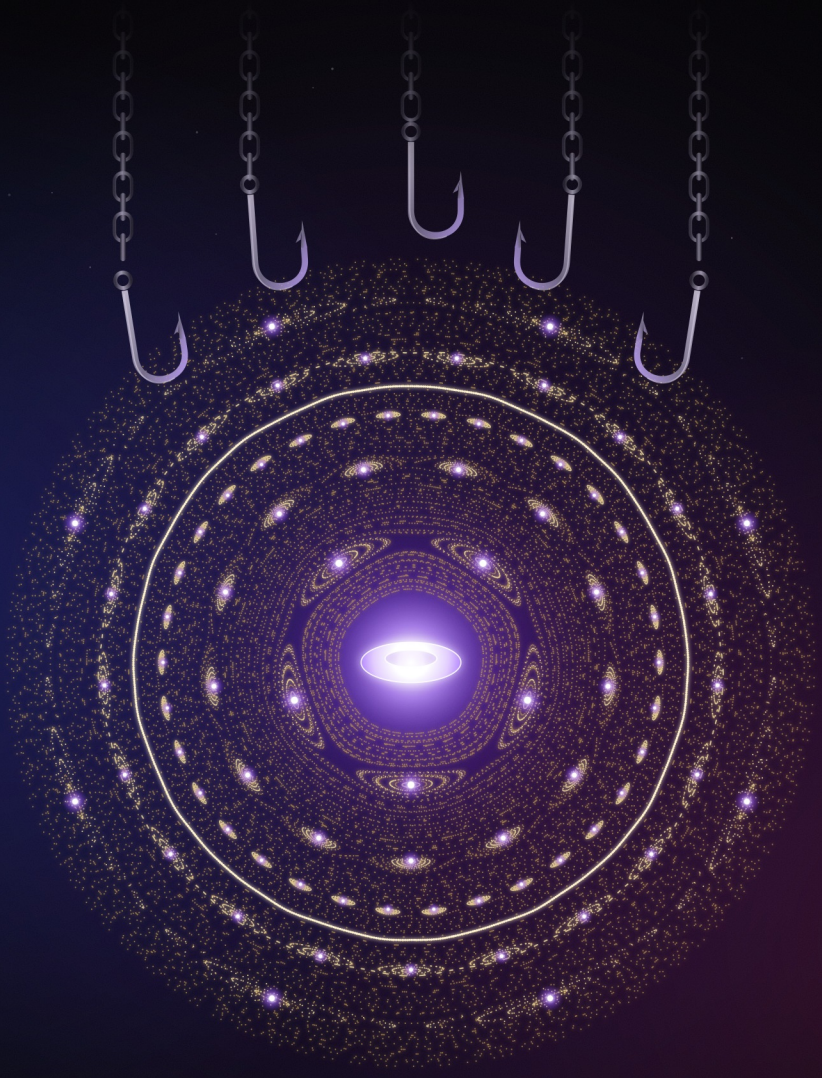


THE

ROTATIONAL TRANSFORM

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Someone should be there at the end.

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THE ROTATIONAL TRANSFORM

THE

ROTATIONAL TRANSFORM

A novella

CYDONIS MEDIA

The Rotational Transform

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Set in EB Garamond and Cormorant Garamond.

CONTENTS

PART ONE: FLESH

1 Shot 40117 2
2 Bexley Wing 9
3 Isotopes 18
4 Rational Surfaces 27

PART TWO: THE HELL PRIEST

5 The Hell Priest 36
6 Lytic 45
7 Cydonia 53

PART THREE: THE FURTHER REGIONS

8 Lament 62
9 Iota 72
10 Milkomeda 80

PART ONE

Flesh

I

SHOT 40117

AT 01:47 ON the eleventh of November, with fog coming up off the Wharfe so thick it swallowed the perimeter lights, Wharfe-2 made a star.

Not a star, Dr Amanda Hariette-Scott corrected herself, because precision was the only religion she had ever kept with any consistency. A plasma. Eleven cubic metres of deuterium stripped of its electrons and driven to a hundred and thirty-seven million kelvin, held in a bottle made of nothing but twisted magnetic field. The Sun would have been insulted by the comparison. The Sun managed its fusion by brute gravity and unlimited patience, at a core power density roughly comparable to a compost heap. Wharfe-2 managed it with fifty superconducting coils, a hundred and forty megawatts of microwave heating, and eleven years of her life.

'Ion temperature eleven point eight keV,' said Tomasz Wilk from the diagnostics desk. His voice had gone careful, the way people's voices went when they were trying not to hope. 'Density flat at one point two times ten to the twenty. Energy confinement time is…' He stopped.

'Is what, Tomasz?'

'Still climbing.'

The control room had been built inside one of the old filling sheds of the Royal Ordnance Factory at Thorp Arch, where, ninety years earlier, eighteen thousand women had packed cordite into shells for a different war. The walls were still a metre of blast-proof concrete. Cydonis Heavy Industries had kept them because the planners insisted and because Amanda liked the idea: a building once used to make things go bang, now used to

make something burn very, very steadily. Above the bank of screens someone had stuck a laminated sign that read PLEASE DO NOT TOUCH THE STAR. Nobody would admit to it.

She stood behind the operators with her arms folded, partly from habit and partly because folding them braced her sternum, and her sternum had been aching since teatime. That was the myeloma. It was always the myeloma now. The malignant plasma cells in her marrow were eating her skeleton from the inside, and they were especially fond of the flat bones: breastbone, pelvis, ribs, skull. On a bad day she felt like a cathedral with woodworm.

Tonight was not a bad day. Tonight she had a star.

On the main display the Poincaré reconstruction refreshed four times a second. It was the most beautiful picture in plasma physics, and the least understood by the investors she had to show it to. You took a single slice through the torus, an imaginary pane of glass standing upright in the vessel, and you followed each field line around and around the machine, marking a dot wherever it punched through the glass. A field line on an irrational flux surface never quite came back to where it started, so its dots filled in a smooth closed curve. Nest enough of those curves and you had the onion-skin cross-section of a healthy stellarator: bean-shaped at one angle, triangular at another, the plasma twisting its own body as it travelled through the machine's five field periods.

On the rational surfaces, where a line closed on itself after a whole number of transits, you got islands. Eddies in the field, chains of them, beads on a necklace. Wharfe-2 was designed to have exactly one such chain at its edge, a five-bead necklace through which the exhaust heat would be guided down onto the tungsten divertor plates. The island divertor. They had borrowed the idea from the Germans at Greifswald and, Amanda privately believed, improved it.

Tonight there were more islands.

'Tomasz, are you seeing a five-eight chain?'

'I'm seeing it. And an eight-thirteen inside it.' He typed, swore softly in Polish. 'Coil currents nominal. Trim coils nominal. Nothing on the magnetics that would seed those. There's no error field.'

'Then the plasma's seeding them itself.'

‘Plasma doesn’t do that, Amanda.’

‘Plasma does as it likes, love. We write the papers afterwards.’

She watched the islands multiply. Inside each chain new chains appeared, islands orbiting islands, at rationals she could name and some she had to work out on the fly: thirteen over twenty-one, twenty-one over thirty-four, a nest of fractions converging on something she could not yet see. Every one of them should have wrecked the confinement. An island was a short circuit; heat ran across it like water through a hole in a dam. Instead the confinement time kept climbing. One point four seconds. One point six. They had broken the world stellarator record forty minutes earlier and were now breaking records nobody had thought to set.

The picture on the screen no longer looked like a cross-section of anything. It looked like geometry. Interlocking lozenges, circles nested inside squares, a lattice repeating at three scales at once, the dots gold against the black background of the display. It looked, Amanda thought, absurdly, like marquetry.

‘Mirnov coils,’ Tomasz said. ‘Coherent mode. Very clean. Low mode number. A hundred and… it’s drifting down. Hundred and twelve hertz, with partials.’

‘Put it on the speakers.’

He did.

The sound that filled the old filling shed was a bell.

Not a tone, not the eerie whistle that magnetic fluctuations usually made when you shifted them into the audible band. A bell: deep, bronze, swinging. Amanda had grown up under the bells of Leeds Minster, had sat on the cold steps by the Calls on Sunday evenings listening to the ringers practise, and she knew the anatomy of the sound. A low hum note. The prime above it. And above that, the tierce, the minor third that every church bell carries in its throat, the interval that makes bells sound like grief. A bell’s partials are not harmonic in the way a plucked string’s are. They are the fingerprint of one particular bronze profile, refined over six centuries of founders’ craft, of tuning on a lathe until the metal sang a minor chord. No magnetohydrodynamic mode in any machine ever built had any business ringing a minor third.

Nobody in the control room spoke. Somebody at the back laughed, a high breathless sound, and stopped.

The bell tolled again. Amanda saw her own breath.

'Has the HVAC tripped?' asked the shift leader, a young woman from Hull named Jess Ostrowski, rubbing her arms.

'No,' said Tomasz. 'No, everything's... it's reading nineteen degrees in here.'

It was not nineteen degrees in here. Frost was feathering the inside of the observation window. And under the ozone-and-coffee smell of the control room there was something else, faint and sweet and wrong, like lilies left too long in a vase, like the inside of a butcher's cold store.

The bell tolled a third time.

Then the plasma went out.

It did not disrupt. Disruptions were violent: the plasma current collapsing in milliseconds, forces of hundreds of tonnes slamming the vessel, runaway electrons drilling holes in the first wall. Stellarators were less prone to them than tokamaks, but they could still end ugly. This was not ugly. Every signal on every screen simply decayed, smoothly and together, over forty milliseconds, the way a candle goes out when you pinch the wick between wet fingers. The Poincaré plot froze on its last frame. The speakers fell silent. The frost on the window began, slowly, to weep.

For a long moment no one in the room moved.

Then Jess said, 'One point nine one seconds,' in a small voice, and the room exploded. People were hugging. Somebody found the bottle of Taittinger that had been sitting in the fridge in the kitchenette for three years with a label on it reading FOR WHEN. Tomasz was pulling up the triple product, laughing, crying, saying numbers that would be in Nature by spring.

Amanda let them have it. They had earned it. She went to the operator's terminal, found the final frame of the Poincaré reconstruction, and saved it to her own drive. Then she stood looking at it while the cork went off behind her.

Gold on black. Circles in lozenges in squares. A shape that seemed, the longer she looked at it, to have more inside it than its edges allowed.

Her sternum hurt. She folded her arms tighter and did not drink the champagne.

It took five days to open the machine.

The campaign had been deuterium only, so there was no tritium to purge, but the vessel had still been bombarded with neutrons and needed a day to cool. Then it had to be brought up from ten to the minus eight millibar to atmospheric pressure with dry nitrogen, slowly, so that nothing condensed on the tungsten. Then the access port at the bottom of the third field period had to be unbolted, and a person in a hooded clean suit and a respirator had to crawl in on her belly with a torch and a camera and look at what a record had done to the inside of a star.

That person was Rhiannon Pask, CHI's lead vessel engineer, forty-three, five foot one, from Barnsley, who had been crawling about inside fusion machines since she was twenty-two and claimed to have left a Kit Kat wrapper inside JET in 2009 that was still there, for all she knew. Amanda watched the feed from her helmet camera in the control room, alone except for the night operator. The rest of the team had gone home. It was nearly midnight. She had come straight from an appointment at St James's and had not eaten.

'First wall looks lovely,' Rhiannon's voice said, tinny through the speaker. 'Barely a mark on her. Divertor tiles, lower, period three. Bit of erosion on the strike line, about what you'd expect. Moving to the toroidal break.'

The torch beam slid over grey tungsten, the dull silver of the tiles, the black geometry of the diagnostic ports.

Then it stopped.

'Amanda.'

'I'm here.'

'There's summat on the divertor.'

The camera steadied. The torch found it.

It was a box. A cube, perhaps nine centimetres to a side, sitting squarely on the lower divertor tile at the exact centre of the strike line, as if someone had placed it there with care. Its faces were black lacquer, polished so deeply

that the torchlight seemed to sink into them like a stone into a well. Across every face ran an inlay of gold, or brass, or something that looked like both: lines and arcs and nested circles, lozenges within squares within lozenges.

