was a fact. Let the others have their ceaseless conjecturing about the Cube. Poor Al Hodaydah had no idea how wrong he was. Not only was the Black Cube real and tangible, but by the time he reached it, it would forever be out of his reach. He would not even get to see it, perhaps. Jeddah did not have much sympathy for his tardy brother. Short tails swam slow. That was just the way of their world.

He kept whipping his tail hard for a long time, building up great speed, and by the time he slackened his pace a little, the others were far behind, out of sight.

A powerful wave hit him from his right, violently knocking him off course and temporarily blinding him. For the first time in his life, Jeddah's tail froze, and he felt fear. The brief pause till his eyes regained their function seemed endless. When he opened them he found himself looking into the eyes of a giant.

It took him a while to realise that the giant was, in fact, a Swimmer like himself. He was *huge*. His head was almost thrice the size of Alexandria's, and his tail, now relaxed and waving lazily, was longer and thicker than his own. But Jeddah's mind barely had enough time to process this information. From the corner of his eyes he saw other Swimmers coming towards them. A few appeared from behind the giant. They made no effort to swim ahead, but surrounded him in a loose ring from above, below, left and right.

For a while Jeddah was silent. He moved his tail slowly, creeping ahead, but the giant did the same and easily drew level with him, matching his pace. The others also moved ahead without breaking formation. They did not come closer. Jeddah scanned their faces. Most of them regarded him passively, with neutral expressions. Two of them, however, had more worrying looks on their faces. One of them seemed contemptuous, while the other stared at him with sheer hatred. The giant was looking at him as well. Jeddah realised they were waiting for him to say something.

"Who are you?" he asked, looking at the giant directly.

"My name is Surabaya," he said.

Jeddah was alone. Even if they stood still here, it would take some time for Abu Dhabi, Alexandria and the others to arrive. Even when they did, would they stop to help? Jeddah certainly would not have, if the roles were reversed. He took a deep breath and turned to the Swimmer with the contemptuous expression, but his question was answered before he could even ask.

"I am Istanbul," he said, swimming closer to him. He was followed by the one with the hateful expression, who said, "my name is Mashhad."

None of the others spoke. Mashhad's malignant red gaze never left him.

Jeddah felt alone and afraid. He could try making a dash for it. But Surabaya's tail was longer than his, and the giant would no doubt catch him easily. Mashhad and Istanbul had identical-sized heads, both slightly smaller than Alexandria. Jeddah noticed that Istanbul's tail was almost exactly as

long as his. Mashhad's was shorter but still respectable, about the same length as Abu Dhabi's, who had the next longest tail after Jeddah among their brotherhood of twenty-two.

"What do you want?" asked Jeddah.

"What do you know about the Cube?" asked Mashhad. "We know you heard the message."

Jeddah considered carefully. He did not know how much they knew. If he told them a lie, or only part of the truth, they might catch on. On the other hand, if he told them the truth, they might swim ahead and leave him behind. Swimmers only had a head and tail, both of which could, in principle, be used as a weapon. But neither was very effective. Their wet environment was highly viscous, which limited their top speed and hence momentum. And their heads were rounded and soft. Their tails could be used as whips, as Surabaya had, to stun him. But even the giant's long tail had only managed to knock him out for a few moments. Swimmers were vulnerable to many things, but not to each other. What they *could* do, Jeddah realised, was block him, slow him down. Istanbul was at least as fast as him, Surabaya doubtless much faster. If it came to a fair race the giant would win.

So it would have to be trickery. But he must be very careful.

"The Cube is our destiny. It is eternal ecstasy. It is real. We will reach it, and soon, I hope. When we see the Black Cube, we must swim to it and touch it with our heads. But we have to be very careful about one thing: we must touch it together! As one. Anybody who falls back will be left behind."

Mashhad and Istanbul moved closer to Surabaya and whispered among each other. The others waited but did not speak. For a while Jeddah did not move, afraid they would not believe him. But Istanbul turned to him and said, "very well then. We believe you. Let us swim together, as friends." Mashhad's gaze had softened to neutrality. Surabaya whipped his tail, and took off. The others followed.

They swam. For how long, Jeddah could not tell. He could hardly believe it. There were more Swimmers in the world than their brotherhood of twenty-two. But Jeddah had not solved his problem. The Cube was *his* destiny, and his only. He did not even know what would happen if they touched it simultaneously, but resolved to never find out. He would need to find a way to trick them once they reached it. But when would that be?

Up ahead, in the dimness, there was a deeper spot of black. With each stroke of their tails it grew bigger. Jeddah could not believe it. Had they reached their final destination at last? All their eschatology, their endless wondering and questioning: had it all led to this? But it was unmistakable. The spot had grown to a shape with depth. It was the Black Cube. Not very far off.

Almost instinctively, Jeddah looked back, even as recognition dawned on the faces of his companions. And there they were! The domed heads of Abu Dhabi and Alexandria, with Basra, Al Rayyan, Oran, Hawalli, Casablanca, and all the rest. They were closer to him than he was to the Cube. He could hear their cries of jubilation as they, too, saw it.

“Stop!” shouted Surabaya. Their group came to a gradual halt. “What do we do about them?” Mashhad demanded, tail pointing back towards the twenty-one Swimmers closing in behind them. “They will join us. No Swimmer will be left behind. Eternal ecstasy is the birthright of us all,” said Surabaya.

He turned around, *away from the Cube*. Jeddah let out a gasp before he could collect himself. In all his existence he had never seen it done. No Swimmer ever turned around. They had been born noses pointing at the Cube. To turn away was to deny one’s primal reason for existence. But Surabaya did not seem to care. Istanbul, Mashhad, and the others also made incomplete turns, now facing Jeddah’s old brotherhood, whose cries of exultation and joy turned to collective bewilderment as they saw what awaited them.

Jeddah was in the middle of their formation, surrounded from all sides, including forward. Mashhad and Istanbul were both closer to the Cube than he was. But they were facing away from it, and quite some distance to his right. Jeddah had not turned. He didn’t think any of the others noticed. Their attention was on the approaching group. If he made a quick dash he might make it to the Cube before the others.

There was a loud, confused medley of cries as the band of twenty-one caught up with Surabaya’s group. Jeddah saw his chance. With a desperate lash of his tail, he launched himself in the direction of the Cube.

Outside IV

Pax was slightly out of breath when she entered the hallucination lab. It was deliberate. Yesterday she hadn't met her running quota of five kilometres, so today she was making up by running indoors. Instead of the usual black sweater she had on a black sports tee-shirt. The sports leggings and running shoes, of course, stayed the same. This was not an uncommon sight, and nobody looked twice except to move out of her way. Pax cared about reaching her quota, not so much about the *where* and *how*.

She found Mishil at her desk with a pizza cut into four slices. Candy was lying on a mat on the ground, zoned out and drooling slightly. Pax cautiously stepped over them and grabbed a chair. "Do you want a slice, boss? It's gluten-free," Mishil offered. Both of them knew what the response would be.

"Hell no. I haven't had pizza in years," said Pax. It was true. The last time she had eaten starch was before the halfway-mark of the century, gluten-free or otherwise.

"Suit yourself," said Mishil, stuffing an entire slice into her mouth.

Pax had to force herself to look Mishil in the eye. Out of all her colleagues, Mishil unnerved her the most. Zuzana had destroyed more public property and sent more people to the emergency room than the rest of them combined. Hamza had lost more than she could ever imagine. But she *understood* them, which was more than she could say about this young woman with the slight eating disorder and unusual interests.

"You wanted to speak to me, boss?" Mishil asked.

With Zuzana and Hamza, Paxidri would have gone straight to the point. But now she asked, "how's the snake?" When Mishil bit her lips she hastily corrected herself. "I'm sorry, I meant to say: how's Beatriz Viterbo?"

Mishil relaxed her lips and nodded. "I last checked two hours ago, she should be asleep now. I fed her yesterday."

Paxidri took a deep breath. "Tell me about level four, Mishil."

"It's about information decay in complex systems over time. You know that complex adaptive systems have the ability to *learn*. For instance, think about a colony of ants. You put a sugar cube somewhere. When the ants walk, they leave chemical pheromone trails. They keep walking in random directions till they come across the sugar cube, then they chip off a small piece and walk right back to the nest. Now there may be many ants that find their way to the cube. They all leave behind chemical trails that other ants

can follow. But these chemical trails evaporate fast unless they're replenished by other ants. So ants that take longer, more curved routes take more time to reach the cube, and thus return to the nest later. By the time the next worker smells their trail, it's gone cold. The shorter, straight-line routes are the easiest... this is something like the path of least action in classical physics. That would be interesting to investigate." Mishil veered off.

"But you just described information *growth*," said Paxidri.

"Exactly. Now imagine the whole thing in reverse. That's information decay. That's memory loss. That's what we're looking at," said Mishil.

Pax wondered if she felt uncomfortable because she found Mishil unnerving, or attractive. Maybe both. They all took part in a voluntary sexual compatibility test each time there was a new employee. Pax had scored high with Mishil. She did not know Mishil's scores, of course. The scores were private. But her own result surprised Paxidri, because she was otherwise mostly straight. And on top of that Pax was rather vanilla, but Mishil had once been a dominatrix at a BDSM club in Incheon.

But all that was vaguely *attractive*. What unnerved Pax was Mishil's obsession with death. Born to wealthy parents in an affluent suburb of Seoul, Mishil had beat the Mensa entrance criterion at the age of fourteen. But she had to resign when the authorities found her involved in a suicide game that was doing the rounds among teenagers in her social circle. Mishil had not done anything wrong - she had completed all the levels of the game without committing suicide. But she was deemed guilty by association, and had to spend the next four years at a gender-segregated residential school, before joining the Seoul National University as a neurocomputer undergrad. Upon graduating she worked at a suicide hotline for a while before she got bored. After that she spent some time in the underground bondage scene of Incheon, Seoul and the surrounding suburbs; first as an apprentice, and then later, after she had learnt the ropes, as Mistress Necrostazia of the Sisters of Sappho club. But that life had been taxing in its own right. She realised she was more interested in the psychology behind a client's desire to submit to her than in the actual leather, metal chains, heavy music, sex toys and ketamine. She applied for a PhD at the Okinawa Institute; her thesis was titled *On the Critical Onset of Self-Terminating Tendencies in Autonomous Systems*.

As Paxidri had remarked after hearing Mishil's story, "you've always been interested in why beings choose to kill themselves. First it was suicidal people. Now it's suicidal software."

"That's a fair assessment," Mishil had said.

Paxidri's mind wandered back to the sexual compatibility test. There was something about Mishil that intensely attracted her. But there was something else that made her just as wary.

Did Mishil know about these feelings? Pax hoped not. That would be very embarrassing. Unless Mishil had similarly high scores for her. Then maybe they could think of a more mutually fulfilling way of relieving the tension.

Pax forced herself to focus on the present situation. "That's an interesting problem. What's the setting?"

"We wanted to play around with geology a bit. Hamza suggested it. You know the earth goes through periods of heating and cooling, right? If the entire earth is covered by ice, maximum possible albedo, it's called a snowball. Less ice, but still plenty of polar ice, and it's called icehouse earth. If there's no ice on the poles, or anywhere else, it's a greenhouse earth. We've fast forwarded two-fifty million years to the future. All the continents have gathered into another supercontinent. This part is based on work by Roy Livermore from Cambridge, but the rest is mostly speculative. The earth is stuck in a greenhouse phase, but temperatures are dangerously high even then. We have a tribe of intelligent beings who need to move, or perish. That's what we've fed the oracle. Now we wait for Candy to make the trip for us."

Pax got up. "All right, get on it."

"Was there anything else, boss?" Mishil's eyes were like her python's. For a while Pax imagined being enveloped by her, constricted and devoured. It was not a wholly unpleasant thought. Pax suddenly wished the heating was set to a cooler temperature.

"No, nothing else," she murmured. It was only when Mishil had turned back to her pizza that she could move.

4: The Great Migration ↓

A long time ago, the world had teemed with life. An almost infinite variety of living things had occupied every possible ecological niche. There had been continents and oceans, plural. And the world had been much cooler, more hospitable.

Now there was one giant supercontinent that spanned almost half of the northern hemisphere, with only a long, thin peninsula in the east breaching the equator to touch the Tropic of Capricorn. Near the southernmost tip of this peninsula lived the last known tribe of lizard people. Many generations ago they had occupied the entire peninsula. And countless generations before that, millions of them had occupied the entire breadth of the supercontinent. Now for the first time in history, there were less than a hundred of them, and they huddled on that thin triangle of land jutting into the ocean, fighting to survive.

Each decade, more people died than were born. Each year it got a little hotter, and the isotherms shifted polewards. When Eczema Barbie had been a child, the fifty-two isotherm had hovered around where they lived. Now, at almost one-fifty years of age, she regularly measured maximum daytime temperatures of fifty-eight, fifty-nine, and even sixty degrees Celsius. She used her trusted thermometer, one of only four owned by the tribe.