'Rhiannon,' Amanda said, and found that her mouth had gone dry. 'Don't touch it.'

'I wasn't going to bloody touch it. Amanda, how did it get in here? We were at ten to the minus eight. Owt in here at shot time would've outgassed and wrecked the vacuum. And it's sat on the strike line. That's ten megawatts a square metre. It'd be slag. It'd be gas.'

It was neither. It was pristine. There was not a scratch on the lacquer, not a fleck of redeposited tungsten on the gold.

'There's a thermocouple on that tile,' Amanda said. 'What's it reading?'

A pause while the night operator checked. He was a quiet lad from Otley who had been with them a year. When he spoke his voice was odd. 'Minus six, Dr Hariette-Scott. The tile next to it's reading nineteen.'

'Bag it,' Amanda said. 'Gloves, double bag, bring it out. Clean room two. Don't put it down anywhere else. Don't show anyone.'

She was waiting in clean room two when Rhiannon came through the airlock with the double-bagged cube held out in front of her like something that might go off, and set it on the steel bench, and stepped back.

'It's cold,' Rhiannon said. She was rubbing her fingers through the gloves. 'It's cold right through the bags, Amanda. It's like it's been in a freezer. It's like it wants to be somewhere colder.'

'Go home, Rhiannon. Thank you. Don't talk about this to anyone yet.'

Rhiannon looked at her for a long moment, the way people had started looking at her these last few months, as if they could see something under her skin that she had not told them about. Then she nodded and went.

Amanda put on fresh nitrile gloves. She opened the outer bag and the inner bag, and she lifted the box out, and held it in both hands under the white clean-room lights.

It weighed less than she expected, and more. The cold soaked through the nitrile at once, a deep and searching cold that did not stop at the skin but went into her fingers, her wrists, travelled up the long bones of her forearms like water up a wick, and settled, at last, in her sternum.

And the pain stopped.

For seven months there had not been a waking hour without it. A dull drilling ache in her breastbone and lower spine, sharpening on stairs, flaring when she coughed, gnawing at her in the small hours when the morphine wore thin. She had learned to talk through it in board meetings and smile through it at investor dinners. It had become the weather of her body.

Now it was simply gone. As if someone had reached inside her and switched it off.

She stood there a long time, holding the box, breathing.

Then she looked down at the lid, at the pattern of gold on black: the circles nested in lozenges, the lozenges in squares, the lattice that repeated at three scales at once. She had seen that pattern before. She had saved it to her own drive five days ago, at 01:49 in the morning, while the champagne went off behind her.

It was the last frame of shot 40117.

2

BEXLEY WING

EIGHT HOURS BEFORE Rhiannon Pask found the box, Dr Ananya Rao had turned her monitor round so that Amanda could see her own skull.

They had known each other for four years now, long enough to have dispensed with most of the rituals. Rao did not ask how she was feeling, because she knew Amanda would tell her in units. Amanda did not ask Rao to soften anything, because Rao had never once tried. It was the best relationship Amanda had with anyone in a white coat, and she suspected that was because Rao, like her, believed that people could bear almost anything except being lied to.

'Lateral skull,' Rao said. 'From Tuesday.'

Amanda leaned forward. The bone of her own cranium glowed pale on the screen, the familiar curve of it, the orbit, the jaw. And all across the vault, from brow to occiput, it was peppered with small dark holes. Round, punched-out, clean-edged. Dozens of them. Some no larger than a lentil, a few the size of a fingernail.

'Pepper-pot skull,' Amanda said.

'The older texts call it raindrop skull. I've always thought that was kinder.' Rao clicked, and the PET-CT came up: Amanda's whole skeleton rendered in translucent grey, hot spots of tracer uptake glowing like embers in a grate. 'New lesions at T11 and T12. Left iliac crest. Ribs seven and eight on the right. The vertebral one at T11 is the one I'm worried about. There's about thirty per cent height loss already. I'd like the spinal team to look at it this week.'

'And the bloods.'

'Paraprotein's thirty-one grams per litre. It was eighteen six weeks ago. Lambda light chains are just over two thousand four hundred. Corrected calcium is two point nine, so we'll give you zoledronic acid today and fluids. Creatinine is up. Haemoglobin is ninety-one.'

Amanda did the sums in her head because she could not help it. Paraprotein from eighteen to thirty-one in forty-two days. If the growth was exponential, which near enough it was, that was a doubling time of a little under eight weeks. It had been eight months a year ago. The curve was bending upward and would keep bending.

'What's left?' she said.

Rao did not look away. That was what Amanda liked about her. 'You've had everything a myeloma patient in this country can be given, and some things they can't. Induction, transplant, maintenance. The daratumumab combinations. CAR-T, which bought you eighteen good months. Two bispecifics. There's a phase one trial at the Christie, a new trispecific, but your renal function puts you outside the criteria, and if I'm honest, Amanda, I don't think your marrow would tolerate it if it didn't.'

'Give me a number.'

'I can give you a median from a cohort that doesn't really contain anyone like you.'

'Give me that, then.'

'Three to five months. If we get the calcium and the spine under control, spring is possible. I'd be lying if I said summer.'

Amanda nodded. She found, somewhat to her surprise, that she felt nothing very much. The feeling would come later, she supposed, at three in the morning, as feelings did. For now there was only the clean cold satisfaction of an answer. She had always preferred a bad number to no number.

'Thank you,' she said.

'I'll refer you to palliative care. Not because we're stopping. Because they're very good at pain, and you're in more of it than you let on.'

'I'm not in any pain I can't do arithmetic through.'

'That is not the clinical threshold, Amanda.'

Amanda laughed, which hurt her sternum, which made her laugh again.

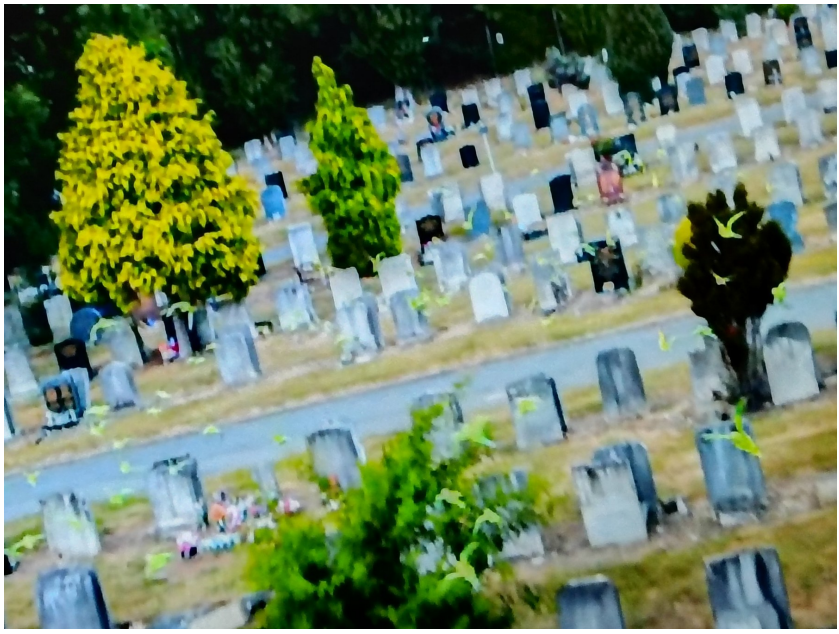
On her way out a nurse she did not recognise looked up from the desk and said, 'Bye, Dr Hariette-Scott, take care, love,' without any hitch, without the half-second pause that she had learned to listen for in her twenties and had stopped listening for somewhere in her thirties. Four years ago, at her first appointment, the hospital system had still carried an old record with a name and a title that had not been hers for two decades. Rao had seen it on screen before Amanda did, and without a word had picked up the phone to medical records and stayed on hold for forty minutes until it was gone. Amanda had never thanked her for it. She was not sure Rao knew she had noticed.

The Bexley Wing faced Beckett Street across four lanes of traffic, and on the other side of Beckett Street the dead of Victorian Leeds lay in rows under the sycamores.

Amanda crossed at the lights and went in through the iron gates. She had done this after every appointment for four years. Her driver, a former soldier from Castleford called Marcus Fenby who never asked questions, knew to wait.

Beckett Street Cemetery had opened in 1845, one of the first municipal burial grounds in England, sixteen acres of sloping ground on the edge of what had then been fields. In the century that followed, the town had buried a hundred and eighty thousand people in it. Most of them had been poor. The rich had their family plots up at the top of the slope, granite obelisks and weeping angels, but the poor went into public graves: deep shafts, twenty or thirty strangers stacked one above another, and when the shaft was full the parish put up a single stone and cut all their names into it, as many as would fit.

She walked the path between the rows. It was grey and damp, the sky the colour of a tin bath. Two golden cypresses stood among the headstones, their foliage so vivid a yellow-green against the dark sycamores behind that they looked like someone had over-saturated the photograph. Plastic flowers in faded pinks and blues sat on a few of the newer graves. Somewhere a magpie was complaining.



She stopped at one of the public stones, as she always did. The lettering was worn almost smooth. She read it with her fingertips as much as her eyes.

Mary Ann Holroyd, aged 3 years. Thomas Pickles, aged 41 years. Hannah Firth, aged 11 months. James Holroyd, aged 6 years. Sarah Ellen Dawson, aged 19 years.

And on, down the face of the stone, twenty-two names. Children, mostly. Cholera, she supposed, or typhoid, or measles, or the scarlet fever that had swept through the back-to-backs of the Bank and Mabgate every few winters. Things that were nothing now. Things that a course of antibiotics, a vaccine, a clean water main would have made nothing.

That was the arithmetic of progress, and she had always loved it. A child in Leeds in 1849 had a one-in-five chance of not seeing her fifth birthday. A child in Leeds now could expect to see eighty. Every one of those names on the stone was a problem that had since been solved by someone very like Amanda: someone patient and stubborn and good with numbers, who had refused to believe that the way things were was the way they had to be.

And yet. The arithmetic only ever ran one way. It did not reach backwards to Mary Ann Holroyd, aged three. And it would not, quite, reach

forwards in time for Amanda Hariette-Scott, aged fifty-one. Some problem-solver in Cambridge or Shanghai or Bangalore would crack myeloma in ten years or twenty, and children in some future Leeds would hear the word and think of it as a thing their great-grandparents had died of, like cholera. She hoped so. She genuinely did. She would simply not be there.

She was not, she thought, afraid of being dead. Being dead was a state of affairs, and states of affairs did not trouble her. What she minded, with a ferocity that sometimes kept her up until dawn, was that she would stop *knowing*. That the universe would go on doing interesting things and she would not get to see them. That there would be a first fusion power station on the grid, and a first child born on Mars, and a first clear photograph of an exoplanet's surface, and she would be under the ground like Mary Ann Holroyd, unable even to read the headlines.

It seemed to her a monstrous waste of a good observer.

She had been born four miles from here, in Harehills, in a red-brick through-terrace on a street off Roundhay Road where the sky at night was the colour of a sodium lamp. Her mother had worked a fabric stall in Kirkgate Market for thirty years and could tell silk from polyester blindfolded by the sound it made when you rubbed it between finger and thumb. Amanda had grown up under that market's iron roof, doing her homework on bolts of cotton, learning to count change before she could read.

She had not seen the stars properly until she was eleven. A school trip to Malham, a youth hostel, and one teacher who had taken the strange quiet kid out onto the limestone pavement after lights-out because the kid would not stop asking questions. Amanda had lain on her back on the cold clints and looked up and seen, for the first time, the Milky Way: not a smudge, not a rumour, but a river of light pouring from one horizon to the other, so dense with stars that it seemed to have texture, to have depth, to be falling towards her. She had cried, and not been able to explain why, and the teacher had sat beside her and not asked.

She had known other things about herself by then, too, though she had not had the words for them yet. The words had come later, at Leeds, where she had read physics in the labs behind the Parkinson Building and spent her evenings in the library reading everything she could find, the clinical papers, the memoirs, the furious pamphlets, assembling an understanding of herself the way she assembled everything: from evidence.

She had told her mother at twenty-two, in the kitchen in Harehills with the radio on. Her mother had listened to the whole thing in silence, smoothing a bolt of seersucker on the table with both hands, and then she had said: 'Well, you'll want to borrow my good coat, then, love. Yours is a disgrace.' And then she had cried, and then they both had, and then they had gone to the market together on the Saturday and her mother had held up fabrics to her face in the strip light to see which colours suited her, as matter-of-fact as if she had been doing it all her life. Purple, her mother had decided. Purple and black, with your colouring. Never pastels. You've got a face for jewel tones.

Amanda had worn purple ever since.

The surgery had come three years after that, in a clinic in Brighton, paid for with the first royalty cheque from a patent on a magnetic diagnostic she had invented as a doctoral student at Culham. She remembered the surgeon's warm, dry hands. She remembered waking afterwards into an unfamiliar quiet, a feeling she had never been able to describe to anyone who had not felt it: not happiness, exactly, but *correctness*. The sensation of a long calculation finally coming out.

She had learned something from all that, something she had never quite been able to say to anyone who was not trans, because it sounded either trite or mad. It was this: the body was a hypothesis, not a verdict. It was a first draft. You could argue with it, with endocrinology and surgery and will and the patient, unglamorous labour of years, and if you were stubborn enough and lucky enough, you could win the argument. She had won. She had made herself, with care and against advice, out of what she had been given.

And now her body was arguing back.

There was a joke in it somewhere, and she had found it years ago in the history of her own field. In 1928 Irving Langmuir, working on ionised

gases at General Electric, had named the fourth state of matter plasma, after the plasma of the blood. He had thought the way the ionised gas carried its charged particles resembled the way blood plasma carried its cells. Both words came from the Greek. *Plasma*: a thing moulded, a thing formed.

She had spent her whole career learning to mould one kind of plasma. The other kind was now moulding her. Her own plasma cells, the antibody factories of her bone marrow, had gone rogue and were now pouring out a single useless antibody by the gram, crowding out her blood, dissolving her bones from inside, cutting neat round holes in her skull like a pattern punched into tin.

She stood by Mary Ann Holroyd's stone until her fingers were numb, and then she went back across Beckett Street to the car.

'Thorp Arch, please, Marcus,' she said. 'They're opening the machine tonight.'

She took the box home with her at half past two in the morning, in the passenger footwell of her own car in a lead-lined sample case, against every protocol CHI had and several she had written herself.

The house was a big Victorian villa on the edge of Roundhay Park, bought with the money from the Series C and far too large for one person. She lived in about a third of it. The largest room, the old billiard room at the back, she had turned into her own laboratory, and it was the only room in the house that looked lived in. Bookshelves rose to the ceiling on two walls, crammed and double-stacked, physics and history and poetry and paperback detective novels jammed in sideways where there was room. In one corner squatted the first high-temperature superconducting test coil she had ever wound, a thick stack of copper-banded pancakes like a beehive, retired now and used as a side table. A workbench ran along the window, cluttered with oscilloscopes and a terminal. On the wall above it hung a plasma globe she had been given at the age of twelve, still working, still throwing out its slow violet filaments towards anyone who came near. Beyond the window the old cedars of the park moved black against the orange sky.



She set the box on the bench under the lamp. Took off her coat. Sat down.

The pain had not come back. All the way home, through the fog on the A58, past Wetherby and Collingham and the dark fields, she had waited for it. It had not come. She felt light. She felt, absurdly, *well*, in a way she had not felt for a year: as if someone had taken a heavy pack off her shoulders and she kept reaching back to check that it was gone.

She did not touch the box again. She looked at it for a long time, at the gold lines on the black lacquer, at the pattern that was the last frame of shot 40117, and she thought very carefully about what she knew and what she did not know.

She knew that the object could not have entered a sealed vacuum vessel. She knew it could not have survived a strike line at ten megawatts per square metre. She knew it was colder than its surroundings and that this

was thermodynamically impermissible for a passive object. She knew its surface bore a pattern identical, as far as she could see by eye, to a magnetic topology that had existed in her machine for perhaps two hundred milliseconds. And she knew that holding it had stopped seven months of bone pain in an instant.

She did not know what any of that meant. But she knew how to find out. She would do what she had always done. She would measure it.

She went to bed at four, in the narrow single bed she had moved into the laboratory months ago so that she would not have to climb the stairs, and she fell asleep at once, without morphine, without pain, for the first time since the spring.

She dreamed of a corridor of grey stone, very long, lit from nowhere. She dreamed of a sky above it that was not a sky, and in that sky something vast and bright and turning, slowly, like a lighthouse lens the size of a moon. And somewhere far away down the corridor, so far away that it might have been in another century, a bell began to toll.

It rang a minor third.

3

ISOTOPES

THE FIRST EXPERIMENT she performed was on herself.

She woke at nine with the light coming grey through the cedars and no pain anywhere, and she lay for a minute savouring it before her mind caught up and began, as it always did, asking questions. Was the effect local or systemic? Was it decaying? Was it a function of contact, or of distance?

So she got up, put on her dressing gown, fetched a surveyor's tape from the drawer, and measured.

She set the box on the bench and walked away from it in half-metre steps, stopping at each mark to close her eyes and score her bone pain on the ten-point scale that palliative care nurses always asked for and that she had always privately despised as unquantitative. At half a metre: zero. At one metre: zero. At two metres: zero. At two and a half metres a faint familiar pressure crept into her lower spine. At three metres it was a two. At four, standing in the doorway to the hall, it was a five and her sternum had begun its old drilling ache, and when she walked back to the bench it faded again as she approached, smoothly, like the volume being turned down on a radio.

She plotted the numbers on the back of an envelope. They did not follow an inverse square law. They followed something much steeper, a sharp edge at about two and a half metres, almost a step function. As if the box projected a sphere of influence with a definite boundary. As if she stood, when she was near it, inside some other set of rules.

She wrote *2.5 m* on the envelope and underlined it twice. Then she made coffee and rang the two people she trusted most in the world.

Ifeoma Okafor arrived first, in a long camel coat with her braids up and her phone in her hand, looking as she always did as though she had come from three meetings and was going on to four. She was CHI's chief operating officer, a former Rolls-Royce nuclear engineer from Chapeltown who had grown up eight streets from Amanda and been to the same Saturday science club at the old Leeds Museum. She was the only person at Cydonis who knew about the myeloma. She had found out by accident, two years ago, by seeing an appointment letter on Amanda's desk, and she had never once mentioned it in front of anyone else.

Tomasz came twenty minutes later with his laptop bag and the haggard look of a man who had not slept. He had grown up in Gdańsk and done his doctorate at Greifswald on the Wendelstein diagnostics before Amanda poached him, and he was, she thought, the best experimental plasma physicist in Europe. He was also a practising Catholic, which she had always found charming and had never thought much about until he walked into her laboratory, saw the box on the bench, and crossed himself.

'I didn't know you still did that,' she said.

'Neither did I.' He set down his bag without taking his eyes off the cube. 'I dreamed about it, Amanda. Last night. I dreamed about a bell.'

Amanda said nothing about her own dream. She showed them the final Poincaré frame on her terminal and the photograph she had taken of the lid, and then she overlaid one on the other and ran a two-dimensional cross-correlation.

The coefficient came back at 0.997.

Ife looked at the number for a long time. Then she said, 'Right. Who else knows?'

'Rhiannon. The night operator. The two of you.'

'And the board?'

'Not yet.'

‘Amanda, we have obligations. We hold government contracts. We have the List X site accreditation. There are people in Whitehall whose actual job is to be told when something like this…’

‘Something like what, Ife? A box?’

‘A box that turned up inside a sealed fusion vessel.’

‘We don’t know that it turned up. We don’t know anything. That’s precisely my point. Give me a month to characterise it properly before we hand it to people who’ll lock it in a basement at Porton Down and never publish a word.’

Ife’s jaw set. She looked at Amanda, and then away, and then back again, and when she spoke her voice was lower. ‘You haven’t got a month to spare, love.’

It was the first time in two years Ife had said anything about it at all. Tomasz looked between them, puzzled.

‘Then I’d better not waste any of it arguing,’ Amanda said gently. ‘Three weeks. Then we tell the board and we tell Whitehall. I’ll put it in writing.’

Ife held her gaze a moment longer. Then she sighed, and took off her coat. ‘Three weeks. And I’m co-signing every sample request.’

They ran the tests over the following fortnight, in CHI’s materials laboratory at Thorp Arch and in borrowed hours at three universities whose instrument managers owed Amanda favours and did not ask why their samples came labelled only with numbers.

The box weighed 418.3 grams on a calibrated balance in still air. That, at least, was ordinary. It did not change in vacuum or under argon. It did not change with orientation. It was the last ordinary measurement they made.

Its temperature was minus six degrees Celsius and it stayed there. They put it in a calorimeter and found it absorbing heat from its surroundings at a steady 3.1 watts, hour after hour, day after day, a constant thermal drain with no corresponding rise in its own temperature and no radiation coming out the other side. Tomasz did the arithmetic on the whiteboard with a hand that was not quite steady: three watts was not much, but it was not nothing, and it had to be going somewhere. The first law of thermodynam-

ics did not permit energy to vanish. It could only leave. And there was nowhere in the box for it to leave to.

'It's drinking,' Ife said, looking at the trace. 'It's like a mouth.'

The surface analyses were stranger. X-ray fluorescence showed the inlay to be a gold-silver-copper alloy, about eighteen carat, consistent with eighteenth-century European goldsmithing. The lacquer was not Japanese urushi but a French imitation of it, a copal varnish built up in dozens of thin coats and polished between each, a technique called *vernis Martin* after the brothers who had perfected it in Paris in the 1730s. The black pigment beneath was bone black: charred bone, ground fine. That much was mundane, if old. But when the instrument manager at the York proteomics facility ran a collagen peptide fingerprint on a speck of the pigment, to identify what animal the bone had come from, the result came back unambiguous.

Homo sapiens.

Nobody said anything for a while after that.

The micro-CT was worse. They had put the box on the rotation stage of an industrial scanner at Sheffield and taken three thousand X-ray projections through it from every angle, which should have let the software reconstruct its interior in three dimensions down to the scale of a few microns. Tomasz brought the results to Amanda's house in the evening on a hard drive, and when he plugged it in his hands were shaking.

'The reconstruction won't converge,' he said.

'Noise?'

'No. Look.' He pulled up the sinogram, the raw stack of projections laid side by side, and pointed. 'There are consistency conditions. Helgason and Ludwig. For any real object, any actual distribution of matter in three-dimensional space, the projections have to satisfy certain integral relations among themselves. It's a theorem. It isn't optional. The projections from this angle and the projections from that angle have to agree on certain moments, or there is no object that could have produced them.'

'And they don't agree.'

'They don't agree. Amanda, there is no three-dimensional distribution of matter that could cast these shadows. The Radon transform has no inverse for it. It's like...' He searched for the words. 'It's like photographing a

room from the north and the south and finding that the two photographs show different numbers of chairs.'

They forced a partial reconstruction anyway, using an iterative algorithm that tolerated inconsistency, and stared at the slices for hours. Near the surface the box was what it appeared to be: lacquered wood over a frame of brass, its faces divided by hairline seams into sliding panels, with a mechanism inside of exquisite and ancient precision. Tiny gears, cut by hand. Springs of blued steel finer than a hair. Pins and detents and wards like the inside of a lock.

But deeper in, the reconstruction began to fold. The mechanism did not stop where the box stopped. It went on, inward, getting finer and denser and more intricate, a lock within a lock within a lock. Tomasz summed the voxels the algorithm assigned to internal structure and came back with an interior volume of 1,940 cubic centimetres.

The box's exterior volume was 729.

The isotopes came last, because they required destroying a piece of it, and that took a long argument.