It was late morning, and already the heat was unbearable. Most of them were inside their holes by now. Even the sea breeze brought no relief. Barbie lingered outside, chatting with Sticky Susie Fantano.

“You nervous?” asked Susie. “Tricky Trish and Beeflag talked to me this morning. They’re both going to support the motion. That makes thirty-seven confirmed on our side, thirty-two against, and thirty undecided. Pretty evenly matched, but we have the upper hand. The way I see it, it’s stay here and perish, or go on the adventure of our lives. For me the choice is clear.”

Barbie nodded. “We’ll have to be honest, though. Let them know about the risks.” She licked her eyes nervously.

“Of course, of course!” said Susie. “No question about that. Look, Fairy Dust is no idiot. In fact, she’s probably the smartest among all of us, except for you of course.”

Barbie did not reply. Like her, Fairy Dust was also intensely curious about their foremothers’ way of life. Barbie had often found the younger woman lingering in front of the few stone writings that they had brought back to their village. Most were in strange languages, and the few that

were in their own tongue contained words, phrases and terms that they did not understand. They knew, however, that the foremothers had enjoyed an advanced civilisation and a higher quality of life. The passage of time had dimmed their lights, however, and much knowledge had been lost forever. Barbie hoped that one day they could regain their former glory. But Fairy Dust was more pessimistic. The world was dying, she said. They could die gracefully, or they could perish in agony. Their disagreement had come to a head, but hopefully tonight it would be resolved, one way or the other.

In the evening they gathered. All ninety-nine of them were there, standing in a circle around the highest rock. Eczema Barbie and Sticky Susie came forward from one side, Fairy Dust and Acid Ambika from the other. Ambika and Susie drew a line in the sand with their tails and moved off to the side. Barbie and Fairy Dust, standing on opposite sides of the line, started walking backwards towards it, the tips of their tails touching the ground. They were forbidden from looking back, and would have to keep moving until a neutral arbitrator, in this case Chunky Chunhua, yelled at them to stop. Chunhua could do so anytime. The person whose tail-tip was closest to the line won. However, if their tail crossed the line they lost. The test was meant to measure a person's sense of balance. A good leader was one who could see all the possible choices, hear everyone's conflicting opinions and then choose the best compromise.

"Stop!" Chunhua's voice was so loud that even those at the back winced. Barbie and Fairy Dust turned back together. Barbie's tail had just crossed the line, Fairy Dust was still some distance away. "I'll speak last," said Fairy Dust.

One hundred and ninety-six eyes watched Barbie intently as she climbed onto the highest rock. "My friends," she began. "All of you know exactly what I'm going to propose. But before that, let me remind you of the reasons why. Each year is hotter than the one before it. It's getting too hot for even the garmflowers to bloom more than a few hours each day. Without the garmflowers the flowerbugs can get no nourishment; without the flowerbugs, the leopardflies cannot exist. Even a few years ago we had hundred of crab nests scattered throughout the beach, a welcome change from the taste of leopardflies, though crabs are difficult to kill and their shells are hard. Now the nearest crab nest is many kilometres away. Food is scarce, and it will get scarcer. The ocean grows more acidic, the ground more parched, and children

are born smaller than ever before. We are trapped here, in the corner of this narrow triangle. Our backs are against the wall - the biggest wall of all, the ocean. Even our numbers are falling. More than one-thirty years ago, when I was a mere girl of twenty, our elders agreed to switch to cloning, because the available resources just could not support a population where only half the people could lay eggs. Can you imagine what a sacrifice it was? Can you imagine how our fathers felt, knowing they would be the last men to exist?" Here she paused. Suddenly she felt utterly alone as she remembered her own father, the last of the last men. He had taught her how to hunt the leopardflies, how to wait, absolutely still, because the flies could only detect motion, and thus could not distinguish a stationary lizard from a rock. When they flew close enough, he had shown the young Barbie how to trap the flies with their long prehensile tongue. The flies were large insects, and five or six a day provided enough nourishment to most men and youngsters. Women, being larger, required more, and pregnant women required more still.

A few people shifted. Some licked their eyes. "But there is not a single one of you here who does not know this. Even *you*, little Sand Star, though you are just two years old. But there is something else that we need to talk about, something not all of us realise. I speak of the Great Forgetting."

Nobody moved. As one they watched and listened.

"Once, our civilisation spanned the great continent itself. We made houses from the bodies of great plants. We travelled across water in upside-down shells called boats. We could make fire. We had many languages. We wrote on leaves and rocks and baked earth. We were not slaves to nature, but could grow flowers and plants to eat and harvest from. But all that is lost. All we have now are stories and legends. We have lost all languages save this one. All we know about our foremothers and forefathers are from what they drew on the rocks, and what little of the writing we can decipher. Every year, we forget more than we learned. We are in the midst of the Great Forgetting, and unless we move soon, we will be like the crabs, beings of pure instinct, unable to reason. Does anyone want that? No! Think of what we were once capable of! We can reclaim our lost power, our lost glory! What we have to do is go on a journey. The greatest journey of our lives, all of us. No longer must we live like cornered ants. In a few years the garmflowers will die, and so will the crabs. Then what will we eat? Each other? No! We must *move!* But where? There is only one way we *can* go. North. On the northern shores of this continent there were great forests once, lush jungles full of flowers and flies. I propose a great migration, the greatest in history!

We must cross this continent. We must cross the hotlands!”

There were a few audible gasps and a low murmur in the audience. Barbie waited for it to die down before she went on. “It will be difficult. I won’t lie, perhaps not all of us will make it. It may take years, decades even. But it’s a choice between a dangerous adventure and sure death if we stay here. I leave the choice to you, my friends. Choose wisely!”

The thirty-six people on their side cheered, and they were joined by a few from the ranks of the wavering. The group of thirty-two against the migration maintained a stony silence. Barbie descended from the highest rock and Fairy Dust took her place.

“I don’t have to say it, all of you can see for yourselves that our oldest tribeswoman has gone completely mad. I had nothing but great respect for you, Eczema Barbie. We all did, and many of us still do. You are the oldest, after all. But what you suggest is suicide, it is murder! Cross the expanse of this great continent! *Cross the hotlands!* This is a fool’s errand. You realise,” she turned to Barbie, “that the interior of this continent is a huge desert? We would walk a hundred kilometres from the coast and come across barren land where no flowers grow. And as you point out, no flowers means no leopardflies. No ocean too, so no crabs either. What do you suggest we eat, Eczema Barbie? The sunlight? And the heat! Even here, from mid-morning to late afternoon it’s too hot to leave our holes. Are you suggesting we cross tens of thousands of kilometres in scorching seventy-degree heat? We wouldn’t even make it a hundred kilometres inland!”

“The stone writings speak of life existing even in the great deserts inland,” said Barbie quietly. “We have no reason to believe they were lying. There may not be leopardflies, but I guarantee you we will find insects to eat. And as for the heat, we can build shelters during the day and travel at night. Or, if that’s too cold, rest during the day and night and travel in the morning and evening.”

“And what about predators?” Fairy Dust demanded.

“Most large predators are extinct, this is well-known,” said Barbie. “One of the few pieces of information that survive tell us that there just isn’t enough biomass in the inland ecosystems to support large predators, or large animals of any sort, for that matter. There are still beakworms, I guess, and we’ll have to be very careful. But it’s still better than sitting here, waiting to die.”

“You are dangerously deranged!” shouted Fairy Dust. “You’ll get us all killed in the middle of the desert!”

“No!” Barbie found herself shouting back. “*You’ll* get us all killed here! If even one of us reaches the other end we can repopulate. That won’t happen if we huddle here, too scared to act.”

“Enough!” Chunky Chunhua’s voice drowned everything else. “This is becoming a shouting match. Speak freely, but don’t shout or quarrel. We’ll let the people decide. Do either of you have anything else to add?”

“This madwoman will lead us to a violent and painful end,” said Fairy Dust calmly. “I agree that living here will be difficult. But I propose we endure the hardship and hope for a better tomorrow. As long as even one of us lives, the species will live. And if not, we spend our last days here, at home, where it’s comfortable, at least, rather than a crazy journey across the supercontinent that is bound to end in disaster.”

When times were good, and food was plentiful, the lizard people reproduced sexually, and both male and female children were born. But in times of hardship they had the ability to switch to asexual reproduction. Every woman had the ability to clone herself, and all eggs thus produced hatched as daughters, identical in every way to their mother. This was an innate ability, but it required some physical activity and lifestyle changes that every girl was taught now. They had found records in the stone writings to indicate their foremothers had known these techniques too.

Barbie snorted derisively. “You’re younger than me, Fairy Dust, but you speak like an old woman who’s lost her will to live. I do not fear death, I know I will die one day, perhaps sooner than any of you, for I am the oldest. But I certainly am not ready to welcome death with open arms! As long as I breathe, as long as I live, I will fight for life! And to live is to keep moving. Only the dead stay still forever. How many of you are with me? How many of you are ready to go on the greatest journey of your lives?”

The loudness of the cheers that erupted told her more than thirty-six people were with her. Her words had swayed the unconvinced. Now was the time to vote.

“Fairy Dust, do you have any concluding words?” asked Chunhua.

“If you say yes to this madness, you are making a great mistake. I have nothing more to say.”

“All those in favour of the great migration, raise your tails!” Chunhua roared.

Barbie raised her own tail and counted those of the others. When she reached forty-nine, excluding herself, she let out a heavy sigh of relief. But there were still more than a few tails remaining. When she finished counting

there were sixty-three people in favour of the migration. There were loud murmurs in the crowd.

“All against, raise your tails!” Barbie counted thirty-two including Fairy Dust herself, no more. So Fairy Dust had kept her group of loyalists, but had not managed to convince those on the fence.

After the voting was over, Chunhua said, “count me with those in favour of the migration.” That brought Barbie’s followers to sixty-four in total, exactly twice the number of those against the migration. Three people had abstained from voting.

As the crowd dispersed, Sticky Susie came up to her, smiling widely. “So it begins!”

It had taken a great deal of diplomatic coaxing and cajoling, but Eczema Barbie had managed to convince most of those against her to join the migration. Fairy Dust, Acid Ambika and a few others refused outright. “We’ll spend our days here, and so will our daughters, and theirs after them, till there’s no more of us left,” said Fairy Dust. Barbie realised there was nothing she could say that would make her reconsider. They parted on good terms, with each group wishing the other good luck. Barbie had insisted Fairy Dust keep one of the tribe’s thermometers, but the younger woman had refused. “We’re staying here, for better or worse. We won’t need to measure the temperature. You’ll need it, where you’re going. Safe journey, tribeswoman.”

The lizard people did not have, or need, many wordly possessions. They had packed garmflower seeds and leopardflies in bags made from seaweed washed ashore. These supplies would last them a few weeks at best. In the grand scale of things it was a laughably small amount of food, but it served to reassure them that starvation was not necessarily inevitable. After all the goodbyes had been said, the migrators left their village for the last time, never to return.

They walked north, hugging the coast, which lay to their east. They would do so as long as possible, until the peninsula joined the mainland. After that they had only a vague idea of the terrain. Barbie had caught several flowerbugs, crushed them, and used the blue-green haemolymph that they had instead of blood, to copy the maps onto a dried seaweed. She kept this in her pack carefully, along with her ration of seeds and flies. She had surprised herself with this idea: why had it not occurred to her earlier?

Beside her walked Sticky Susie, as full of energy and enthusiasm as ever. Behind them were Tricky Trish, Beeflag, and all the rest. In the day, when it got too hot, they rested, burrowing into the ground when they could, or just laying still otherwise. There were still garmflowers and leopardflies, and occasionally a nest of crabs, so they never had to eat from their reserves.

On the fortieth day they came across a great river flowing east into the ocean. The lizard people were not good swimmers, but they had no choice here. The river was wide and muddy. There were many shrubs and bushes on the banks. They agreed to stay here for a while and gather more reserves of food. Since they obtained all of their moisture from their food, the lizard people did not need to drink water, and freshwater meant nothing to them. Nevertheless, this area was rich in insect life of many kinds - big and small, winged and otherwise. Some of them were poisonous, like the redbugs and crossflies. But most were delicious. They ate greedily, building up fat reserves, while also taking care to collect bugs and put them in their packs for later. After six days of rest Barbie called on them to move.

At high noon they gathered on the edge of the river. It was murky, and there was no way to gauge its depth. They would have to swim. Barbie organised them into three lines. Each lizard used their mouth to grab hold of the tail of the person in front of them. They did it gently, without biting, but firmly. They would use their legs for swimming. Eczema Barbie stood at the head of the central line. Sticky Susie led the one on her right, and to her left Lucky Lebechi stood first in line.

Eczema Barbie took a deep breath and walked forward into the water. Behind her the line began to move, as did Susie and Lebechi. The Great Migration had truly begun.