In the end Amanda allowed a single scraping, fifty micrograms of material, taken with a tungsten carbide blade from inside one of the hairline seams where it would not show. The technician who took it, a careful young woman at the Leeds isotope laboratory, reported afterwards that the blade had come away with its edge rolled over, as if she had been cutting granite. And when Amanda examined the seam under a stereo microscope that evening, she could find no mark at all where the material had been taken.

The results came back on the first of December.

The copper in the inlay had a delta-sixty-five value of plus four hundred and twelve per mil. Amanda read the number twice. Natural copper on Earth varied by a few parts per thousand, a range of maybe twenty per mil from the most extreme ore deposit to the most extreme meteorite. Plus four hundred and twelve was not an unusual sample. It was not from anywhere.

No geological process in the Solar System could fractionate copper isotopes that far. It was like finding a stone whose density was a tenth that of air.

The lead from the solder joints was worse. Lead isotope ratios were a clock: the uranium and thorium in a rock decayed over billions of years into particular isotopes of lead, and from the ratios you could calculate when the lead had been separated from its parent. Every lead ore on Earth gave an age less than four point five seven billion years, because that was when the Earth and every other body in the Solar System had formed.

The lead in the box gave a model age of six point one billion years.

It was older than the Sun.

And the wood. They had sent three subsamples of wood for radiocarbon dating, from three different panels. The accelerator mass spectrometry lab in Oxford, who had been told nothing, returned three dates and an email with the subject line *Please check your sample labelling*. The first panel gave a calibrated age of AD 1784, give or take twenty years. The second contained no detectable carbon-14 at all: radiocarbon dead, older than fifty thousand years. And the third contained more carbon-14 than any wood that had ever grown on Earth. More than the atmosphere had held in 1963 at the very peak of the bomb tests, when every living thing on the planet had briefly been made faintly more radioactive by the fallout of the Cold War.

Three panels. Three ages. One box.

Amanda sat at her bench that night with the reports spread around her and the box at her elbow, inside its two-and-a-half-metre sphere of painlessness, and she thought: it is not that this object is old, or new. It is that it does not belong to any one time at all. It has been assembled out of pieces of many times. Like a collage. Like a patchwork quilt run up out of offcuts from her mother's market stall: silk from one bolt, seersucker from another, a scrap of brocade from a bolt sold off forty years ago.

Her researches into its history took her, of all places, five miles down the road.

The British Library kept its northern storage site at Boston Spa, a short drive from Thorp Arch across the Wharfe: three hundred kilometres of shelving in a low hangar in the fields, sixty million items in the dark. Amanda had a reader's pass. She spent two afternoons in the reading room there, among the thin late-autumn light and the humming dehumidifiers, requesting things from the stacks and waiting for them to come up.

She searched the catalogues for automata makers, for puzzle boxes, for French marquetry and *vernis Martin*. She found, eventually, a name. Lemarchand. Philippe Lemarchand, a maker of toys and singing birds and automata, working in Paris in the reign of Louis XV, whose clockwork nightingales had been prized at Versailles and of whom almost nothing else was recorded. One auction catalogue from 1891, privately printed for a sale of the effects of a Bradford wool merchant, listed among the lots:

Lot 214. A puzzle box after Lemarchand, black lacquer with gilt inlay of geometric design, the panels sliding to reveal further panels. Very fine. The mechanism unsolved.

Beside it, in the margin of the library's copy, someone had written in brown ink in a slanting Victorian hand: *Withdrawn from sale at the request of the family.*

And beneath that, in a different hand, smaller and more hurried, the ink blotted as if the writer had pressed hard enough to tear: *Do not solve it.*

She found other things. Fragments. A footnote in a 1920s study of English occultism referring to a 'configuration' prized by a circle of Edwardian sensation-seekers who believed it opened a door to what they called the further regions of experience. A clipping from the Yorkshire Post in 1921, a short paragraph on an inside page: the family of a former officer of the King's Own Yorkshire Light Infantry, a Captain Elliot Spencer, decorated at the Somme, appealing for information about his whereabouts. He had been missing since the spring. He had last been seen at his lodgings in Leeds. Among his effects, the paragraph noted, there had been a quantity of foreign curios collected during his service.

Amanda photographed the clipping on her phone without quite knowing why.

She was a physicist, and she did not believe in doors to the further regions of experience. She believed in measurements. But she had a box on

her bench whose interior was larger than its exterior, whose lead was older than the Sun, which drank heat like a mouth and silenced the cancer in her bones, and she was beginning to understand that she might have to widen her definition of what counted as a measurement.

That night, at her bench, she picked it up again.

She had not meant to. She had meant only to look at the seams under the lamp. But her fingers found the lid on their own, the way a tongue finds a missing tooth, and they rested on one of the golden lozenges, and she felt it give, very slightly, under the pad of her index finger. A detent. A spring under tension.

She should have stopped. She did not stop. She pressed.

The lozenge slid a quarter of an inch to the left, with a click so small and so precise and so beautiful that she felt it in her teeth. Beneath it was more gold, a new line, a curve that had not been visible before. Somewhere inside the box a mechanism turned over, tick by tick, unfolding through a volume that was not there.

On the wall above her bench the plasma globe flickered. Every one of its violet filaments, which for forty years had reached towards whatever hand came near, swung round together and pointed at the box.

The temperature in the room dropped. She saw her breath.

And very faintly, so faintly that it might have been the blood in her own ears, so far away that it might have been ringing in another century, she heard a bell.

She put the box down. Her hands were shaking. She pushed her chair back two and a half metres, and then three, and then four, until her spine began to ache again, and the ache was almost a relief.

It was a lock, she understood. All of it. Every sliding panel, every hidden gear, every nested chamber of that impossible interior. A lock built out of geometry, which opened when a particular configuration was achieved.

And her machine, her beautiful stellarator, twisting its field lines through rational surface after rational surface in pursuit of the perfect bottle for a star, had stumbled on the first step of the combination. It had

knocked. And something on the other side had answered by sending the key.

4

RATIONAL SURFACES

DECEMBER CAME IN hard and black, with sleet off the Pennines and the Aire running high and brown under Crown Point Bridge, and Amanda Hariette-Scott had the most productive month of her life.

She carried the box everywhere. She had a case made for it, a slim satchel of black leather lined with lead foil, and she kept it on her lap in the car and on the floor between her feet in meetings and on the bedside table at night, never more than an arm's length away, and inside its two-and-a-half-metre sphere she worked without pain. She worked fourteen hours a day. She signed off the Wharfe-3 coil procurement. She rewrote, alone, in a week, the transport model that a team of six had been failing to finish for a year. She sat at her bench in the billiard room until three in the morning with the plasma globe throwing violet light over her hands, and she felt as she had felt at twenty-five, after Brighton, when the long calculation of her own body had finally come out: correct. Awake. Herself.

She knew perfectly well what this was. It was a drug. She was keeping a strange object close to her body because it took her pain away, and she was not asking hard enough what it wanted in return. She knew how that sounded. She had sat on enough ethics panels to recognise a dependency when she saw one.

But she was also, for the first time since she had found the box, beginning to understand it, and understanding had always been the strongest drug she knew.

The key, as she had begun to think of it, lay in shot 40117.

She had gone back to the raw magnetics and rerun the field-line tracing herself, at a resolution twenty times finer than the real-time display, letting her own code chew through the reconstruction for nine days on CHI's cluster. When the Poincaré plot finally resolved, she saw what she had only half seen in the control room that night. The island chains that had bloomed in the plasma's final half-second had not been random. Their rotation numbers formed a sequence. Three over five, the designed edge chain. Then five over eight. Eight over thirteen. Thirteen over twenty-one. Twenty-one over thirty-four. And on, inward, finer and finer, fifty-five over eighty-nine, a hundred and forty-four over two hundred and thirty-three, until the resolution of her code gave out.

The ratios of successive Fibonacci numbers. The convergents of the golden mean.

She sat back from the screen and laughed out loud, alone in the billiard room at two in the morning, because she knew this. Every plasma physicist knew this. It was the deepest result in the whole mathematics of confinement.

In any magnetic bottle, in any Hamiltonian system at all, the flux surfaces were not equally strong. The surfaces whose rotation numbers were rational broke first, the moment you perturbed them, shattering into island chains. The surfaces whose rotation numbers were irrational held on longer, because an irrational surface never repeated itself and so could never resonate with a disturbance. But some irrationals were more irrational than others. Some could be approximated very closely by fractions and broke easily. And one number in all of mathematics was the hardest to approximate by fractions, the most stubbornly, nobly irrational of them all: the golden mean. Its continued fraction was all ones, forever. Its fractions converged on it more slowly than any other number's could.

Which meant that, as you perturbed a magnetic field harder and harder, the very last flux surface to survive, the final wall between ordered confinement and total chaos, was the one whose rotation number was the golden mean. Kolmogorov, Arnold and Moser had proved that it existed. Greene

had calculated exactly when it broke. When it went, the field lines from the core of the plasma could wander, unimpeded, all the way to the wall.

The last barrier. The final torus. The thinnest wall there was.

She turned the box over in her hands, looking at it with new eyes. It had six faces. Each face was divided into panels. Each panel had a finite number of positions. She had been mapping them for a fortnight, cataloguing which moves the mechanism permitted and which it resisted, and now she saw the pattern. Each permitted configuration corresponded to one of those convergents. The box was not merely a lock. It was a lock that walked, step by careful step, down the Fibonacci ladder towards the golden mean.

And the final configuration, the one at the bottom of the ladder, the one that her machine had only begun to approach before the plasma went out, was the breaking of the last surface. The opening of the thinnest wall in the universe.

She did not know what was on the other side of it. She found that she very badly wanted to.

Tomasz knew what she was doing, and it was making him ill.

He came to the house on the ninth of December, grey-faced, his eyes bruised with sleeplessness, and stood in the doorway of the billiard room without coming in.

'I hear it at mass,' he said. 'At St Anne's. During the consecration, when they ring the sanctus bells. I hear the other bell underneath it. The minor third. Every time.' He swallowed. 'Last night I dreamed I was in a corridor, and there was a man at the end of it, a long way off, standing very still. Dressed in black. I couldn't see his face. But I could see that his head was... that there was something wrong with his head. Something in a grid.' He touched his own scalp, as if to check it. 'And I knew that he was waiting for you.'

'For me?'

'Not for me. Not for any of us. For you, Amanda. I knew it the way you know things in dreams.'

She did not tell him that she had had the same dream. That she had had it every night for a week. That in her version of it the man at the end of the corridor had turned his head, very slightly, as if listening for something, and the light had caught on the heads of the pins.

'Destroy it,' Tomasz said. 'Please. Put it in the vessel and run a shot through it at full power. Put it in a furnace. Drop it in the sea off Flamborough Head. Give it to the government and let them bury it under a mountain. I don't care. But stop solving it.'

'I'm not solving it, Tomasz. I'm studying it.'

He looked at her for a long time, at the case on the bench beside her, at her hands, which had been resting on the box without her quite noticing.

'I don't think you know the difference any more,' he said, and left.

The board met at Wellington Place on the twelfth, in the glass-walled meeting room on the eleventh floor with its view east over the railway viaduct to the dark mass of the Minster and the Corn Exchange beyond. Amanda chaired. The box sat in its leather case at her feet.

She knew something was wrong the moment she saw Julian Haldane's face.

Haldane sat on the board for Haldane Rourke Capital, the London and Dubai fund that had led the Series C and held twenty-two per cent of CHI. He was in his early sixties, tall, silver-haired, beautifully tailored, with the soft voice and lizard stillness of a man who had made his fortune buying companies at the moment of their greatest weakness. He was also, Amanda knew, a collector. Everyone in the investment community knew about Haldane's collection: Etruscan bronzes, medieval reliquaries, Elizabethan alchemical manuscripts, a cabinet of curiosities in his flat at Leeds Dock that he showed only to people he wanted something from. There were rumours about the less presentable parts of the collection. There were rumours about Haldane, too: about the private clubs in Mayfair and Marrakech, about appetites that had grown jaded and expensive. Amanda had always found him faintly reptilian and had never let it affect her judgement of his money.

He let her get through the operational update. He let Tomasz present the shot 40117 results, which were greeted around the table with something close to awe. He waited until any other business, and then he folded his hands on the table and said, in his soft voice:

'Before we close, Chair, I think the board needs to discuss the question of leadership continuity.'

The room went still.

'I've received information,' Haldane went on, not looking at her, looking at the rest of the board, 'that our Chief Executive has been receiving treatment for a serious illness. A terminal illness, I'm told. For some years. Information that was not disclosed to this board, despite its obvious materiality to the company's valuation, to the key person insurance, and to the fiduciary duties of every director at this table.' Now he looked at her. His eyes were pale grey and perfectly calm. 'I'm very sorry, Amanda. Truly. But the market will not wear a dying CEO. And I'm afraid I cannot support the proposal you circulated last week to release the Wharfe stellarator design under an open licence. Not when the person proposing it may not be here to see the consequences.'

There was a long silence. Amanda felt every eye in the room on her. She felt, too, for the first time in weeks, the absence of pain as a kind of armour.

'It's true,' she said. 'I have relapsed refractory multiple myeloma. My consultant thinks I have until the spring. I didn't disclose it because it hasn't affected my capacity to do this job, and the record of the last four years will show that. Shot 40117 will show that.' She held Haldane's gaze. 'If the board wants to discuss succession, I'd welcome it. I've been planning for it. Ife Okafor has my full confidence. But the open licence proposal stands, and I will be putting it to a vote in January, and I expect it to pass.'

Ife spoke up then, steady and cold, and so, to Amanda's surprise, did two of the independent directors. The motion Haldane had clearly been preparing to table never came. The meeting closed in an atmosphere like the aftermath of a car crash.

Haldane caught her at the lifts.

They were alone. He stood a little too close. He smelled of cedar and something sweeter under it.

'I meant what I said in there,' he murmured. 'I am sorry. But I didn't stop you to talk about the company.' His eyes went down to the leather case in her hand, and stayed there. 'Lemarchand,' he said softly. 'Isn't it?'

She said nothing.

'I've been looking for one for twenty-six years,' Haldane said. 'Since I was a young man. I've chased them across four continents. I came close in Lisbon in 2011. I was outbid in New Orleans. I have a letter in my collection, written by one of the very few people known to have solved one, describing what he saw when he did.' His voice had dropped almost to a whisper. Something had come into his face that Amanda had never seen there before: a hunger so naked it was almost embarrassing. 'I've tasted everything this world has to offer, Amanda. Everything. There is nothing left on this side of the wall that can surprise me. Name your price.'

'It isn't for sale.'

'Everything's for sale. You of all people should know that. What's it buying you? A few pain-free weeks before the end? I've read the literature. I know what it does.' He smiled, and it was a dreadful smile. 'You can't take it with you, Amanda.'

The lift doors opened. She stepped in and pressed the button, and the last thing she saw before the doors closed was Haldane standing in the corridor with his hands at his sides, watching the case with the patient fixity of a heron at a pond.

She collapsed four days later, in her own kitchen, at six in the morning.

She had gone downstairs to make coffee. The box was in the billiard room, at the far end of the house. Twenty metres. She had done it a hundred times; she had grown used to the pain coming back when she left its sphere, like stepping out of a warm room into the cold. But this time when she stepped out of the sphere the pain did not just come back. It came back with interest. As if it had been accumulating while the box held it off, like water behind a dam, and now the dam had a hole in it.

She remembered her spine giving way, a sickening crunch somewhere below her shoulder blades. She remembered the floor tiles very close to her

face. She remembered the confusion and the terrible thirst that meant her calcium was through the roof, and fumbling for her phone, and Marcus Fenby's voice saying *I'm coming, Doctor, stay there*, and then very little.

She woke in a side room on the haematology ward at St James's with a drip in her arm and her spine in a brace and every bone in her body singing. Rao was there, and Ife, and the corrected calcium had been three point six, and the T11 vertebra had collapsed by another forty per cent, and the paraprotein was forty-four. She had lost two days.

'The box,' was the first thing she said.

Ife's face told her before Ife did.

'Somebody went into the house on Sunday night,' Ife said. 'While you were in here. They had the alarm codes. They went straight to the billiard room and they took nothing else. Not your laptop. Not your mother's jewellery. Just the case.' She held Amanda's hand. 'The police think it was professionals. I don't think we need to wonder who paid them.'

Amanda closed her eyes.

She lay in the side room for two more days while they poured saline and bisphosphonates into her and the spinal team argued about whether to operate. The pain was beyond anything she had felt before, beyond arithmetic, a white roaring that left room for nothing else. The morphine took the edge off it and took her mind with it, and she hated that more than the pain.

On the fourth night, at a quarter past one in the morning, her phone buzzed on the bedside table.

A voicemail. Julian Haldane.

She played it with shaking fingers, the phone pressed against her ear in the dark.

'Amanda.' His soft voice, thick with excitement, slurred with something, wine or worse. 'I wanted you to know. You deserved to know. Four faces in two days. You were so close, weren't you? You were so close and you were too frightened to finish it. Too *careful*. That's always been your problem. You measure things. You never just *taste* them.' A wet laugh. 'I'm on the last face now. I can feel it moving under my fingers. Can you hear it?'

And behind his voice, beneath it, rising, she could. A bell. Deep and bronze and swinging, tolling its minor third, so loud now that it distorted the phone's tiny speaker.

'I'm going to see what you were too frightened to look at,' Haldane whispered. 'Think of me.'

The message ended.

Amanda lay in the dark for perhaps ten seconds. Then she reached up and turned off the drip, and peeled the tape off the back of her hand, and pulled out the cannula, and pressed her thumb over the welling blood. She swung her legs off the bed. Her spine screamed. She ignored it.

She rang Marcus Fenby.

'Leeds Dock,' she said, when he answered. 'As fast as you can. And Marcus. Bring the big torch.'

PART TWO

The Hell Priest

5

THE HELL PRIEST

LEEDS AT HALF past one on a December morning was a city of wet orange light and empty roads. Marcus Fenby drove the big black Volvo down Beckett Street, through the lights at Burmantofts, round the back of the bus station and under the railway arches at Crown Point, faster than Amanda had ever seen him drive, and he did not ask her a single question. She sat in the back in her coat and the spinal brace and the thin blue hospital gown, a blanket over her knees, a walking stick across her lap, and watched the city slide by in the rain. Every pothole went through her spine like a nail.

Leeds Dock had been Clarence Dock once, a coal wharf on the Aire, and the old basin was still there, black water ringed by flats and offices and the angular grey tower of the Royal Armouries, where the nation kept its swords and halberds and cannon behind glass. Haldane's building stood on the far side of the basin, twelve storeys of glass and brick. His penthouse took the top floor. From the car park Amanda could see its windows, and they were the only windows in the whole building that were dark.

No. Not dark. As she watched, something moved in them. A light, very faint, blue-white, flickering the way a fluorescent tube flickers just before it dies.

'Doctor,' Marcus said. It was the first word he had spoken since the hospital. 'Whatever this is. Are you sure?'

'No,' she said. 'Help me out of the car.'

The night porter was sitting at his desk in the lobby with his eyes open, staring at nothing, a cup of tea untouched and filmed with ice at his elbow. He did not look up when they came in. When Marcus waved a hand in front of his face he did not blink. He was breathing, slowly, and there was frost on his eyelashes.

The lift was cold. The steel walls were furred with rime, and when Amanda pressed the button for the twelfth floor her fingertip stuck to it for a moment and came away stinging. As they rose she could hear it, coming down the shaft to meet them, louder with every floor. The bell. Not in her dream now and not on a phone speaker. Real, physical, shaking the cables, its hum note so deep she felt it in her diaphragm and its tierce so mournful it made her eyes water.

The doors opened on a corridor of soft grey carpet and recessed spotlights, all of them dead. At the end of it the door to Haldane's apartment stood ajar. Blue light leaked from the gap.

She made Marcus stop at the threshold.

'Whatever you see in there,' she said, 'stay by this door. Don't come in. Don't speak to anything. If I tell you to run, you run, and you don't come back. Do you understand?'

Marcus had done two tours in Helmand. He had carried men to helicopters. He looked at the blue light leaking under the door and he was trembling, very slightly, all over, like a horse that smells fire. 'Yes, Doctor.'

She pushed the door open with the end of her stick and went in.

The first thing she noticed, because she was who she was, was that the light was wrong.

It came from the far wall of the long living room, where there should have been floor-to-ceiling windows looking out over the dock. The windows were still there; she could see the black water through them, the lights of the Armouries. But in front of them, in the middle of the air, there was a seam. A vertical split in space perhaps three metres tall, its edges ragged and fibrous like torn muscle, and through it poured a cold blue-white radiance. It did not fall off with distance as light should. The far end of the room was

as bright as the near. And the shadows were wrong. They did not point away from the seam. They pointed towards it, every one of them, the shadow of every chair and lamp and Etruscan bronze in Haldane's cabinet of curiosities leaning in towards that light like iron filings towards a magnet.

The second thing she noticed was the cold. Her breath came out in clouds. The windows were thick with frost on the inside. She guessed it was fifteen below, perhaps twenty.

The third thing she noticed was Julian Haldane.

He hung in the air in the centre of the room, two metres above the Persian rug, at the convergence of a dozen chains. They came out of the seam, out of the walls, out of the ceiling, out of places in the air where there was nothing for chains to come out of, and each one ended in a hook, and each hook was sunk deep into his flesh. Through the meat of his shoulders. Through his cheeks. Through the skin of his chest and back and thighs, which had been drawn out into tents and points like canvas pegged in a gale. He had been stripped of his beautiful tailoring, or it had been stripped from him, and his body was pale and soft and old, and the chains were pulling, very slowly and in a dozen directions at once, and he was still alive.

His eyes were open. His mouth was open. He was making a sound, a high continuous sound, and she could not tell, she genuinely could not tell, whether it was agony or rapture. His face held both at once, clenched and slack, weeping and smiling, every muscle in it at war with every other. It was the face of a man who had asked for something he did not understand and was now receiving it in full.

The box lay on the rug beneath him. It was open. Not open as a box opens, with a lid: open as a flower opens, its six faces folded back and back into one another along hinges that should not have existed, revealing panel after panel of gold, a structure that kept unfolding inwards and outwards at once, turning, ticking, its inlays glowing with the same cold light that poured from the seam.

And around it, in the blue light, stood the ones who had answered.

There were three of them.

One was a woman, or had been. She was tall and pale and dressed in black leather that seemed less to cover her body than to have been grafted onto it, stitched to her skin along seams that wept a little at the edges. Her throat had been opened from jaw to collarbone and held open with an arrangement of fine steel wire and clamps, so that the inside of it was displayed like the interior of a flower, and when she breathed Amanda could see the pale rings of her trachea expand and contract.

One was shorter, broad, his whole head wrapped in a bandage of discoloured cloth, and his face was nothing but mouth. His lips had been peeled back and pinned with steel retractors, exposing every one of his teeth to the gum, and the teeth never stopped moving. They chattered. They clicked together in a continuous dry rattle, like a typewriter, like hail on a roof, like a clockwork toy wound too tight.

And the third stood a little apart from the others, closest to Haldane, with his hands folded at his waist, watching the man on the hooks the way a connoisseur watches a performance he has seen many times and still finds worth his attention.

He was tall, taller than the others, and very still. His robes were black leather, high-collared and long-skirted like a priest's cassock, and where they opened at the chest Amanda could see that they opened into him: the skin beneath had been flayed back and held with steel, and the flesh beneath that displayed. His hands were long and pale and graceful. His face was white as candle wax, and calm, and it was a fine face, the face of a man who in some other century might have sat for his portrait in uniform. And across that face and over the whole dome of his hairless skull ran a grid of incisions, deep and precise and perfectly regular, and at every intersection of the grid a nail had been driven into the bone.

She counted them before she could stop herself. Eight rows. She estimated the spacing at two centimetres. Someone had measured him very carefully.

He turned his head and looked at her.

His eyes were entirely black.

'You are not the one who called us,' he said.