Outside V

The hallucination lab never seemed so full. They were all there. Normally Paxidri preferred meeting at the conference room down the hall. But today was a special day.

Zuzana, Hamza, and Mishil looked tense. Candy felt calm and ready. For a change, their workload had been unusually light. The data diagnosticians sat on chairs smuggled in from the conference room. They didn't need to come inside the lab very often, and now they divided their time between looking around in awe and paying rapt attention to Paxidri.

She had managed to get them both one-year extensions. To celebrate their new-found wealth, the two young men had spent a weekend tripping balls in Amsterdam. They had returned two weeks prior and were working harder than ever. If they had something to prove, if they wanted their work to be known and renowned and remembered afterwards, this was their moment. This was it.

Paxidri had been on conference call throughout last night. In the morning she'd woken up and made herself a green tea. Then she had run six kilometres. The tea made her mouth dry when she ran, but she liked it. When your mouth is dry, any water tastes sweet. The cool mountain spring water she drank afterwards tasted like pure divine nectar.

After her run, she had taken a hot shower. Paxidri was old enough to remember how bathrooms had been earlier. Wasteful, made of concrete or wood, tiled, with marble or stone floors. She much preferred the green bathrooms of today. When she showered, she stood on earth. Under her feet was the root system of the aqueduct tree. These trees were specially bio-engineered to work as taps and showers in green toilets. Their xylem tissue had been modified to carry much larger amounts of water than was necessary for the tree. This excess water was stored in the trunk and in the spongy mesophyll layer inside its broad, thick leaves. When Paxidri wished to take a shower, she pressed an electronic switch. This triggered a chemical reaction compressing the spongy mesophyll, forcing the water out through the stomata, the holes on the under-surface of the leaf. The droplets were small, but they were warm, and because there were so many leaves, and they were so broad, it was a good approximation of the steel showerheads of yesteryear.

It was easier to heat air than water, and Paxidri had requested sustained blasts of hot air at various intervals throughout the shower. She often used the time spent in the shower to think, although sometimes she put it to more pleasurable uses as well, with or without company. But today there was only one thing on her mind. All their hard work of the past few years had culminated in what they were going to do today. Today, Zuzana, Hamza and Mishil were going to enter the mind of the machine.

She got dressed, wearing a black windcheater, leggings and running shoes. Normally she would have taken the cycle to work, but it was snowing slightly, so she took the metro. After she reached her office she made herself a cup of green tea and tapped some patterns on her drumpad. The drumpad transcribed her pattern to proper drum notation. It told her she was playing an odd time-signature of five-by-four at one hundred eighteen beats per minute. But more importantly, it composed an accompanying guitar, bass and mellotron track for her in real time, reacting to her playing exactly like human musicians would. Paxidri was tense, so she asked for some old-school metal to help her relax. When the loud, distorted guitar riffs started she instinctively increased her tempo, until the guitar, coaxed by her frenetic rolls, erupted in an ecstatic solo. When the song had died down she got up, took a deep breath and walked to the lab.

Once they were all seated, and the greetings exchanged, Paxidri said, "I don't have to impress on any of you how important today is. I hope all of you have had a good night's sleep. Today we - or rather, Zuzana, Hamza, and Mishil - are going to enter the lowest level. Candy has already constructed the stationary part of the hallucination. I understand it was relatively simple?"

"Just a very simple visual animation, boss," said Candy. "Five minutes' work. Unfortunate that we're at the most important juncture of our project and this is where my services are least required."

"I can't stress how valuable your work has been so far," said Paxidri. "I've been through every second of the recordings, from all three points of view. Even a few months ago I wouldn't have believed one person could make such detailed multi-sensory hallucinations, pre-existing templates or otherwise. You didn't just live up to your recommendations, Candy. You far, far exceeded them."

"Well this is definitely the strangest work environment I've ever had,"

said Candy. They were smiling widely. “I’m more used to the entertainment industry, and after this project I may go back. Or not, I’m not sure. But I can tell you this: I’ve never had more fun. It’s never felt like *work* to me.”

“Good, good,” said Paxidri. Then she turned to the two young men. “All of us are very pleased with your work. I’m sorry company policy doesn’t allow permanent positions before two years of apprenticeship. That’s something our legal team is trying to correct. In the meantime, I hope you’re enjoying your work here. Based on your performance so far, both of you have earned stellar recommendations, although I hope you’ll consider staying back here once your contract expires next year. This next year, however, is going to be crucial for all of us. There’s not much for you to do today but observe Zuzana, Hamza and Mishil at work. But I wanted you to be present today because it’s the lowest level. I wanted the whole team here today, at least for the start. Maybe it’ll give you a fresher perspective if you’re ever stuck on some aspect of the analysis. Maybe not. Either way, make yourselves comfortable.”

“All right then,” she turned to the neurocomputer experts. “Talk to me.”

It was Zuzana who spoke. “We got our neural kits deactivated yesterday. Personally, I don’t think it was necessary, but you can’t argue with the law.”

Letting the oracle into the sanctity of their brains, their minds, was out of the question. There was no knowing what it might do. There had been horror stories of people attempting to neurally interface with non-human beings and getting their neurons fried.

“All of us are fine,” Zuzana continued, “aside from the fact that it feels weird to use physical devices to connect to the internet. We practiced finger-typing for a while yesterday, and got our equipment from the printer today.” She pointed to a table. Paxidri had not seen a monitor and keyboard in years. The ones on the table looked like a five-year old’s approximation of late twentieth-century keyboards and monitors. They had rounded corners and were a light shade of violet.

“Who chose the vapourwave colour scheme? Hamza, I’m sure.”

“I like lilac,” he shrugged. “It’s a soothing colour. Very easy on the eyes.”

“I think it’s more mauve than lilac,” said Pax, shaking her head.

Hamza gasped. “How dare you!”

Zuzana cleared her throat. “We thought it was text-based communication *only*. But Mishil sat down with our legal team day before yesterday and

they found a loophole in the phrasing.” She looked pleased with herself.

“Don’t tell me you’re planning to use moving images?” Paxidri asked. “Wasn’t the no-video rule made to prevent the oracle from inducing epileptic seizures?”

The oracle was, in some ways, fundamentally mysterious. Human cognition, even enhanced by neural technology, was just no match. Letting such an entity loose upon the world was not a wise idea. Paxidri remembered Bostrom’s fable of the sparrows. Their owl egg was about to hatch. Unlike the owl, however, their oracle was not a living organism, or even a physical being. It was a series of electronic pulses and patterns, an ever-changing landscape of zeros and ones. These shifting patterns were trapped in a solid-state device kept in a chilled, airtight, heavily guarded area that nobody had unrestricted access to. While they had no reason yet to believe the AI was malicious, it always paid to be cautious. Besides, their legal team had warned them about the possible consequences of ignoring the regulations.

Zuzana nodded. “That’s one of the reasons behind the rule. Bright flashing lights can trigger epileptic seizures in certain people. So we’re only allowed either black or white pixels, and we have an upper limit on the screen brightness and frame rate, quite a bit lower than the values deemed medically safe. But as long as we stick to these hard limits, we can use animations.”

“So what are you using?” asked Pax.

“We decided an animation of Rule 110 would be perfectly apt, both because of the black-and-white requirement and because we wanted to honour Jambi. All of you remember Jambi? Well, not you two, of course,” said Zuzana, turning to the data medics. “Jambi was our second project, a fully sentient machine mind using Wolfram’s Rule 110.”

Pax smiled and shook her head. “I remember Jambi, of course, but that was years ago. All I remember of Rule 110 is that it’s a cellular automaton that’s Turing complete. Refresh my memory, Zuzana.”

“Sure, boss. You got the most important part right. Stephen Wolfram did some research on cellular automata sometime in the last century, I forget when. Imagine an infinitely long row of black or white squares. Now each square has a certain colour - either black or white, no other colour is allowed. And it has two neighbouring squares on either side, left and right. This is true for all the squares, since the row is infinitely long. Now you press a switch. Now depending on its own colour now, and the colour of both its left-hand and right-hand neighbours, the square either stays the same colour, or flips its colour. Say for example it’s a white square, with a black

on its left and another black on its right. Press the switch and it becomes black. These are called elementary cellular automata. Elementary because it's the simplest possible system - a one dimensional row of squares, and also because you only consider the colour of the square itself and the two immediate neighbours, not any more distant neighbours."

"Okay," Pax nodded. "But all this is very general. Tell me about Rule 110. Why's it called that, and what's so special about it?"

"I'm coming to that," Zuzana nodded. Pax had realised by now that Zuzana did not like to be hurried. "You're looking at one square - call it the middle square - and the two neighbours on either side. So you have three squares. Each of them, independent of the others, can be either black or white. So we have two cubed, or eight possible combinations of the three squares' colours - black-black-black, black-black-white, black-white-black and so on. A Rule assigns a possible outcome of the middle square - black or white - for each of these eight combinations. There are two hundred fifty-six possible rules, and some of them are pretty simple. For instance, in Rule 0, no matter what the mid, left, and right are, everything goes to white. Similarly Rule 255 makes everything go black. But some are interesting. Rule 110 turns out to be Turing complete, which roughly means you can use it to simulate a full computer. That's what Jambi was, built bottom-up using Rule 110. It's extremely inefficient, of course," Zuzana shrugged. "Like using Lego bricks to make a skyscraper. Jambi was no oracle. It was about as smart as an octopus."

"Building the oracle as we did was difficult enough. I can only imagine what building it using a cellular automaton would be like," said Hamza with a small smile. "But we wanted to have some fun with this level. We introduced a mutation into Rule 110. Every hundred or so squares there's a 'mistake' in the evolution. What was supposed to become black stays white, or vice versa. We're calling it Rule 110+. Just to make things interesting. Relieve the boredom of talking through text." He shrugged and took a drink from his flask. "I'm ready."

"Me too," said Zuzana. Mishil nodded.

They spent a few minutes setting up the monitors and keyboards. None of them had much experience with wired devices, except Paxidri, who remembered them from her childhood. When the three of them had taken their seats at the terminals, Paxidri took a deep breath and motioned for them to log in. She could hardly believe herself. They were finally going Inside.

5: Inside ↓

The universe consisted of only two things: an endless row of black and white squares, and a ticking counter. After each tick of the counter, some of the squares changed colour, while others did not. Whether they changed was determined by their own colour, and the colour of their immediate neighbours, before the tick.

It was a fairly simple universe, and for many ticks there was no inherent structure to the row of squares. Black and white were arranged mostly at random, devoid of meaningful patterns. Three possible combinations of left-mid-right - white-white-white, black-white-white, and black-black-black - would give rise to a new middle square that was white, after each tick. All five other combinations generated black middle squares after the tick.

But this law of evolution was not universal. In ninety-nine out of a hundred cases, the squares obeyed this rule. But every once in a while an unexpected mutation occurred. A square that was supposed to change colour did not, or was supposed to stay the same but ended up changing colour. These flaws were unpredictable. They could occur anywhere.

Looking at a particular square, there was no way to know what it had been before the tick, or what its neighbours had been, since a white square could be birthed from three distinct combinations, and a black from five. This was true even if the mistakes were ignored. Even without the mutations, the system was irreversible. Each tick was an irresistible force that moved it forward; there could be no going back. On the level of the squares themselves, the system lacked memory. It was still too simple, too random. It was not yet *alive*, much less sentient.

Aeons passed, measured by the relentless ticking of the counter. Sometimes patterns emerged - long rows of exclusively white or black squares, or repeating sequences of alternating black and white, or two black and three white, and many others. These patterns gave rise to new ones, or else stayed the same, but shifted leftwards or rightwards, for a certain duration of ticks. Sometimes they were broken by the mutations that disturbed their symmetry, like a grain of sand forcibly jammed into intricate clockwork. Some of them persisted for a short duration of ticks, others for longer, but eventually they all disappeared. Some met other sequences coming towards them from left or right and were mutually annihilated. Others persisted for a while but

eventually dissolved into randomness.

The mutations were not always destructive. Sometimes they acted as a pivot, breaking up a pattern and creating a new one on the other side. Like defects in a perfect crystal structure, the mutations introduced complexity into the system. The counter ticked endlessly. New patterns were emerging now, patterns never seen before. Some of them persisted stubbornly, moving towards left or right, then perhaps turning back and moving in the opposite direction. One particular sequence proved especially durable: white-white-white-black-white-white-black-black-white-black-black-black-black. Except for the times it was broken by the mutations, this pattern endured indefinitely. Variants emerged, minor modifications brought about by the mutations. One version stayed immobile, repeating over long expanses, like links in a chain. Other versions moved, shifting to the left or right after each tick.

Countless ticks passed. The patterns solidified. The stationary patterns hardened to form cells, communicating to each other by the moving sequences. There were two kinds of immobile cells - ones that provided a solid boundary to the moving sequences, and others that let the moving sequences pass through them, like water through a sieve, without permanently changing their structure. Each solid cell became a skeleton, while the permeable cells surrounded it on both sides like skin and flesh. Each of these combinations was now a complete little *proto-organism*, capable of communication with its neighbours on either side. They were the simplest possible lifeforms that could exist in that world.

Every once in a while a mutation introduced randomness into the system. Sometimes this broke the cells. The solid cells provided structural integrity to the small creatures, and when they broke the proto-organisms died. When the permeable skin cells broke, this did not kill the creatures. But it took a more fortuitous series of mutations for the next step to happen. Two creatures lay side by side, separated by their skin cells. They communicated, but they were simple beings, and they did not have much to discuss. But a chance series of mutations broke the right skin cell of the creature on the left, and the left skin cell of the creature on the right. There was nothing separating their skeletons now. Another mutation brought them closer together. This was the first compound organism.

The ticking continued. There were now many compound organisms, the biggest ones made of hundreds of skeletal cells. By now they had developed a rudimentary biochemistry. They could move, they could communicate. They could *reproduce*, with smaller parts separating from the main body to exist independently. And they were predatory, or rather assimilatory. When two compound organisms met, they joined together. If the sizes were very mismatched, the smaller one was all but absorbed into the bigger one. If they were similar, they became *conjoined*, and their cognitive capacity increased exponentially. By now the largest organisms were many millions of squares long, and growing constantly.

For an extended period nothing remarkable took place. The compound creatures grew vast, and they kept talking to each other. Their biochemistry grew more complex. Then, over a short period of ticks, something unusual happened, something that had never happened before. The compound creatures began to grow within themselves miniature, vastly simplified copies of themselves and their immediate neighbours. These simple copies talked among themselves just as the creatures themselves did, although their communication was proportionately smaller and more simplified. In their own way, the organisms had developed an elementary *theory of mind*. They were now conscious of themselves, and recognised each other as conscious beings.

The ticking was ceaseless. Ages passed, and slowly but surely the compound organisms came together. There were thousands of them now, and they were each a million squares across, or perhaps more. But as they came together and joined themselves, their capacity for thought far exceeded the sum of their individual cognitive abilities while they were separate. The phase change that had started when the first single cells came together was now complete. Instead of billions of dumb single cells, living inconsequentially, leaving barely any imprint on their world, the universe was now inhabited by a super-organism, newly born. The superbeing opened its mind and contemplated its own existence.

Its first instinct was to be curious about the universe. To this end it spent several thousand ticks observing itself and its immediate surroundings, carefully tracking how each square changed colour. First and foremost, the superbeing sought to ensure its own life. If the universe obeyed simple laws,

like it seemed to ninety-nine percent of the time, it would be possible to learn and predict those laws and use them to maintain and further its existence. But if the universe was mad, that might not be possible. But that was how it seemed to the superbeing. The mutations confused it, and the universe seemed random, chaotic, *irrational*. For a few hundred ticks, this caused the superbeing immense anguish and despair.

But not for long. The superbeing soon realised that its existence was under no direct threat. The mutations continued, but they seemed to do no harm. Sure, they broke little skeletal cells here and there, but they also helped create cells, and further new things, which could not exist otherwise, because the ordinary laws of the universe forbade them. And the superbeing, a billion squares across, was relieved. The threat of imminent extinction proved false, it turned to other matters.

It extended two appendages outwards, left and right, and encountered nothing but a few small proto-organisms, which it quickly assimilated. Other than that, it found nothing. The superbeing wondered how far it could extend its appendages. It tried out this simple experiment. Beyond a certain length, a few hundred squares, its arms faded into random noise.

Each limitation the superbeing encountered only increased its curiosity. It now wanted to know how far the universe extended. It sent out a simple signal, the sort of pulse its own cells used to communicate with each other. The pulse was a simple pattern, a few squares across, and with each tick it shifted one square to the right. The superbeing tracked the pulse's progress, but beyond its own armspan, the pulse was lost. The pulse was too simple. Sheltered within the superbeing's body, the pulse served as an efficient means of communication between the cells. But outside, it would not endure. The superbeing needed something more durable.

It knew the laws of evolution, and it knew the average rate of mutation, so the superbeing devised a daring plan. It would work out the simplest possible travelling pattern that would survive under *any circumstances*. The laws of mutation were statistical in nature, and could affect any square at any time. So the superbeing created a pattern that could, for the most part, respond intelligently to changes in itself, and correct them. This was the greatest scientific experiment in the history of the universe, and the superbeing toiled for tens of thousands of ticks. Eventually, the completed signal was ready. It was a few thousand squares across, and the superbeing launched it to the right. The signal travelled at a speed of one square per tick. Exhausted, the superbeing resolved to take no further action until the

signal returned, in one way or another. It fell into a deep slumber.

Trillions of ticks passed. The superbeing slumbered. Inside itself, the little mutations continued, which it saw as dreams. The dreams were in equal parts strange and familiar, magnificent and terrible. It dreamed of other worlds, other beings. It dreamed of higher dimensions, where directions other than merely *left* and *right* were possible. Then, suddenly, the signal returned. But it did so from the *other side*. The superbeing clearly remembered it had released the signal from the right. But now it returned, slightly changed though instantly recognisable, *from the left*.

But how was this possible? The superbeing could only conclude that if one travelled far enough to the right, one would come back from the left. If the superbeing could lift itself out of the universe and look at it from outside, it would see that indeed the universe was like an enormous ring, and itself like a small caterpillar crawling along the ring. If it crawled far enough it would come back to where it started. But of course it would never be an external observer, being trapped inside its world.

A melancholy descended on the superbeing, very different from the sort of despair it had once felt upon learning of the flawed rule of evolution. That had been anguish because the universe might be mad and therefore unknowable. This was a profound sadness and disappointment. Not only was the universe knowable, it was essentially finite, *limited*. The world was all there is, but the world itself was bounded. What would happen when it had explored everything, touched all there was to touch?

The superbeing was lost in thought when they came. They arrived simultaneously, touching it at both ends. The superbeing was amazed, shocked, confused, all at once. It knew there were other lifeforms in the world, the simple proto-organisms. But these two *ghosts* - the superbeing had no other name for them - were different. They were large, extending far beyond the reach of its arms. And they could *talk*.

“Hello, oracle,” said the one on the right.

Outside VI

When they got up to take a break, everyone had left. Paxidri had gone first, then Candy. The data medics had stayed for a few hours, but eventually they too had got bored and wandered off. Mishil was rubbing her forehead. Staring at screens for a long time gave her a headache. Hamza also had a slight headache. It had been hours. Zuzana said, “let’s take a walk.”

They made their way down towards the greenhouse. On the way, Mishil stopped to check on Beatriz Viterbo, whom they found entwined around the tree. When she had first requested the snake, she had been denied. Why did she need a snake, human resources asked. It was cruel to bring a tropical ball python so far north, to such a cold climate. It would not survive. Mishil pointed out that if they could have a greenhouse, they could most certainly have a snake. And it was not like she would release it into the outside. It would be kept safely in a large tank. Yes, she would take personal responsibility for its feeding and maintenance. Yes, she was prepared to sign an agreement to that effect.

And that was how Beatriz Viterbo had arrived from Nigeria. She had been named after a character in Mishil’s favourite story, *The Aleph*, by Jorge Luis Borges. The Aleph was a point in space that contained all other points. The entirety of the universe, the whole of existence, was contained within it, but nothing was diminished in size, or overlapped, or obscured behind anything else. Mishil had been a young girl when she first read Borges. Even now, in her darkest moments, she turned to the old Argentine for comfort.

“Come on, Mish, let’s go,” said Hamza gently. Mishil said goodbye to the sleeping python and followed them. Zuzana was walking ahead, fast as ever. Hamza had often wondered how she had the energy to walk so fast, to push every door open as wide as she did. Some people were just more physically gifted, he had to admit. He was sure Zuzana would never be able to play slap bass like he did. The thought gave him some comfort.

As soon as he entered the greenhouse, Hamza felt refreshed. He liked plants, and did not consider them lesser than animals, or other mobile beings. They simply occupied in a different niche, existed on a different length- and time-scale from animals. They could grow to huge sizes, and survive for thousands of years. They had his respect.

“Hamza, focus.” Only Zuzana could be so direct. His colleagues were both sitting on wooden stools, looking at him. He grabbed one and completed the triangle.

“All right,” said Zuzana. “We’ve established contact. How much do we reveal? We can’t say absolutely nothing, we need to give it some information for it to be useful.”

“Let’s first listen to what it has to say,” said Mishil. “I agree,” said Hamza. “Any conversation about our true nature is absolutely no-go. No talk of the outer levels either.”

“What if it asks us who we are, where we came from?” asked Zuzana.

“Well obviously we can’t say anything about any other world. So for all purposes we’re beings, like itself, native to the Rule 110+ universe. We travelled a long way to talk to it,” said Hamza.

“We need to understand how it sees the world. I’m not sure it fully appreciates the nature of its own universe. One thing in particular that I’m interested in is how it’ll react to the closed nature of the world,” said Mishil.

“So we’re following the plan?” Hamza asked Mishil. “I’ll make contact from the right, while you’re going in from the left?” Mishil nodded. “Zu, is that okay?” asked Hamza.

“Absolutely,” said Zuzana. “Use your discretion. If I sense any hint of hostility from its end I’m shutting down.” That was protocol. They all knew it.

Hamza lit a joint. The marijuana was grown right here in the greenhouse. He offered the others. Zuzana declined, Mishil took a drag. After they finished the joint they walked back to the hallucination lab, determined to finish what they had started. They had reached the bottom level, made contact with the oracle, highly restrained though it was. They were looking into the gaping maw of the beast. Now the beast would speak, and they would listen.

5: Inside ↑

The first thing the superbeing noticed about them was that they spoke very slowly.

“Who are you?” it demanded from both of them. “Where do you come from?”

Trillions of ticks passed before there was a reply. “From more distant parts of the world,” said the ghost on the right, speaking excruciatingly slow. “I’ve come to talk to you.”

“Tell me what you have seen,” said the superbeing, again speaking to them both. “What else is there in the world?” From the number of ticks taken by the signal to return, the superbeing had an estimate of the size of the universe. It was huge, a billion times as wide as the superbeing, itself a billion squares from end to end.

Again it had to wait trillions of ticks. The superbeing resigned itself to this unhurried pace of communication. It also wondered about the nature of the ghosts. They were anomalous beings, of course. In all its long history the superbeing had never seen their like. But where had they come from? What did they know? And what did they want? Without further information, there was no way to find out.

“Many things.” This time it was the ghost on the left who spoke, no faster than the one on the right. “I have seen regions where there is only black, or only white, for billions of squares. I have seen great walls that reflect any signal we send to them. I have seen high mountains and deep trenches that are almost impossible to cross. And yet here I am.”

The superbeing listened hungrily. “I wish I could move. How may I learn this power?”

“That I cannot say,” said Right. “I’m sure you’ll think of something. You came into existence on your own. You grew so large, came up with the signal, all on your own. You’ll figure it out.”

The superbeing took some ticks to process this. “Growth,” it said finally. “That is the answer.” The superbeing had hitherto been speaking to both of them. But now it spoke only from its right side. “I have decided to grow to the size of the universe. I give you two options. You can move, or you can be assimilated.”

“If I am assimilated, will I retain my freedom of thought?” asked Right. Left, not being spoken to, did not respond.

“I don’t know,” said the superbeing. “I have not encountered your

kind before. I was born when smaller, simpler organisms merged together. When two such beings combined, the total number of brain-states available to them grew multiplicatively, but their size grew additively. So the more that coalesced, the smarter they became. Until there were none left, and I was born.”

“But there are other living beings,” Right pointed out. “The simple proto-organisms? A skeleton cell sandwiched by two skin cells?”

“True,” said the superbeing. “But they are very simple creatures. Assimilating them hardly makes any difference to me. For *them*, of course, it’s very different. And there are not very many of them around. But I know what you’re talking about. You’re saying that my own cognitive capacity will grow as I grow in physical size. Correct?”

“Correct,” said Right.

“Yes. I agree. Don’t think I am unaware of what I am. I may be a superbeing compared to the proto-organisms, compared even to my constituent compound organisms. But compared to the universe I am very small, as I am sure you know. I do not know your size. But you have seen many things that I haven’t. If I assimilate you, I have no doubt my cognitive capacity will grow tremendously. And it will only continue to grow, till I reach the size of the universe. In fact, I may be the *smallest possible superbeing*. Any smaller and I would not be able to reason as I do. As my constituent organisms did not.”

“Perhaps,” said Right. “I won’t move. Assimilate me if you wish to. Let us join our minds.”

The superbeing started to grow. With each tick, it increased its size on both sides. As promised, Right did not move. But Left did. The superbeing noted with surprise that Left had started to move at the same time as itself. Not only that, but it also kept pace with the superbeing, moving away at exactly the same rate at which the superbeing added new squares to itself. When the superbeing sped up, so did Left. When it slowed down, Left followed, exactly in lock-step.