His voice was not what she had expected. It was quiet and cultured and almost gentle, the vowels clipped and old-fashioned, a voice from a cut-glass

Edwardian drawing room or an officers' mess. It carried without effort. It seemed to come from very close.

'No,' Amanda said. Her own voice was steadier than she had any right to expect. 'That's him on the hooks. I'm the one who found it.'

The chattering one turned towards her and his teeth went faster. The woman with the opened throat tilted her head, and when she spoke the words came wet and whistling out of the wound rather than her mouth. 'She is sick,' the woman said. 'Smell her. She is rotten to the marrow.'

'Yes,' said the priest. He had not taken his black eyes from Amanda's face. 'I hear it. Your bones are singing, madam. There is a choir in them. Ten thousand million voices, all singing the same note.'

Amanda stared at him. 'Monoclonal,' she said, before she could stop herself. 'A single clone. A single antibody, the same molecule, over and over. One note. That's...' She almost laughed. 'That's actually a very good description.'

Something moved at the corner of his mouth. It might have been the beginning of a smile.

Behind him, Julian Haldane screamed. It was a different sound from before, higher, and Amanda made herself look. The chains had begun to pull harder. They pulled with a terrible deliberation, the care of an anatomist, not tearing but *separating*, drawing him out in every direction at once, and his body was beginning to give along lines that she realised, with a horror that went past horror into a kind of awful clarity, were the lines of his own anatomy: the planes between muscles, the seams of fascia, the sutures of the skull. They were taking him apart the way you would take apart a clock to see how it worked.

'He asked for this,' she said. It was not quite a question.

'He asked for experience,' the priest said. 'He was tired of the world. He had tasted all its pleasures and found them thin. He opened the door and asked for more. We have given him more.' He turned his head a fraction towards Haldane, then back. 'We do not deceive, madam. We only answer. Every one who opens the box has asked. Most do not understand what they are asking for. That is not our concern.'

'And you're going to take him with you.'

'He is ours now.'

Haldane's scream rose to a pitch she would hear in her dreams, and broke, and then there was only the wet sound of the chains and the ticking of the box and the bell. She did not look away. She would not give him that, she thought, whatever he had been. She would not give any of them that.

When it was done, and the chains had drawn back into the seam and the walls and the air, taking with them everything that had been Julian Haldane, there was a long silence.

'You did not run,' the priest observed.

'I can't run. I've got a collapsed vertebra.'

'You did not *wish* to run. I would know. I would smell it.' He took a step towards her, and she held her ground, leaning on her stick. Close to, she could see that the nails in his skull were not all alike. Some were old and pitted and dark, some newer and bright. They had been replaced, over time. Maintained. 'Why did you come here?'

She thought about lying. She thought, very briefly, about all the clever things she might say. Then she said the truth.

'Because it's mine,' she said. 'My machine found it. I've been studying it for six weeks. I wanted to know what was on the other side, and he stole it from me before I could find out. And I wanted to see you.' She drew a breath of freezing air. 'I wanted to see what you are.'

'Your machine.'

'A stellarator. A magnetic bottle for a star. Fifty superconducting coils.' She gestured at the box, still unfolding gently on the rug. 'Your door is a sequence of geometrical configurations converging on the golden mean. So's the last flux surface in a magnetic confinement device. When we pushed our plasma far enough, it started walking down the same ladder of fractions your box does. I think we knocked on your door by accident. I think the box came to see who was knocking.'

The priest was silent for a long time. The woman with the opened throat had drawn closer to listen. Even the chattering one's teeth had slowed.

'In three hundred years,' the priest said at last, quietly, 'I have been called by murderers and libertines, by mystics and by the merely bored. By men who wanted pleasure and men who wanted pain, and men who did not know there was a difference. No one has ever come to us by mathemat-

ics.' He tilted his head, and the light ran over the heads of the nails. 'You are a natural philosopher.'

'I'm a physicist.'

'It is the same thing. They had not yet thought to divide it when I was young.'

She looked at the grid on his skull, the precise and orderly lattice of it, and she thought of her own skull glowing on Rao's monitor, peppered with holes. Something reckless rose in her. 'Someone's been at your head with a hammer,' she said.

'And someone,' he replied, without missing a beat, 'has been at yours with a very fine awl.' He raised one long pale hand and held it near her temple, not quite touching. She felt the cold of it on her skin. 'I can feel the holes. Dozens of them. Your own body has been perforating your skull, has it not? Cutting it into a pattern. Quite without your permission.'

She did not answer. She could not. Her throat had closed.

'You are dying,' he said softly. 'Your physician has given you until the spring. You will die in a narrow bed in a room that smells of disinfectant, with tubes in your arms and your mind dissolved in opiates so that you do not feel your bones crumble. You will not be able to think. That is what you fear, madam, is it not? Not the pain. Not even the dark. The not *thinking*. The universe going on without you, doing all its interesting things, and you not there to see.'

'Yes,' she whispered.

He lowered his hand.

'There is a man's name,' she said, because she had to say something, and because she wanted to see what it would do. 'Captain Elliot Spencer. King's Own Yorkshire Light Infantry. Decorated at the Somme. Went missing from his lodgings in Leeds in the spring of 1921. Among his effects were a number of foreign curios.'

And for the first time, something happened to the priest's face. It was very small. A flicker, deep in the black eyes, like a fish turning far down in a still pond. The woman with the opened throat drew in a hissing breath through the wound.

'That man,' the priest said, after a pause, 'has been gone for a very long time.'

'He lived about a mile from here,' Amanda said. 'Hunslet, I'd guess, or Holbeck. They had lodgings for officers there after the war. He'd have walked along this river.'

'Perhaps he did.' His voice was very quiet now. 'No one has spoken that name to me in a hundred years.'

The bell tolled. The seam behind him had begun to narrow, its fibrous edges drawing together like a wound knitting. The other two stepped back into the light, and were swallowed by it.

The priest remained a moment longer.

'The box will return to you,' he said. 'It always returns to the one who will open it. And you will open it, natural philosopher. Not tonight. Not as he did, grasping and weeping. You will open it with your eyes open, knowing exactly what you are asking for. I have never seen that.' The faint suggestion of a smile again. 'I find that I should like to.'

'And if I don't?'

'Then the spring will come, and the narrow bed, and the room that smells of disinfectant. And the universe will go on without you.'

He stepped back into the light.

The seam closed with a sound like a great door shutting a long way away. The blue radiance went out. The shadows swung back to point the way shadows should. Through the windows the lights of the Armouries came back, ordinary and yellow, reflected in the black water of the basin. The bell stopped.

In the sudden silence Amanda heard the frost on the windows begin to crackle as it melted, and from the doorway behind her, the sound of Marcus Fenby being quietly and thoroughly sick on Julian Haldane's grey carpet.

The box lay on the Persian rug. Its faces had folded back together. Every panel had returned to its starting position, as if no one had ever touched it. Beside it, driven deep into the oak floorboards, was a single steel hook with a few inches of chain attached, the end of the chain sheared clean.

She bent, very slowly, her spine screaming, and picked up the box.

The pain stopped.

She stood there in the middle of the dead man's flat, holding the box against her chest, breathing in the cold air that smelled of lilies and the

butcher's cold store, and she found that she was shaking. Not with fear, though there was fear in it. With something else. Something she had felt only twice in her life before: once on the limestone at Malham at the age of eleven, looking up at the Milky Way, and once on the night of shot 40117, watching the islands bloom.

She turned round. Marcus was leaning in the doorway, wiping his mouth with the back of his hand, his face the colour of paper.

'Marcus,' she said gently. 'We were never here.'

He looked at the box in her hands, and at the hook in the floor, and then at her face. Whatever he saw there made him straighten up.

'No, Doctor,' he said. 'Never.'

6

LYTIC

JULIAN HALDANE WAS reported missing on the nineteenth of December by his housekeeper, who arrived at the penthouse at eight in the morning and found the front door open, the windows streaming with meltwater, the carpet ruined, and a steel hook driven so deep into the oak floor that it took the police two days and a hydraulic jack to get it out.

The investigation went nowhere, as Amanda had known it would. The night porter remembered sitting down at his desk at midnight and nothing after that until a cleaner shook him awake at six, hypothermic, with frost still melting in his hair. The building's CCTV had recorded fifty-two minutes of interference on every camera at once, from 01:11 to 02:03. A detective sergeant from West Yorkshire Police came to see Amanda on the ward, because Haldane's assistant had told them about the board meeting, and she lay in her bed in the spinal brace with a drip in her arm and answered his questions with perfect truthfulness about everything except where she had been between half past one and four. The nurses' notes were confused. Someone remembered her cannula having been resited. The sergeant looked at her, a frail woman with a collapsed spine and a terminal diagnosis, and closed his notebook.

Later Tomasz obtained a still from the corrupted footage through a friend at the security firm, and showed it to her without a word. It was not static. It was a pattern of gold dots on black, circles in lozenges in squares.

Haldane Rourke Capital's stake in Cydonis went into the legal limbo reserved for the property of men who disappear without dying. Haldane's

motion on leadership was never tabled. In the new year, the board would vote on the open licence for the Wharfe design, and without him there was nobody left to stop it.

Amanda found she could not feel very much about any of that. She had seen how Haldane ended. Whatever she had felt about him in life had been taken apart along with him, plane by plane, seam by seam.

The box did not stop the disease. She had known it would not. But it was still a hard thing to watch.

She went home from St James's a week before Christmas with the box in its leather case on her lap and a bag full of medication and a referral to the community palliative team. Inside her sphere of two and a half metres she felt nothing. But the numbers did not care what she felt. The paraprotein went to fifty-two. Her kidneys, clogged with light chains, were failing by degrees; the creatinine rose every week and her ankles swelled. Her haemoglobin fell below eighty and she went into the day unit at Bexley Wing for transfusions, two units at a time, sitting in a reclining chair with the box at her feet and a book of Lagrangian mechanics on her knees while the bags emptied into her arm. She had a single fraction of eight grey to the spine on the twenty-second, lying on the radiotherapy couch with the case on the floor beside the gantry, and the radiographers, who had been warned she might need help getting on and off, watched in astonishment as she climbed up unassisted.

Rao saw her pain scores on the system and called her in.

'Zero,' Rao said. 'Every day for a month. With a collapsed T11, lesions in your pelvis and ribs and a calcium that's been over three. What are you taking, Amanda?'

'Nothing you didn't prescribe.'

'Then what's happening?'

Amanda thought about it. 'A placebo,' she said, 'with an unusually large effect size.'

Rao looked at her for a long moment. Then she looked at the leather case at Amanda's feet. She did not ask. She was a good enough doctor to

know when a question would not be answered, and kind enough not to make her patient refuse.

'Whatever it is,' Rao said quietly, 'I'm glad. But it's not stopping the disease. You know that.'

'I know.'

'Are you putting your affairs in order?'

'I'm putting a great many things in order.'

She told Ife and Tomasz everything on the twenty-third of December, in the billiard room, with the curtains drawn and the plasma globe throwing its slow violet light across the bookshelves. She told them about the voicemail and the drive and the porter with frost on his eyelashes. She told them about the seam, and the light that cast shadows inwards. She told them about the hooks. She told them about the three who had answered, and what the tall one had said to her, and what she had said to him, and she told them, finally, about the name she had found in the British Library and the flicker it had raised in those black eyes.

Ife listened without moving. When it was over she got up, went to the drinks cabinet, poured herself three fingers of Amanda's whisky and drank it in one, and then she sat back down and said, in a perfectly level voice, 'Right. Then we destroy it.'

'Yes,' said Tomasz. 'Yes. Thank God. Amanda...'

'We can try,' Amanda said. 'If it'll make you both feel better, we can try. I'll design the experiment myself. But I don't think we can, and I think the trying will tell us something important about what it is.'

They did it on the twenty-seventh, in the dead days between Christmas and New Year, when the Thorp Arch site was empty except for security and the frost lay thick over the old munitions sheds.

CHI's laser laboratory occupied a long blacked-out room beside the Wharfe-2 hall. It was where they developed the Thomson scattering diagnostics: big neodymium-glass lasers that fired pulses of infrared light into

the plasma and read its temperature from the way the light scattered off the electrons. Along one side ran an optical table three metres long, a slab of honeycombed steel floating on air legs to isolate it from vibration, crowded with mirrors and lenses and beam dumps. Along the other ran the racks of power supplies and the chiller. It smelled of cold metal and ozone. It was the cleanest, darkest, most precisely controlled room Amanda owned, and she had chosen it deliberately.

They mounted the box on a kinematic stage in the centre of the table. Then they began, as she had insisted, with the gentlest possible measurement.

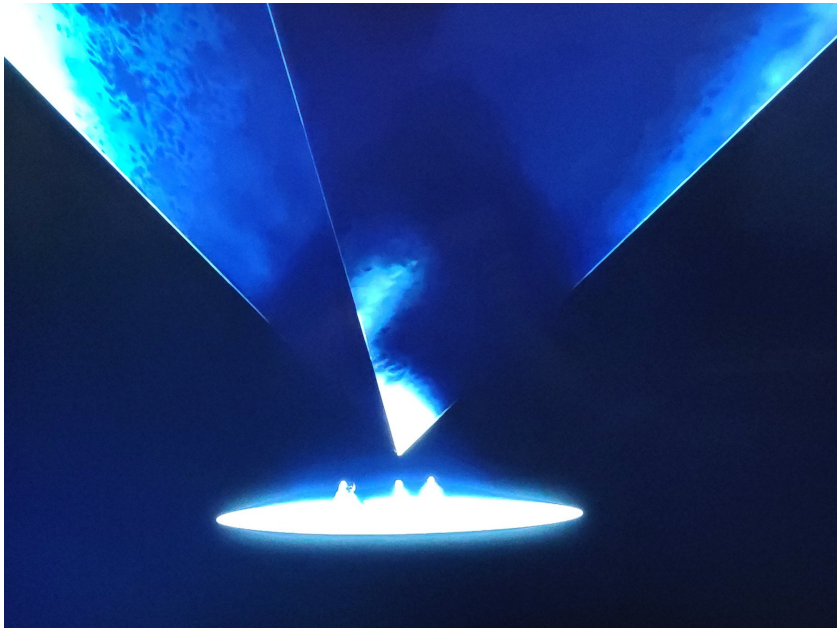
Tomasz had set up a fan of blue alignment lasers, low-power diodes at four hundred and fifty nanometres, the kind they used to trace the path of the invisible infrared beam through the optics. He angled six of them to pass the box at different distances, grazing past its faces at five, ten and twenty centimetres, and threw a little theatrical fog into the air so they could see the beams. Then he switched them on and killed the room lights.

For a moment none of them said anything.

The beams bent.

They came out of their diodes straight as rulers, six blue blades of light cutting through the haze. And as they approached the box, they curved. Not refracted, not reflected: curved, smoothly and continuously, the way the path of a comet curves as it falls round the Sun. The beams nearest the box bent hardest, swinging inward through angles of twenty degrees or more. The ones further out bent less. They converged, all six of them, on a single point a few centimetres above the box's upper face, a point so bright that Amanda had to look away from it, and then, on the steel surface of the table below, the light that had been focused through that point fell in a shape.

It was an ellipse. A long, flat, blazing white ellipse, as bright as a welding arc, lying on the table with the box at its focus like the eye of a cat. Its edges were razor sharp. Its interior glowed. And along its upper rim, small bright protrusions stood up like figures on a distant stage.



There were three of them. Amanda counted them before she knew what she was doing. One was tall and narrow. One was broad. And one stood a little apart from the others, and the top of its tiny glowing head seemed, if she looked at it very hard, to be not smooth but faceted. Spiked. Crowned.

'Caustic,' Tomasz whispered. 'It's a gravitational caustic. That's an Einstein ring seen edge-on. Amanda, that's lensing. That's the box lensing light like a galaxy cluster.'

'Measure the deflection,' she said. Her voice sounded very far away. 'At five centimetres.'

He did, with a protractor and a camera and a frightening calm. The beam that passed five centimetres from the box's centre had been deflected through just under a third of a radian.

Amanda did the sum on the whiteboard. General relativity predicted that light passing a mass M at a distance b would be bent through an angle of four times G times M, divided by c squared times b. Rearrange. Solve for M. The weak-field formula was not really valid at an angle that large, but as an estimate of the order of magnitude it would do.

She wrote the answer down and stared at it.

'Five point six times ten to the twenty-four kilograms,' she said. 'Give or take a factor of two.'

Ife, who had been an engineer for twenty years and knew her orders of magnitude, went very still. 'That's...'

'About the mass of the Earth.'

They all looked at the box sitting quietly on its stage. It weighed four hundred and eighteen grams. The optical table it rested on, a slab of steel designed to detect vibrations of a fraction of a micron, did not sag. The air legs did not deflate. The plumb line Tomasz had hung from a gantry a metre away, as a crude gravimeter, did not swing towards it by so much as a hair. Nothing in the room was attracted to it except the light.

'That's not possible,' Ife said. 'Equivalence principle. Anything that bends light bends everything. You can't have curvature that only light sees.'

'No,' Amanda agreed. 'You can't. Not in our space.' She was thinking aloud now, the way she did in seminars, the way she had not done in months. 'Unless the light isn't going through our space at all. Unless, when it comes close enough to the box, the light leaves our geometry and goes through somewhere else, and comes back out the far side. A short cut. A detour.' She looked at the white ellipse burning on the table, at the three tiny figures standing on its rim. 'It doesn't curve our space. It's a *throat*. A hole into some other space that's very, very heavy. And when light falls past the mouth of it, the light feels the weight of whatever's on the other side.'

'The Labyrinth,' said Tomasz, very quietly.

Nobody answered him.

After a while Amanda said, 'Fire the Thomson laser at it.'

They did. Five joules of infrared in nine nanoseconds, a pulse that could punch a hole through a razor blade, aimed straight at the centre of the box's face. The camera on the far side of the table, positioned to catch whatever came through or bounced off, registered nothing. The calorimeter behind it registered nothing. The thermocouple taped to the box's lacquer did not move from minus six. Five joules had gone in and nothing whatever had come out, not light, not heat, not sound. It had simply been swallowed.

They fired twenty more pulses. Each was swallowed.

It was Tomasz who finally switched the system off. He stood with his hand on the interlock key, head bowed.

'We could try Wharfe-2,' he said, without conviction. 'A full-power shot. Put it on the strike line.'

'Tomasz.' Amanda's voice was gentle. 'That's where we *found* it. It sat on the strike line at ten megawatts a square metre and came out cold. It came to us through the plasma. We can't destroy it with anything we have. I don't think we can destroy it with anything anyone has. It's like trying to burn a direction. It's like trying to break the number five.'

He nodded slowly. When he raised his head his eyes were wet.

'You're going to open it,' he said. 'Aren't you.'

She did not answer. In the silence the blue laser haze drifted and settled over the table, and the white ellipse slowly faded as the diodes cooled.

'He's a demon, Amanda,' Tomasz said. 'You saw what he did to Haldane.'

'I saw what Haldane asked for.' She took a breath. 'I don't know what he is, Tomasz. I know he was a man once. A soldier in a war that made no sense, who came home and went looking for a meaning and found that box instead. I've met worse men than that at investor dinners. I've *taken money* from worse men than that.' She smiled, a little crookedly. 'And whatever he is, he's the only being in the universe who's offered me a choice that isn't the narrow bed.'

'It isn't a choice. It's damnation.'

'You believe that. I don't believe in damnation. I believe in the second law of thermodynamics, and the second law of thermodynamics says I am going to stop. Soon.' She reached out and took his hand. 'I'm not asking you to approve. I'm telling you because you're my friend, and because I'd like you to know what happened to me when I'm gone, so that you don't spend the rest of your life wondering.'

He held her hand for a long time. Then he said, his voice cracking, 'Will you at least let me pray for you?'

She thought of the old sanctus bells at St Anne's, and the other bell beneath them.

'Yes,' she said. 'I'd like that very much.'

Rao called her in on the second of January, to go through a new skeletal survey before a final family meeting that Amanda had no family to attend.

She turned the monitor round, as she always did, and this time she was frowning.

'It's odd,' Rao said. 'I've been doing this for twenty-two years, and I've never seen a distribution like it.'

Amanda looked at her own skull on the screen. The holes had multiplied since November. There were scores of them now, perhaps a hundred, clean-edged and dark, and with the new ones filling the gaps between the old she could see, for the first time, that they were not scattered at random.

They were arranged. Not in a simple grid, but in curves and nested arcs, in lozenges and circles within squares, a pattern repeating at three different scales over the dome of her cranium. As if someone had taken a template and laid it over her skull and punched along the lines.

'Lytic lesions are random,' Rao said. 'They have to be. They follow the marrow, and the marrow doesn't have a pattern. But these look almost... arranged. Like they're converging on something.' She shook her head. 'I'll send it to the radiologists. It's probably an artefact of the reconstruction.'

'Probably,' said Amanda.

She sat in the chair with the leather case between her feet and looked at the picture of her own skull, at the gold-on-black pattern that her disease had been drawing on her for months without her knowledge, the last frame of shot 40117 cut into her bone a hole at a time. And she understood that the configuration was not only in the box.

It was in her. It had been in her all along. Her own plasma cells had been solving it.

7
CYDONIA

THE BOARD VOTED on the fourteenth of January. Seven for, none against, one abstention from the lawyer representing Haldane Rourke's frozen stake. At nine o'clock the following morning, every drawing, every coil geometry, every line of control code and every scrap of experimental data from eleven years of the Wharfe programme went up on a public repository under an open licence, free for any government, university, company or teenager in a bedroom anywhere on Earth to download, study, copy and improve.

Amanda announced it to the staff herself, standing in the old filling shed at Thorp Arch where the Wharfe-2 control room now stood, in front of the bank of screens and the laminated sign that still said PLEASE DO NOT TOUCH THE STAR. There were three hundred people crammed into the room and spilling out of the doors, and she stood in front of them with a stick in one hand and the leather case slung across her body and no brace, because she would not be seen in a brace, and she told them the truth.

'Most of you will have heard by now that I'm ill,' she said. 'You've heard right. I have multiple myeloma, and it's beaten everything we've thrown at it, and I'm not going to be here much longer. I'm not telling you that so you'll be sad. I'm telling you because you deserve to know why I'm in such a hurry.'

A few people laughed, uncertainly. She smiled at them.

'Ninety years ago, eighteen thousand women worked in this building and the sheds around it. They packed cordite into shells. They worked twelve-hour shifts, and the explosives turned their skin yellow, and some of them died here, in accidents that nobody wrote about in the papers. They did it because they had to. Because there was a war, and the war needed bombs.' She looked around the old blast walls. 'I've always liked that we built our star in here. I like that we took a place that was made for burning things down and used it to build a fire that keeps people warm. But I've come to think that a fire like that shouldn't belong to anyone. Not to me. Not to Cydonis. Not to the British government, or the Americans, or the Chinese. It should belong to everyone, the way the Sun does.'

She paused. Her voice had caught, and she waited for it to come back.

'So as of this morning, it does. The design is out there. All of it. Somebody in Lagos or Lima or Lahore is downloading it right now, and in ten years they'll have built something better than anything we've managed. I hope you'll help them. I hope you'll be proud of them. And I hope you'll keep building your own, because you're the best team in the world and you're not done yet.' She nodded towards the back of the room, where Ife stood with her arms folded and tears on her face. 'Ife Okafor will be your Chief Executive from the first of February. She's cleverer than me and better organised than me and she has a much nicer coat. Listen to her.'

And then, because she could not think of anything else to say that would not make her cry in front of three hundred people, she said, 'Right. That's it. Get back to work,' and walked out through the side door into the frost, and leaned on the cold blast wall of the shed for a long time with her eyes closed, breathing.

She spent the following week putting things in order.