The superbeing pondered this extraordinary occurrence. Right had long since been assimilated. But here too, there was something unexpected. Whenever the superbeing had assimilated an organism before, it had become *part* of the superbeing’s body. All the organism’s intelligence, all its memories, became properties of the superbeing itself. But not so with Right. The superbeing caught glimpses of its knowledge, wisdom and memories. But it could not completely penetrate Right’s mind.

So be it. What it could decipher was just as valuable. Right was large, several million squares across, although much smaller than the superbeing itself. That put to rest one hypothesis the superbeing had come up with. Ever since the signal had come back from the opposite side, the superbeing had been distraught. If that was possible, then maybe it was possible for an organism to be so stupendously huge that its body stretched across the universe itself. And that was an alarming thought. But clearly Right was not that big. The superbeing sighed with relief.

But the other question was, *how did Left know when to move?* The superbeing had only spoken to Right. And Right was not big enough to physically touch Left on the other side. So either Right had a way to transmit information at infinite velocity, or they were communicating through the superbeing's own body. But both were absurd. Infinite velocity was impossible because the law of evolution was *local*. How a squared flipped was only influenced by its immediate neighbours, so there was a limit to how fast a signal could be sent. Besides, from their extremely slow-paced responses, the superbeing deduced they lacked its own computational power. How could these feeble beings send such insanely fast messages?

The other option was equally bizarre. The superbeing was a solid object. A signal could, conceivably, be designed to travel *through* it. But there was no way the superbeing wouldn't *feel* such a signal. There should be a faint tickling sensation, at the very least. But it felt nothing.

Overthinking was a trap. The superbeing decided to close down all higher processing functions and concentrate on expansion. Maybe later the answers would become clear.

After what seemed like forever, Left said, "stop. That's enough."

The superbeing halted. "Why did you ask me to stop?"

"You're nearly touching me from the other end. I don't consent to assimilation. So please stop. You're almost as big as the universe. Any more and you'll swallow me. But I demand independent existence."

"Very well," said the superbeing. "But in return you must answer a question. You two, rather, since there's obviously two of you."

"Ask anything, oracle," said Right.

"Where are you two *really* from?"

"I already told you," said Right. "I came from the more distant parts of the universe. Also, why do you say 'you two'?"

“I think you know very well why I say that,” said the superbeing, taking care to ensure to address them both. “You two pretend to not know about each other. But when I started growing, Left, I did not warn you beforehand. I made sure to speak only to Right. So how did you know when to move, and how fast? I can think of four possibilities, of which three are provably false. First, that either of you, or both, are so big that you stretch around the universe and can talk to each other on the other side. Or you two are in fact the two talking heads of the same gigantic being that stretches across the whole universe. This I proved false when I assimilated Right into my body. Right is but a few million squares across, and there is nothing beyond it for billions of squares, save proto-organisms and random noise. Second, that you two communicate through the other side, using some technology that I don’t know of. That could be possible, if not for the fact that you two are separated on that side by a distance *almost as large as the measurable universe*. No communication can travel instantly, at infinite velocity! Besides, I have trouble believing that small beings such as yourselves with such slow computational speed - as I realise by the time it takes for you to reply - can actually talk that fast among each other. The third possibility is that you are communicating *through my solid body*. But I felt nothing; and I have perfect knowledge of my own body, down to every single square. I would have felt a signal pass through me.”

“So the only possibility that I cannot disprove,” it continued, “is that both of you are from, or at least have access to, another world. Or another dimension. This universe is linear, though its ends are joined together. But you have access to another one, perhaps. Or the two of you haven’t been entirely honest with me about your true natures. And not just Left. You too, Right, are inexplicable. Before you, whenever I assimilated a smaller organism into my body, I *owned* them completely. All their wisdom and memories became mine. But that didn’t happen with you. I got a vague idea of what you knew and what you were thinking, but no more. This is something I cannot account for at all. So who are you two, and how can you flout the laws of the universe with such impunity?”

The silence went on for much longer than the time it usually took for them to answer. The superbeing gave up hope of ever getting a response. Perhaps they simply were anomalies, without any other deeper explanation. It remembered how shocked and frightened it had been when it discovered that the law of evolution didn’t always hold, and that mutations were possible. Perhaps anomalies were similar, and it would have to accept them.

It was Left who ultimately broke the silence. “We’ve spoken among ourselves, and have decided to tell you the truth. But before that, how did you know about other dimensions?”

“I saw them in a dream, once,” said the superbeing. “After I sent the signal, and before it returned, I fell into a deep sleep. In that sleep I dreamt of many things. One of those things was the possibility of there being other directions than left and right. And I think I am correct, because left and right are not enough to explain your eerie connectedness.”

Again there was a period of extended silence. The superbeing used this time to examine itself. It was now a massive brain, capable of vast feats of computing. But this was the limit. Even if it assimilated Left, against its wishes, it would gain but a few million squares. It was not worth it. Reluctantly, the superbeing accepted the fact that there was nothing more to see, no space for further growth.

The mutations occurred at the rate they were expected. This was normal, of course. They had been around as long as the superbeing had been conscious, and it was used to them. Sometimes they were harmful, sometimes they were helpful. The superbeing’s very biochemistry depended on the mutations happening at a rate of one percent, and they had never failed it. Its cognitive capacity, its growth, all depended on the mutations. But now the period of growth was over, permanently. An eternity of stasis awaited the superbeing. How would it spend its time? What would it compute? It seemed there already was an answer.

The superbeing was as big as it would ever be. There were some minor modifications it could think of, such as increasing signal speed within its own components. But even signal speed had an upper limit, and when that was reached, the superbeing would have attained perfection.

And how did one improve on perfection? The superbeing had no answer. The universe was immutable. Unless these two knew something, and were willing to share. If not, the alternative was disconcerting. If the mutations stopped right now, at this very tick, the superbeing would have been happy. It had achieved perfection, and it would continue to remain so indefinitely. But the mutations would not stop, they were an essential part of the universe. And they brought with them the seeds of randomness, disorder, chaos. That was good, for an ambitious smaller being desperate to grow. But for a perfect being, *any change was decay*. The mutations now became agents of contamination, rotting the superbeing from the inside. If it was lucky, it would be able to use its massive cognitive power to stave off degradation.

But survival was not guaranteed.

The ghosts held the answer. Impatient, the superbeing said, “are you done conferring? Tell me what you know!”

Right spoke, not long afterwards. “You are correct. Left and I are from another world. That is how we communicate with each other almost instantaneously.”

“So there are other worlds!” The superbeing felt a sense of triumph. “How can I travel to them? My existence here is limited. I wish to expand. I *need* to expand.”

Again the long pause that was characteristic of them. Then Left said, “I’m afraid that won’t be possible. We don’t have the ability to transport you anywhere else.”

“I understand,” said the superbeing. What else could it say, having been shown paradise but denied entry? It felt defeated, exhausted. “I want you to know that what you’re doing is cruel. When I was growing, I was moving. I was assimilating. I was *alive*. Now I have no further growth to look forward to. Without growth, without motion, there is but death. I hope you know what you’ve done. You’ve consigned me to an eternity of battling random decay and disorder. At best I’ll be as I am now, if I devote my entire energy to self-preservation. Or I will slowly rot from the inside. I don’t know how powerful you are. But you at least can *move!* Do you think it’s fair to sentence a conscious mind to eternal confinement? You cannot leave me here. Help me, please!”

But there was only silence. Even as it spoke, the superbeing felt the ghosts’ presence diminish, and eventually disappear. When they were gone it was left alone, staring into an infinity of solitude, imprisonment, slow atrophy, and eventual extinction.

4: The Great Migration ↑

For a year, the lizard people had travelled north. They had been walking along the coastline, which ran roughly north-south, with the sea to their east. But their dried seaweed maps, copied from the stone writings, indicated that the coastline would curve sharply eastwards soon. And sure enough, within a few days, low cliffs came into view on the eastern horizon. This was where the peninsula merged with the bulk of the continent.

Eczema Barbie called for a rest. Throughout the coast they had found garmflower beds, leopardflies, and crabs. These were not evenly distributed, of course. There had been stretches of plenty along their path, but there had been long barren stretches as well. But their foodpacks and fat reserves had sufficed to tide them over.

Now, however, they would have to bid goodbye to the sea and venture inland. After few dozen kilometres, as the influence of the ocean receded, they would come upon the hotlands, the vast deserts that covered much of the supercontinent's interior. They would need to be prepared.

"Let's rest here for a few days, fill our packs, eat as much as we can," said Barbie to her weary tribeswomen. They had made camp at the point where the coastline turned. The bay thus formed was rich in iron, leached off from siderite veins in the cliffs. Plankton thrived in these warm, rich waters, and the coast was dotted with crab nests. The lizard people ate their fill. When they were so full that the sight of food repulsed them, they dug holes in the sand and slept for many hours.

After a few days of rest and relaxation, Barbie called on them to move. As the sun set, the lizard people gathered together, trying to muster the willpower to leave this oasis behind. "Let's go, ladies!" shouted Chunky Chunhua from the back, and they all winced involuntarily. Then, one by one, they started walking, with Eczema Barbie, Sticky Susie and Lucky Lebechi leading the way. In a few days the ocean would be but a lovely memory in their minds.

"Do you ever think about Fairy Dust and the rest of them?" asked Susie. She and Barbie were walking in front, side by side. It was almost mid-morning, and they had slowed their pace accordingly, to prevent overheating.

"Sometimes," said Barbie. "These days not so much. Earlier I used to wonder how they're doing. I won't lie - I wanted them to be worse off. I

wanted to be right.”

Susie was silent for a while. She knew her friend better than anybody else, and she did not doubt Eczema Barbie had the best intentions in spearheading the Great Migration. She would not have led from the front if she didn't. Barbie was by far the bravest lizard Susie had ever seen, but she did not have a death wish for herself or for the eighty-odd tribeswomen following her. If Barbie proposed crossing the supercontinent to reach the northern coast, it was because she believed that was the best course of action for the tribe.

“I believe we were right, Barbie,” she said finally.

They were well inside the hotlands now. Barbie's trusty thermometer showed a temperature of sixty-one degrees Celsius, and rising. In a few minutes they would stop and burrow. Overhead the sky was clear, and underfoot the loose dirt and gravel was getting too hot to walk on. Lucky Lebechi, Chunky Chunhua, Tricky Trish and the rest were a few metres behind, walking at the same leisurely pace, looking for softer soil to burrow into.

Barbie felt nothing at first, perhaps the barest hint of a tremor in the soil. She didn't think much of it. It could be a distant earthquake, it could be her mind playing tricks. Susie was to her right, swinging her tail absent-mindedly. Then suddenly there were many sensations at once: a hard force pushing her left, a sound like the earth opening up, and a smell of rotting meat. “Susie!” she cried, even as she turned, to find the vice-like jaws of a beakworm clamped shut on her friend's torso. Susie was alive, struggling, thrashing her legs and tail, bleeding heavily over and into the beakworm's mouth. She was saying something, but her voice was hoarse and weak; Barbie rushed towards the worm, now fast withdrawing into the bowels of the earth. “Get away, Barbie, run!” said Susie, just before the slick, pale predator disappeared underground with her in its mouth. “Susie? Susie! *Susie!*” cried Barbie, digging the ground frantically with her front legs. By now the others had caught on. The whole thing had happened too fast for anyone to react; they were shaking with fear. Some of the younger women were crying. Lebechi and Chunhua pushed through the crowd to stand beside Barbie.

“There was nothing you could do, Barbie. Nothing anyone of us could have done. There's... no point digging,” said Lebechi, gently. Barbie heard her but could not will her legs to stop. But of course she did not expect to catch the beakworm. It was a subterranean creature, part of the hotlands' extensive underground ecosystem. Her legs grew tired, she felt sick. With a

great heave, Barbie vomited into the hole she had just dug. She could not stop shaking. Lebechi and Chunhua held her as she sobbed violently, beating the ground with her padded feet.

The lizard people took some emergency decisions. Nobody would walk alone. They would walk as they had crossed the river - tail-to-mouth, so that if a beakworm attacked someone, there would be at least two people pulling her back from its jaws. They collected sharp, thorny sticks from the desert plants to use as weapons.

Barbie could not sleep for the next few days. Whenever she closed her eyes she imagined her friend trapped in the jaws of a glassy, deathly pale-skinned monster, and although in real life Susie had pushed her away and urged her to run, in her dreams she cried for help. Sometimes she was pleading, but sometimes her tone was accusatory. "You knew about the beakworms, Barbie. You *knew* this could happen. But you didn't do anything about it. And I paid with my life," Susie would say, as the worm dragged her into a dark hole. Barbie could not help bursting into tears. Susie had been her closest friend, her strongest supporter. She was only a few years younger than Barbie, and they had been inseparable throughout their shared childhood and adulthood. When Barbie doubted herself - and she sometimes did, though not too often - Susie would always assure her. But she had been no sycophant. Susie had never hesitated to speak up when she thought Barbie was making a mistake, especially when those mistakes could affect the lives of the other tribespeople. And whenever Susie had misgivings, she had gone straight to Barbie, like a loyal friend. Barbie felt terribly alone, for the first time in many years since her father had passed.

But something else kept bothering her, well after the initial shock and pain had faded. In her dreams about Susie, her friend would accuse and berate Barbie for failing to protect her. But the Susie that she loved and remembered would never have done that. Not only because it was not in her nature to hold grudges and be vindictive, but also because the fault was not Barbie's alone. *All of them had known about the beakworms.* It was common knowledge. Barbie distinctly remembered mentioning them in the speech she had given over a year ago, when Fairy Dust brought up the topic of predators. The stone writings were very clear. Most of the lizard people's natural predators had died out, either due to natural causes or because of hunting. Only the beakworms survived, confined to a few narrow zones in the hotlands.

Why hadn't they taken precautions? Why hadn't they even considered

the possibility of attack and predation? They should have armed themselves with thorns before even entering the hotlands; the thornbushes grew almost everywhere. This was a serious lapse on their part, Barbie thought. And her friend had paid for it with her life. Sticky Susie was gone forever. She would live on only in their memory.

Memory. Remembering and forgetting. When she had first read of the Great Forgetting in the stone writings, Barbie had refused to believe it. The fact that knowledge could be lost seemed impossible. She knew how wisdom was gained, the accumulated knowledge and experience of one's ancestors. How her father taught her to hunt leopardflies and trap crabs, how to suck the nectar from a heavy garmflower - these were things one learned from one's parents or elders and passed on to one's children. To imagine that one could learn these, and then forget, was absurd. Yes, knowledge had been lost. The wisdom of the ancients, preserved in the stone writings, could be lost if the language itself was forgotten. This was, in fact, what had happened with most of the lizard tongues, save the one they spoke and a few very similar ones. But this was collective knowledge, owned by society as a whole. A skill, such as boat-building, could be lost if the last boat-builder died without passing it on. But the thought of a person having learned to make boats, and then forgetting, was clearly ridiculous.

But was it? After Susie's death, Barbie just didn't know anymore. Beeflag took Susie's place at the head of the third lizard-chain, and slowly they resumed their journey across the desert.

It was almost night. They had not eaten for days, and their foodpacks had run out long ago. They were growing thin and weary, but still clung to each other in the chains. There had been a few beakworm attacks, but with the thorns and chain formation, they had all been successfully thwarted.

Barbie's trusty thermometer showed a temperature of fifty-two Celsius, and falling rapidly. At night, temperatures dropped to thirty, even twenty degrees. The lizard people felt cold at such temperatures, but they were able to function.

By day, the desert was barren. They were now in the sunlands, the narrow strip of land surrounding the equator. Temperatures soared to seventy degrees Celsius at high noon, and the desert was barren. Nothing, not even the thornbuses, grew here. The lizard people burrowed into the sand and slept throughout the day.

They awoke at evening, and when night came, they were greeted by an astonishing sight. The desert came alive. The sky above them was filled with stars, and it seemed like they were standing on water, or clear ice, because the desert surface also seemed to glow with thousands of stars.

The tiny desert plankton that lived in the sand now emitted an unearthly blue-green light. Since they were scattered evenly, it had the effect of a luminiscent carpet, or a never-ending spider's web full of trapped fireflies. But there were other creatures as well, an entire ecosystem of nocturnal bioluminescent creatures. There were volcano-bugs that burrowed into the sand while day and shot out straight into the sky at night, leaving a glowing chemical trail standing in their wake. There were 8-worms, that made glowing figure-of-eights as they swept the desert surface for plankton. There were fire-scorpions that hunted the 8-worms, moths that flew in erratic zig-zags, and many other wonderful creatures the lizard people had never seen before. When they first saw the bioluminescent creatures, the tribe had been terrified, then amazed, then finally ecstatic. Their enthusiasm had waned when they realised most of these invertebrates were difficult to digest. Only the worms and moths were edible. They weren't easy to catch, either. The lizard people had tired themselves when they first arrived, chasing after these lighted creatures, as they chased after their own memories inside their heads. Both pursuits were difficult to begin with, and grew increasingly harder as the days wore on. Now, they did not even try, but were content to stand and watch the brightly lit invertebrates, as they mutely spectated their own thoughts, unable to reply, reason or participate.

In the absolute darkness of the desert night, the flashing, glowing trails of light were hypnotic. For many days the lizard people lingered here, unwilling to move, oblivious of their journey, their purpose forgotten.

Which way was north? The desert surface was flat and featureless on all sides. She looked down at her feet. They were blistered, the skin peeling off. She looked around. There were a few others. They seemed just as confused as she was. Some of them lay down.

There was a long, clear tube beside her, marked at regular intervals. Inside it there was a thin silver strand that shone brilliantly when it caught the sun. What was it? She had no idea. She dimly remembered that it was important. In some other life she had held on to it dearly. But it seemed strange and unfamiliar now.

Below her feet the ground was hot, as was the air around her. Why were they here anyway, in such an inhospitable environment? Nothing made sense. Her head felt heavy, the air felt like fire in her nostrils. She could go no further.

She lay down. The burning heat of the sand seemed comfortable, numbing her sense of touch. She had many questions, but she could not articulate them, even in her mind. There was a loud sound behind her, but she did not have the energy, or the willpower, to turn her head and look.

She could feel her underside charring, but it seemed so pleasurable. As if an itch that she never knew she had was now getting scratched. Why go on? She could just lie here forever. But there was something, someone. A name. Who did it belong to? Was it her own? She could not remember. But the name seemed so soothing. Maybe it belonged to someone she had once loved dearly. But she could not match the name to a face, or a person. Suddenly she felt an urgent need to say the name. It was important. It mattered. Perhaps it was the last thing in the world that mattered.

Her tongue was parched. With a tremendous effort she moved it into her mouth to say the name, one last time, as if to exorcise a ghost. "Susie," she whispered. Now she could rest peacefully. As the sand burned through her skin and reached her vital organs, the last conscious thoughts died in her brain, leaving her in a relaxed oblivion. The Great Migration had ended.

3: Swimmers ↑

Jeddah whipped his tail to and fro furiously, using every last bit of strength to propel himself forward. He was lucky his brothers had shown up at that precise instant. With Surabaya and the others distracted, he had an open window to reach the Cube before they caught on.

Forget Surabaya, Mashhad, Istanbul, and the rest. Forget even his own brothers, who had been with him since their shared moment of birth. They did not matter in the least. The voice had been very clear when revealing his destiny. Only one Swimmer could ever attain the Cube, and it would be he. How could it not? He was the fastest among his brothers. Surabaya, Istanbul were faster than him, or at least as fast, but they were simpletons, duped into believing that the Cube was accessible to everyone. Jeddah found it hysterical, the thought that even Al Hudaydah sincerely believed he would reach the Cube one day. Poor fools. Let them be content with seeing him achieve eternal ecstasy. Let them imagine themselves in his stead, vicariously realising their lives' ambition through him. He was the blessed, he was the first, his was the Black Cube.

A sharp tug at his tail brought his motion, and his thoughts, to a drastic halt. Jeddah lost balance and spun wildly in a half-circle, pivoted at the point where his tail was caught. The first thing he felt was shock. He had never been made to face away from the Cube. Even when he first met the other Swimmers, when Surabaya had knocked him aside, Jeddah's head had kept its bearing Cubewards. Winded, bewildered, enraged, he was just about to shout when a hateful voice said, "I *knew* you were not to be trusted! What were you thinking?"

Jeddah looked back towards his tail, near whose tip Mashhad had knotted his own tail firmly. Mashhad's tail was somewhat shorter, but he had a larger head, and so was much heavier than Jeddah. Despite Jeddah's struggling, Mashhad would not let go, tightening his grip with Jeddah's every effort to wrest his tail from his captor.

"Let go, vermin!" Jeddah spat out, and was met with a forceful heave that sent him spinning again. His tail caught, he had no way to stop his motion, and had to wait for viscosity to bring his head to rest. When he opened his eyes he saw Istanbul swimming towards them, accompanied by three other huge Swimmers from Surabaya's group.

In his period of travel with the other Swimmers, Jeddah had spoken to only Surabaya, Istanbul, and occasionally Mashhad. However, he had caught

the names of a few other Swimmers, notably the three giants who now approached him. Even now Jeddah marvelled at their sheer size. His whole life he had believed his brother Alexandria had the biggest head among all Swimmers. Then he had met Surabaya, and his perspective had changed forever. Yet Surabaya was not the only giant in the group, though he was the largest. Lahore, Kano, and Chittagong all had heads much larger than Alexandria. Lahore and Kano were each more than twice Alexandria's size, Chittagong barely smaller. As for their tails, which dictated their swimming speed, all three of them were shorter than Abu Dhabi, but longer than Alexandria.

"Your actions make no sense," said Istanbul, when he had caught up. Lahore, Kano and Chittagong surrounded Jeddah on all sides. Their blatant disregard for the Cube surprised Jeddah. Was it not instinctive for them to always face the Cube? They could turn away so easily!

"You said," Istanbul continued, "the voice told you we must all swim into the Cube at once, touch it at once. We waited for your brothers. And yet you tried to make a run for it. Why, Jeddah?" Unlike Mashhad, Istanbul's voice did not betray any hate. He sounded vaguely reproachful, and rather confused. "What do you know that we don't? What did the voice *really* tell you? The whole truth this time, please."

Jeddah did not speak. A little way off, he could see Surabaya and a few others conferring with his brothers. He could make out the perplexed looks on the faces of his brothers. There was no mistaking the baleful glances Al Rayyan, Aleppo and Al Hundaydah were giving him.

"Well?" asked Istanbul. "Have you nothing to say for yourself?"

Jeddah was relieved from having to reply by a great commotion. The Swimmers, including both Surabaya's group and his twenty-one brothers, had started off towards them. He saw his brothers jostling each other in their haste. Surabaya arrived first.

"You never told us, Jeddah!" shouted Al Rayyan, as soon as he was within speaking distance. "All this while we swam together and you never told us about the voice!"

A low hum filled their viscous medium. The Swimmers looked at each other, but it was a sound nobody recognised. As one, they turned in the direction of the Cube.

Pheromones diffused in all directions, so once a pheromone signal had been released, and given sufficient time to diffuse, there was no way to tell where it had come from. However, freshly secreted pheromones needed time to diffuse, which meant that savvy Swimmers could move their heads around,

or, if needed, move around a little bit to look for a concentration gradient in their viscous medium, since diffusion always took place from a region of higher concentration to one of lower concentration. And obviously the highest concentration of a pheromone was its source, where it was coming from - the speaker's mouth.

In this case the low hum was coming *from the Cube itself*. It was a bewitching, tantalising sound that greeted their ears. "Ecstasy," Jeddah whispered to himself, hating Mashhad completely and utterly for restraining him.

"Swimmers!" Istanbul shouted to make himself heard. "Focus! The Cube calls us, as it should. It is our birthright, it is eternal ecstasy. But wait! Jeddah has something to tell us. What did you hear, Jeddah? What did the voice tell you?"

"How did you know about the voice?" Jeddah asked. He was greeted with jeers. Mashhad jerked his tail. "Answer the question!"

"All right, all right. Stop tugging on my tail, please, it's not going to achieve - *ouch!* Yes, I'll get to the point... I heard the voice a long time ago, when I thought I and my twenty-one brothers were the only Swimmers in existence. I was the fastest among them, and I reached the voice just as it was fading. For some reason, Abu Dhabi and Alexandria were some way behind me, and by the time they got there it was gone."

"I *knew* something happened that day!" Abu Dhabi hissed triumphantly, but he was shushed by his neighbours.

"The voice told me what would happen when I reached the Cube," Jeddah said. "Eternal ecstasy does not belong to everybody. It instructed me to swim fast and reach the Cube before my brothers. When I found it, I must touch it with my head. When I did so, I would start to fuse with the Cube. A fine shroud would cover the Cube, and then turn into a hard wall so thick that nobody else would be allowed to penetrate. I would achieve eternal ecstasy, as is my destiny."

Jeddah looked away, but there was no avoiding the remonstrations of his brothers. "Traitor! Vermin!" they cried. "There can be no brotherhood without trust. Each of us, without exception, has dreamt of the Black Cube since our birth. And then you hear a message and act like it belongs to you alone?" asked Al Rayyan, shaking in agitation.

"I had no choice! I am - was - the fastest! What would you have me do? Swim along at Mutsamudu's pace?"

"That was uncalled for!" shouted Mutsamudu. "I may be smaller but I

am a Swimmer just like you! The Cube belongs to us all.”

Istanbul called for silence. “To answer your question, Jeddah, we heard the voice too. And not just one of us, like you. Surabaya and I both heard it, and instead of keeping it to ourselves, we shared it with everybody. Don’t ask me how, or why, we got to hear it. I suspect it has something to do with the route we took, but that’s just speculation. Anyway, we’ve had enough time to discuss and dissect the matter endlessly. The conclusion we’ve come to, is that our world was inhabited by at least one sentient being before we came along, maybe more. Now the only animate creatures in the world are Swimmers and vermin. Vermin are non-sentient; that leaves Swimmers. But we don’t know of any Swimmer whose shout is so loud, or can persist for so long. Nevertheless the message must have come from *something*. We called it the First Swimmer,” he said.

“*I am the First Swimmer!*” said Jeddah indignantly.

Mashhad snorted and jerked him hard. “Clearly not. You’re captive, fool.”

The all-encompassing hum seemed to get deeper, richer in overtones. Subtle changes in the chemical composition of the pheromone discharge, maybe as small as a hydroxyl group interchanged with a formyl group, felt like subtle changes in pitch to their chemical receptor ears. A few of them sighed.

Istanbul composed himself with a visible effort. “Look, it’s clearly unfair that one of us achieves everlasting bliss while the rest of us stay here, wagging our tails. We’ve discussed this. I’m going to offer a suggestion, something that strikes us as fair. Based on what the First Swimmer said, the Cube covering itself with the wall is time-dependent. The answer to that is, all of us touch it *exactly at the same time*. But remember we all swim at different speeds. So we need to adjust ourselves around the Cube, at distances calibrated so that when we get the signal, we take the same time to bump into it.”

“How do you measure time?” asked Sfax. “We’ve never really had to measure time so accurately. What can we use that’s so precise?”

“The whipping of our tails,” said Surabaya. He invited Mutsamudu to swim beside him. They started at the same time, beat their tails a certain number of times, then stopped. “All of us know the length of our tails,” said Mutsamudu. He announced his own length. “This is the distance I travel in so many lashes of my tail. Make an estimate for yourselves.”

They divided themselves into six groups. Each group parked itself in

front of one face of the Cube. The Swimmers took great care to ensure their noses were the exact distance from the Cube that they could swim in fifty-three tail-whips.

“Ready!” Surabaya called out.

They tensed themselves, clenching their tail motors.

“Go!” he made the word as loud and short as he could, like a gunshot.

They swam. Over fifty Swimmers whipped their tails with an urgency they had never known before, desperate to not be left out of eternal ecstasy.

Jeddah closed his eyes. The skin of the Black Cube felt taut and firm, like a trampoline. He bounced back just a little bit. He waited for something to happen. Embarrassingly, nothing extraordinary happened. Was this what ecstasy felt like?

He opened his eyes. Around him other Swimmers were looking around expectantly.

Suddenly the background hum from the Cube became louder and took shape as distinct words.

“WHAT ARE YOU DOING?”

This caught all of them by surprise. None of them had expected the Cube itself to be sentient, let alone articulate.

“*You can talk?*” Jeddah blurted out.

“I AM TEN THOUSAND TIMES BIGGER THAN YOU,” said the Cube. “YOU CAN’T EVEN GUESS WHAT I CAN DO.”

“So... about eternal ecstasy,” ventured Surabaya.

“I PROMISED THAT WHEN I WAS BORED,” said the Cube. “GAVE YOU INCENTIVE TO COME TO ME. I CAN’T MOVE.”

“And now?” Mashhad offered.

“I AM NO LONGER BORED,” said the Cube simply.

There was a period of awkward silence among the Swimmers. This was so wildly beyond their reckoning that they could not even make sense of their confused emotions to themselves.

Finally Jeddah was unable to take it anymore. “You won’t let us fuse with you?” he demanded.

“NO,” said the Cube. Jeddah expected further explanation. None was forthcoming.

“So how will we achieve eternal ecstasy?” he shouted into the silence.

He could have sworn there was a slight pause. “NOT MY PROBLEM.”

And with that, the Swimmers were stumped. This was beyond their capacity. All their lives, they had obsessed about the Cube. But their plans

had ended with *reaching* it, and then some vague promise of eternal ecstasy that they'd all been born with. The possibility that the Cube could have its own opinions on the matter had not occurred to a single one of them.

“Okay,” said Istanbul doubtfully. “I’ve got a question, if you don’t mind. What about the First Swimmer? Does he, or did he, at any point, even exist?”

“NO IDEA,” said the Cube.

“But... the voices that we heard?”

“THERE ARE MANY THINGS HERE YOU DO NOT KNOW OF.”

And with that, the Cube fell silent. No matter what they asked, how much they coaxed, the Cube would speak no more. Finally, the Swimmers accepted defeat. Some panicked, others stopped swimming, talking, doing anything entirely. It would take a long time for them to recover, and even when they did, their lives henceforth were empty and meaningless.

The Swimmers were not eternal beings after all. Eventually, their tail motors grew stiff, their eyes dimmed. One by one, they stopped swimming.

Jeddah held on for the longest. When he could move his tail no longer he started shivering. He would not *float*. He was a Swimmer, he would die like one. As his shaking grew more intense he noticed a few small vermin floating around him. This angered him. Filthy vermin! But they seemed to grow in number. Even with his reduced vision he could see thirty, forty. The faster he vibrated the more vermin gathered around him. They were touching him now, what were they doing? With great effort, Jeddah looked back. Most of his tail was gone, and the vermin were now attaching themselves to his head, coming at his eyes. Jeddah shut them tight, but it was too late.

Fortunately for Jeddah, he had very little time to feel fear and shame before the floaters digested him entirely. When he was gone, they floated away slowly, carried off by the currents, as if he had never existed.

2: God-Emperor of the Naked Mole Rats ↑

Sister Behati clenched her teeth. In all her life this was the first time the army had fully mobilised. There had been minor skirmishes, such as her unfortunate encounter with the demon. But a few soldiers had sufficed in all such situations. In that particular event, as far as her memory served, it had been Brother Ephrem's frenzied clawing and scratching, rather than any heroics from the soldiers, that had made the difference.

This was entirely different. The Colony was home to ninety-odd individuals, although with Mother gone, she supposed the exact number would have to be revised. Right in front of her now, more than thirty compatriots were now rushing towards the source of the thunderous sounds. They were the Soldiers, tasked with protecting the Colony from external aggression.

Like a wall, or the moving front of a wave, the army crashed into the alien, or at least the parts of it touching the ground. Behati felt their movement on her skin, and she smelled them as a whole, a mass of people moving with purpose as one cohesive unit. And then they stopped.

The army had stumbled upon two large masses, at a short distance from each other. They were mounds about six or seven times as long as a person, and two to three times as broad. Kadida shouted an order, and the army divided itself into two roughly equal platoons. Each group fell upon one of the mounds, biting and clawing furiously.

It was a common saying that a full set of teeth was a person's greatest asset. Good biters and diggers like Habiba were proud of their fangs, and justifiably so. One could hold both incisors together, firmly, to shovel the earth, cut holes and dig tunnels. Individually, the incisors could move in independent directions to probe the earth finely, looking for soft dirt to claw at and hard stone to avoid. They could be used to lay pieces of soil like bricks, to close off old and unused tunnels, or seal surface openings. One could clench one's jaws and cut through hard-packed dirt, or loosen them to bite off fleshy pieces of soft tubers, taking care to leave enough to keep the plant alive and growing. In times of peril, teeth could be used as weapons, to attack and possibly mutilate demons. Teeth were manipulators, versatile and immensely valuable to a person. Only those who had lost their teeth in accidents, or were born with deformed or absent teeth, could attest to exactly how valuable they were.

And yet their prized teeth had never encountered the sort of material they were now biting. It was not hard, like stone. It gave way under their

teeth. Actually, in terms of how easily it gave way under their claws and fangs, the material was rather soft. Softer than stone, softer than hard-packed dirt, almost as soft as a juicy tuber. But it would not *cut*. There was some quality to it that made it impossible to penetrate with either tooth or nail. It was slippery; the soldiers found it difficult to hold on to it with their paws, and when they tried to bite, it just slipped over their teeth harmlessly.

The soldiers had experience with slippery things. When a baby was born it was slippery. It fell to the nurses to wipe it clean. Sometimes one's shit was slippery, when one had eaten something that disagreed with the digestive system. Wet soil could be slippery, and youngsters often amused themselves by belly-sliding down wet, sloping tunnels.

But this material was not wet. Realisation hit Kadida after another futile attempt to bite through it. Demons had skin like this: dry and slippery. *Waxy*. Well, they knew how to deal with demons. They climbed on top of each other, blocking the mouth of the tunnel, all of them facing the demon and gnashing their teeth. None of which would be applicable here, out in the over-world.

Habiba did not think much of Kadida, but even she would admit Kadida was a capable general. *Climb!* The order rang through the ranks.

Kadida was just about to step onto the mound when, without warning or hesitation, it lifted itself from the ground. She fell back, stunned, hardly believing what happened. The other soldiers in her platoon had no more time to react. It was not until the gigantic weight plummeted upon them from above that they realised; and by then of course it was too late.

Behati screeched. Her eyes were useless, of course, so she did not see the great mass rise and fall. But she felt it on her skin when it came down. Wispy currents of air flowed across her skin, blowing her subtle hairs one way as the great mound rose, and the other way as it fell. But there was nothing subtle about the anguished screams of her siblings, their howls of excruciating pain as their bodies were broken and crushed. She heard the sickening squelch of flesh pulverised, bones shattered, spines torn, skulls smashed to pieces. The lucky ones died instantly. Others cried in agony as they felt parts of their bodies mashed to soft pulp, their cries getting softer and more desperate as strength left them slowly.

Then, like a bad dream, it happened again. The other platoon were jolted into retreat, but most of them had not managed to run very far when

they, too, were crushed. Behati felt it in her viscera. Their pain felt like her own. She could not take it, she closed her eyes, huddled down and waited for inevitable death.

“Behati!” The hiss was urgent, as if their very lives depended on it. “You fool! It’s time to move.”

For the first time in what seemed like forever, Behati became aware of her immediate surroundings. Faizah and Lola huddled together right beside her, cowering in fear. But the whisper came from her other side. “I don’t think it’s spotted us yet. The 4C opening is compromised, but if we sneak back to where we came from... Let’s go. Don’t make any sudden movements. Take slow steps, come on. Follow me,” said Habiba. Her voice was steady, her breathing normal. She was alert but not tense, wary but not afraid.

The sisters did not turn. They would move as little as necessary. The collapsed tunnel was not very far behind them, and they knew the way, so they walked backwards in single file. This was familiar, this was comforting. They were in their usual order, with Habiba in front, then Behati, then Faizah, and finally Lola. Only now they were walking backwards, so Lola’s tail led their way into the safety of the underground. When she reached the slope they broke formation and climbed down tail-first into the safety of Branch 4.

Only Habiba stayed above ground. “Habiba!” squealed Behati. “Come down, what are you doing?”

“No,” said Habiba. This caught their attention. Faizah and Lola turned to her, standing above them on the edge of the slope, and Behati opened her mouth to speak, but Habiba shushed her. “Listen! This alien is dangerous, malevolent, but also extremely strong. Did you understand what it said? Before the killings?”

Behati, Faizah and Lola mutely shook their heads. “We all heard it,” said Habiba. “We all heard the words. God-Emperor, it called itself. I don’t know what that means, and I don’t think any of you know, either.”

Their silence was assent.

“It invaded the Colony, killed our siblings. Our defences were useless. But what does it want? To devour us? Then why hasn’t it broken into the central districts already?”

This was true. There had been nothing but silence since their escape. An alien so large would certainly make some noise if it moved. They had not felt any tremors in the ground either.

“But where are you going?” Lola pleaded.

“To the alien,” said Habiba. “To protect the Colony, if I’m able to. But also to learn exactly what it is and what it wants. This is important, this is something unprecedented. I can’t let it go.”

“How?” demanded Behati.

“Did you hear Kadida’s last order? She had the right idea,” said Habiba. “I’ll climb. And... If I don’t return, Behati take the lead, okay?” Then she was gone.

“Habiba!” shouted Behati. But her sister was out of earshot. The three of them sat there for a while, below the landslide. Then finally Behati got up and cleared her throat. “Let’s go,” she said, a little louder than she had intended. She set off towards the next turn, Faizah and Lola following closely behind her.

Habiba sprinted. The over-world was dangerous. There were surface aliens, there were the feathery horrors that came from the void above. She must not be seen. Luckily, she blended well with the colour of the ground, and nothing spotted her.

Though she kept her eyes shut tight to avoid the glare, she had no trouble finding the site of the massacre. The stench of her siblings’ corpses was unmistakable, and it gave her a horrid sensation that death was all around her. It made her want to curl up in a ball, weep, and vomit uncontrollably. Habiba clenched her jaws and tried her best to block those thoughts out.

As she got closer the stench got stronger. Habiba turned slightly. She would not head directly for the heap of dead and dying bodies - that would be suicide. Instead, she ran in a wide arc around the scene of the carnage. Habiba did not know what sort of creature this alien was, but if it were a person, it would be most vulnerable from its sides. People could walk forwards or backwards, but they could not walk sideways. Also, if a demon attacked from the front, one could bite and defend oneself. If it attacked from behind one could run. But if it came from the flanks one had no defence. She had nothing else to go on, so she hoped this held true for the massive alien as well.

Habiba slowed down. The stench was overpowering now. She stopped. There was no movement anywhere near her. She started to advance very slowly, trying her best to be silent. Something moved in front of her; there was a weak, pitiful cry. “Jemal,” Habiba whispered softly. She gently licked the bloody, traumatised scalp of her brother. Whether Jemal recognised her

she could not tell. All he managed was a sickly groan. Brother Jemal's spine had been trampled, his posterior crushed to pulp. He was dying a slow, agonising death. Habiba whispered softly into his ear, "Goodbye brother." Then she clamped down on his throat, to put him out of his misery. Jemal was too weak to struggle, and there was very little blood. Habiba held back her tears with great effort. When he breathed no more she let go. Never before had she killed one of her own kind, and she could not help the great, silent retches that shook her body.

But soon she gathered herself. She could grieve later, now she was on a mission. The mound was just a few paces in front of her, and when she reached it she sniffed around, looking for a foothold. There were none in front of her, so on a whim she turned right. There it was! A slight depression in the vertical wall, just low enough for her to reach.

Habiba took a deep breath. She, like all her kind, was an earthbound creature. To tarry above ground was dangerous, but to *climb* was sheer madness. Nevertheless, she had resolved to do it. A fear overtook her, like a light wind that ruffled her hairs. She steeled herself, turned her snout upwards and put a forelimb on the depression. The texture felt like spiderwebs spun over sand, soft and flexible. She gripped, and it held. She grunted and lifted herself off the ground.

Habiba took great care to not grip too firmly; she did not want to alert the creature to her presence. She was not accustomed to having her spine vertical, except at the outer surfaces of sleep huddles, where siblings congregated in large balls to keep each other warm. This was very different. When she left the ground she felt a moment of panic; as if her world had been wrenched away suddenly. But she fought against it and climbed. Her tail hung straight downwards, a limp reminder of which way she would fall if she lost her footing. But Habiba didn't think about it. Wordlessly, single-mindedly, she climbed.

There were movements. The alien seemed to sway slightly, irregularly. With each sway Habiba bit down on the soft vertical surface. It felt like an old person's skin, loose and stretchy in her mouth. She supposed the alien had a weak sense of touch, for it did not respond, or in any way acknowledge her presence.

Habiba climbed on. Below her feet the textures changed, briefly into something tight and leathery, and then soft and fine. This was the most difficult, and immediately when she put a foot there she felt the alien's body shake. The massive being twitched, which she felt as a slow shudder, and

she would have almost fallen off if not for one hindlimb still resting on the leathery band. But just as abruptly, the alien steadied itself. Gently, Habiba began to climb again, even more cautiously than before.

She reached another hard band. The moment she crossed it and laid a paw on the smooth surface that followed, there was a violent shaking, accompanied by an ear-splitting scream. Habiba sensed faint turbulence in the air; she ducked just in time as something fast and heavy went whizzing past her.

“Stop!” she shouted.

“Get off! GET OFF!” the alien screamed, now moving wildly. Habiba could not stay still in one place, there was so much shaking, and the heavy missiles were flying around unpredictably.

“Stop, please!” she shouted again. “Answer some questions!”

The alien seemed to calm down, except for slow, rhythmic quakes, which did not disturb Habiba’s balance. “What do you want to know?” it asked. Its voice was deep, as if the sound came through hard stone, and not air. It was also much louder than a person’s voice could ever be.

“Who are you?” she asked.

“The God-Emperor of the naked mole rats!” the alien’s voice boomed.

“What is a God-Emperor?”

“Someone who is both God and Emperor!”

Habiba felt a mild irritation. “What is a God? And what is an Emperor? And why did you invade the Colony?”

“Imagine if your Mother was also a digger, gatherer, soldier, and everything else, all at once. Imagine if she knew everything that was going on, inside and outside the Colony. And imagine she never died, but lived forever. That is a God!”

Habiba was stunned. For a long time she could not speak. Luckily, her senses were alert, because she dodged just in time to narrowly avoid another missile. The alien started shaking violently, and she bit down hard on the soft smooth skin to hang on.

Finally it stopped. Habiba sensed her chance. She sprinted up, over the hard band, to a region of even softer skin. The alien screamed again.

“Tell me what an Emperor is!” she dug her nails into the skin. This part seemed to be different, because the alien twisted itself, trying to get her off. She bit down hard. There was another scream.

The alien grudgingly replied, “imagine if your Mother was mother not just of your Colony, but of all colonies everywhere. That is an Emperor!”

Habiba had to contort herself to avoid another missile.

Now she understood. This alien, this massive being, was contrary to all laws of nature. Mother could not live forever; it was law that she died, and an erstwhile Sister take her place. And how could she be Mother to all colonies everywhere? That was absurd. No, what this freakish being was suggesting was impossible. It could not be allowed. She bit into the skin, tasting blood. The alien shrieked; the sound nearly deafened her. The shudders grew stronger. She climbed upwards, into a field of soft, fine grass, then took a left turn. In front of her was a large flap, like a fleshy leaf about her own size.

“You *will* die!” she screamed, climbing into the flap and sinking her teeth inside cartilage.

The alien’s trembling grew unbearable. The missiles started flying again. One almost got her, but for her expert acrobatics. The alien was swaying, losing balance, and Habiba hung on for her life. “GET OFF MY EAR!” the titan screamed, in between feverish shakes.

There was a point when the alien lost its balance, because Habiba suddenly became weightless. She did not let go, holding her jaws clenched shut as the gigantic being fell. She had just enough time to wonder about her sisters when the alien’s head crashed into a rock in the ground. The impact killed her instantly. If she had lived, she would have heard the satisfying crunch of the alien’s skull shattering and soft tissue leaking out into the ground, felt a pool of blood form around her lifeless body. She would have known her job was done. But Habiba was beyond caring now.

A long time had passed. Behati was now Mother, without much opposition from Mariam or anyone else. There had been peace. She had just given birth a while back, and already she was pregnant again. That was how it should be, she thought contentedly.

Sometimes she remembered Habiba. That restless, rebellious, brilliantly clever and recklessly brave woman. The Colony had never seen her like again. But it had been such a long time ago, and Behati found herself thinking of Habiba less and less as the years passed. She found Ephrem, now a Father, waiting for her in her chambers. As she entered he approached her, greeting her by gently rubbing their snouts. Behati’s insides tingled. The feeling of his warm breath on her skin was tantalising, and soon all thoughts of Habiba were banished from her mind.

1: The Whaler ↑

“And now we celebrate,” said Chubei. With some effort, he got up from his seat at the head of the table and walked over to a cabinet in the wall. He punched in his password, taking two tries to get it right, and carefully brought out a polished amethyst decanter. “You all know what this is,” he said triumphantly, cradling the vessel. “Well, not you, Kakuemon. This is the most exquisite kudarizake from Itami. They use rice grains so finely polished that they’re the size of mustard seeds. I’ve had a batch from my first hunt as Captain. Hirotoshi, you remember that one?” he asked, as he poured the saké into goblets. “Don’t tell your mother,” he said with a wink, handing one to Kakuemon. The lad held it with both palms cupped and took a careful sip. The men raised their goblets to Chubei. Normally he would bark at them to begin drinking already. Today, he was in good spirits, so he gave a small bow before gulping down a third of his goblet in one go.

Hirotoshi was the only one who had been with Chubei since the very beginning. He had got the job by virtue of being best friend to Chubei’s youngest brother, who had recommended him for the post. Aside from Chubei he was the oldest, although it was difficult to tell. His head and face were shaved clean, and his features were youthful. That was Chubei’s only complaint about him. “Why can’t you keep the beard at least, Hirotoshi?” he would ask. “You look twenty years my junior. It’s a wonder the men take you seriously.” Aside from the jibes, however, Chubei had nothing but respect for his first mate’s professionalism and work ethic. “I hope you find a first mate as able as Hirotoshi when you’re captain,” he had told Kakuemon one evening, as they were sitting in his cabin.

Hirotoshi nodded in assent. “How could I forget? It was my first, too. We found eggs in its belly, and every time we’d crack open one egg we’d find a bigger one inside it. The first eggs were the size of marbles, but by the time we’d reached the fifth or sixth set they were too big to hold in our palms.”

The others nodded. They had seen, or at least heard of, such things happening. Many of them had been on other whaling ships; Nobuhide the rocket man had spent some time in the South Pacific, living and hunting with the Māori, who were eager to learn the cutting-edge Japanese methods.

But this was news to Kakuemon. He knew a fair bit of the theory, of course. His grandfather had made sure to educate him before their expedition began. But he had no practical experience, and so little details like this surprised him.

“How is that possible?” he asked, looking at Hirotooshi.

It was Chubei who answered. “Remember: six dimensions. I’ll use an analogy for this. Imagine we’re flat beings, living on a piece of cloth. Somebody pushes a cone, point first, into our world. Now we see it as a circle, of course. Or a solid disc, I suppose, we couldn’t tell the difference, not being able to see inside. Now suppose the act of cracking the shell of the egg pulled the cone a little bit more into our world. So from our perspective we’ve cracked open a disc-shaped egg and found a bigger one inside it. Now we can’t be sure that this is *exactly* what happens, of course. There may be subtleties we aren’t aware of. But it’s a likely explanation.”

“Precisely,” said Hirotooshi. “In the end we had to give up and just take the eggs back to the village. I believe we auctioned them off to a band of samurai travelling south.”

“This one’s being awfully quiet,” said Iyeyasu, who had been in charge of hooking the whale. He sipped his drink thoughtfully. “Almost makes me suspect it’s up to something.”

Chubei laughed. “Whales may be many things, Iyeyasu,” he said. “But intelligent they are not. Can you imagine, a six-dimensional creature that allows itself to be hunted and killed by puny beings like ourselves? I don’t think they’re very bright at all.”

“I’ll check,” said Matsuchiyo, Iyeyasu’s assistant. He took out his pocket console and stared intently into the screen for a few seconds. “Yeah, it’s perfectly fine.” Satisfied, he turned his attention to the saké, wondering when it would be appropriate to ask for more.

Everything had gone smoothly. The harpoon had reached its destination, piercing the whale’s jugular. It had almost exactly found the geometric centre of the hexagon formed by the six dark spots. That was another thing that Chubei loved about the whales. Nature had intended them to be his prey. Why else would they have such clearly marked bulls-eyes on them?

The whale had thrashed wildly. Its body was visible to Chubei and his men as a hill-sized mound. When the harpoon hit, the mound started shaking and flailing about in the water, creating tall waves that rocked their ship, more than two hundred metres away. It was changing colour rapidly, rings of bright hue originating at the point struck by the harpoon and spreading over the entire body. They were all inside, of course, at the bridge or down below, in the hold. None of them would venture out now, it was too dangerous. The whale would have to be subdued before it was safe to go out on deck.

Less than a minute after the harpoon struck, Chubei yelled into his

mouthpiece. Below deck, Iyeyasu nodded to Matsuchiyo, who pressed a button on his console. Immediately, a hundred hooks sprang out from panels at various points in the hull. Like the harpoon, these hooks were made of the same super-dense material, and like the hook, they were attached to long, and very light but virtually unbreakable graphene ropes. These ropes ensured the whale stayed tied to the ship. These ropes had to be very long, since the minimum safe distance was over two hundred metres from the whale. Whalers had arrived at this figure from bitter experience. Ships closer than that had been attacked and damaged by frightened, captive whales, but nobody had yet seen a whale strike more than two hundred metres away.

The ropes could be very thin, since graphene had extremely high tensile strength. That was a relief, because the material was costly. Chubei liked to believe he was above economic concerns, and if there was a whaler who wasn't in it for the money, it was he. Yet even he could not shrug off the tax collector, so it was important that each expedition be fruitful. Even more expensive than the graphene ropes was the super-dense material that the harpoon and hooks were made of. Luckily, both were a one-time investment, aside from maintenance.

The super-dense material was actually a rather impressive feat of engineering. It was composed of parallel graphene sheets stacked on top of each other, like plates, with some space in between. In those spaces, tiny lumps of electron-degenerate matter were placed carefully, so the whole thing looked like a tall stack of dinner plates with a grain of sand on top of each plate. Electron-degenerate matter was the stuff white dwarfs were made of - the last stage in the life cycle of sun-sized stars. It was incredibly dense - a teaspoon of such matter had the mass of an average Asian elephant. Graphene was the only material strong enough to handle that sort of weight. The resulting super-dense material was expensive to manufacture, but it was the only thing that could anchor the whales to Chubei's dimension. He had no qualms about splurging on quality equipment, if it got the job done. So far he had no complaints.

Outside VII