She left the house on Roundhay Park to a trust, to become a science centre for the children of Harehills and Chapeltown and Gipton: a place to come after school and on Saturdays, with telescopes on the roof and oscilloscopes on the benches and a plasma globe on the wall that never stopped reaching for small hands. She endowed a fund in her mother's name to take

any child from those streets who wanted to go, every year, for a night in the youth hostel at Malham, and out onto the limestone pavement after lights-out, to lie on their backs on the cold clints and see the Milky Way for the first time. She left a sum to the Friends of Beckett Street Cemetery for the care of the public graves. She left her books to Leeds University and her coil-stack side table to Rhiannon Pask, who would understand.

She wrote letters. One to Ife, which took her four drafts. One to Tomasz. One each to Rhiannon and to Marcus Fenby and to Jess Ostrowski from Hull, who had read out the number on the night of shot 40117 in such a small voice. And one to Ananya Rao, which was very short, and said only: *Thank you for the forty minutes on hold. I noticed. I've always noticed. A.*

She put them all in a drawer of her bench, in the billiard room, where they would be found.

On the twenty-first of January she asked Marcus to drive her to the mission operations room at CHI's Leeds office, very late at night, so she could watch the feeds from Cydonis One and from Mars.

The room was small and dark and lined with screens, and at two in the morning there were only two controllers on shift, who stood up when she came in and did not know what to say. She told them to sit down. She took the spare chair at the back and settled the leather case on her lap and looked up at the big central screen.

Cydonis One hung against the black, two hundred and eighty miles up, crossing the terminator over the Indian Ocean. The external camera on its forward truss showed the station in raking sunlight: the great open wheel of the habitat ring, slowly turning, its spokes and trusses bright white against the dark; the pressurised modules wrapped in their quilted insulation like parcels; the long copper-gold sails of the solar arrays catching the sun; and stencilled along the main truss in letters two metres high, the words she had argued with the marketing department about for a month: CYDONIS ONE. Below them, on the side of the logistics module, the company's

mark: a spray of dots resolving into a stylised atom, and beside it, CYDONIS HEAVY INDUSTRIES, C.H.I. LTD.

There were four people aboard. It was not, by any standard of the big agencies, a large station. It was a test bed, a factory for growing crystals and fibres in microgravity, and a proving ground for the compact power systems that would one day fly to Mars. Amanda had never been to it. She had always assumed she would go, one day, when the company was settled and she could spare the time.

One of the controllers, a young man with an Irish accent, cleared his throat. 'Dr Hariette-Scott. The crew asked if you'd come in. They wanted to show you something. They're coming up on the UK in about four minutes.'

She watched the station cross Africa, the Mediterranean, the Alps. And then the camera swung away from the truss and down, and there below her lay the dark curve of the Earth at night, and the coast of England picked out in sodium orange, and the long glittering spine of the M1 running north, and at the top of it, on the edge of the black Pennines, a smudge of light that she knew without being told.

Leeds.

The crew had turned the cabin lights off and were floating at the cupola windows. One of them held up a piece of card to the internal camera, hand-lettered in marker pen.

TA, BOSS.

Amanda laughed out loud, and then found that she was crying, and could not stop for some time.

The Mars feed came after, with its fourteen-minute delay.

R2 was the second of CHI's surface rovers, a six-wheeled beast the size of a lorry, sent ahead of the first human crews to scout landing sites and set down power and fuel. It sat on a plain of rust-coloured sand at the foot of a great eroded butte in Cydonia Mensae, the region of mesas and knobs that had given the company its name, where in 1976 a Viking orbiter had photographed a hill that looked, under low sun and at low resolution, like a hu-

man face. Amanda had chosen the name as a joke on herself: a reminder that the universe was under no obligation to mean what you wanted it to mean.

R2 towed a trailer behind it, a skeletal frame carrying banks of solar panels patterned in diamonds, and on its own back, lashed down under a red cargo net, sat a folded pressure habitat that would one day be the first human shelter on that plain. Its white hexagonal cab bore a painted chevron and the designation R2 in black. In the background the cliffs rose in terraced layers of ochre and umber, and down their flanks, in the thin Martian dawn, dust devils were spinning, slow tan columns drifting across the scree.

She watched the sun come up over Cydonia. It rose small and white and cold, a third smaller than the Sun seen from Earth, and the sky around it went from black to a strange pale blue, because on Mars the dust scattered red light away from the line of sight and let the blue through, so that sunset and sunrise were blue and noon was the colour of butterscotch. She had read about it for forty years. She had never seen it live.

The first crewed landing was scheduled for 2041. She had helped build the road. She would not walk on it.

And she found, sitting in the dark with the case on her lap, watching a robot she had paid for watching a dawn she would never stand in, that this was not what grieved her. The first crew would land without her. The second, and the hundredth. Somebody would grow up on Mars and think of Earth as an old country. All of that would happen and she was, she realised, at peace with it, because she had seen the beginning of it, and the beginning was the part that mattered most to the people who came after.

What she could not bear was the thought of never seeing the *end*.

She went home and took down her old textbook from the shelf.

It was an Open University text she had bought second-hand in Kirkgate Market at fifteen, an introduction to galaxies and cosmology, its spine cracked and its pages gone soft and brown at the edges, annotated in four different colours of ink across thirty-six years. She opened it at the summary

of the chapter on the spatial distribution of galaxies and read it again, slowly, by the light of the plasma globe.

Our Galaxy was a member of a small group, some thirty galaxies dominated by two giants, the Milky Way and Andromeda. Groups like ours gathered, at larger scales, into clusters of hundreds or thousands, with masses of a hundred trillion to a thousand trillion suns. Most of that mass was invisible. Between seventy and ninety per cent of the mass of every cluster was dark matter, detectable only by its gravity, by the way it bent the paths of light from more distant galaxies behind it, the way the box bent the beams on her optical table.

And she knew the rest of the story, the part that had not been in the book when it was printed, because it had not yet been understood. The universe was not only expanding. It was accelerating, driven by something nobody could explain, and the acceleration meant that every galaxy beyond our little group was running away from us faster and faster. In a hundred and fifty billion years they would all have slipped beyond the horizon, their light stretched to nothing, and an astronomer born then would look out and see only one galaxy in the whole of the sky.

That galaxy would be ours, or what had become of it. The Milky Way and Andromeda were falling towards each other at a hundred kilometres a second. When she was a student, every textbook had said they would collide in four billion years. Then the astrometry had got better, the Gaia satellite had measured the motions of a billion stars, and the more careful calculations said the collision was closer to a coin toss within the next ten billion. But in a hundred billion years, one way or another, the whole of the Local Group would have fallen together and merged into a single vast smooth swarm of old stars. The astronomers had a joke name for it. Milkomeda.

And in that swarm, the stars would go out.

Not all at once. The bright ones first: the blue giants in a few million years, the Sun in five billion, swelling into a red giant and shrinking into a white dwarf the size of the Earth. Star formation would slow as the gas ran out, and stutter, and stop. But the smallest stars, the red dwarfs, barely massive enough to fuse hydrogen at all, burned so slowly and so frugally that they would last for trillions of years. The very smallest, at eight per cent of the mass of the Sun, would never become red giants. They would simply

grow hotter and bluer as they used up their hydrogen, glowing for a while as blue dwarfs, a kind of star that did not yet exist because the universe was not yet old enough to have made one. And then they would fade to white, and then to nothing.

The last star in the universe would go out somewhere around a hundred trillion years from now. After that there would be no more starlight anywhere. Only cooling embers, and black holes, and the long dark.

She sat with the book open on her knee and the leather case at her feet.

She did not want to see the next century. She did not need to see the first child born on Mars. Other people would see those things, and it was right that they should.

But no one would see the last star die. No human being could. No human being would exist then, or anything descended from humans, or very probably any living thing at all. That light, the very last light that the universe would ever make, would fall on nothing and be seen by no one, and the most important event in the whole history of the cosmos, the end of the age of stars, would happen in perfect darkness with no witness.

It seemed to her a monstrous waste of a good observer.

Rao telephoned on the twenty-sixth.

The kidneys were going, she said. The creatinine was rising every day. They could keep transfusing, but the transfusions were buying days now, not weeks, and Rao thought it was time to talk about stopping them. There was a bed at St Gemma's Hospice, in Moortown, from Thursday. They were very good there. They would keep her comfortable. She should think about whether she wanted to go.

'Days to weeks?' Amanda asked.

A pause. 'Days to weeks.'

'Thank you, Ananya. For everything. I mean that.'

'Amanda.' Rao's voice was strange. 'Is there anything you want to tell me?'

Amanda looked at the leather case on her bench, at the faint cold that came off it, at the frost that had begun to form on the inside of the window above it in the last few days whenever the night was clear.

'There's a letter for you,' she said. 'In the drawer of my bench. Somebody will give it to you.'

She rang Ife that evening and asked her to come round for a drink on Wednesday night. Ife came, and they sat in the billiard room and drank the last of the good whisky and talked about everything except what they were both thinking about: the Saturday science club at the old Leeds Museum, and the time a stegosaurus model had fallen on a supply teacher; the first investor pitch they had done together, in a Premier Inn in Bradford; Ife's sister's new baby; the Wharfe-3 coil vendors and how impossible they were. At midnight Ife stood up and put on her camel coat and looked at Amanda for a long time.

'I'll see you, then,' she said.

'You will,' said Amanda.

Ife bent and kissed her on the forehead, very gently, on the skull where the holes were. Then she went out into the night, and Amanda heard her car start, and heard it sit in the drive with the engine running for a long, long time before it finally pulled away.

Tomorrow, Thursday, there was a bed waiting at St Gemma's.

Tonight was clear and very cold, and the stars were out over Roundhay Park.

PART THREE

The Further Regions

8

LAMENT

SHE DRESSED FOR it.

It took her nearly an hour, because her fingers were not what they had been and her spine would not let her bend, but inside the box's sphere there was no pain, and she had all the time in the world. She had laid the clothes out on the narrow bed that afternoon. She had bought them in the autumn, in a moment of defiance, after an appointment at which Rao had used the word *palliative* for the first time, and had never worn them.

A blouse of heavy purple silk satin, the colour of a bruise just beginning to bloom, with a high draped neck that fell in soft folds over her collarbones and long full sleeves gathered at the wrist into deep buttoned cuffs. The satin moved like water and caught the lamplight in long liquid ripples. Her mother would have rubbed it between finger and thumb and listened to it and nodded: real silk, not polyester. A skirt of black leather, high-waisted and cut close in long vertical panels from waist to mid-calf, so supple it warmed to her body at once. Black satin heels with thin straps that crossed twice at the ankle. She had not worn heels for a year. She would wear them tonight.

She sat at the mirror and painted her nails a deep violet, one careful stroke at a time, and her hands did not shake. She did her lips in red, a true blue-red, the kind her mother had called pillar-box. She worked a little wax through her short dark curls. And last of all she put in her mother's earrings, the only thing of her mother's she had kept for herself: long drops of

cut crystal on silver that threw tiny rainbows across her cheeks when she turned her head.

She looked at herself in the glass for a long time.

The illness was there to see, if you looked. The hollows under the cheekbones. The greyness under the make-up. The way she held herself, very straight and very careful, as if she were made of something that might break. But the woman in the mirror was, unmistakably, the one she had made. The one she had argued into being at twenty-two in the kitchen in Harehills, and fought for in clinics and court and boardrooms, and been, every day since. She had a face for jewel tones.



Purple and black, love, her mother said, from thirty years away. *With your colouring. Never pastels.*

'Never pastels,' Amanda agreed aloud, and smiled at the woman in the mirror, and went to open the box.

She switched off every light in the billiard room except the plasma globe. Its violet filaments writhed slowly in their glass sphere, throwing soft moving light over the bookshelves, the old coil stack in the corner, the bench, her hands. Outside, through the tall window, the night was clear and bitterly cold, and above the black cedars of the park the stars were out: Orion lying on his side over the rooftops of Oakwood, Betelgeuse orange at his shoulder, the Pleiades a small cold smudge above. More stars than she had seen from Leeds in years. As if the city had dimmed its lights for her.

She checked the drawer. The letters were there.

She sat down at the bench, set the box in front of her, and looked at the clock on her terminal.

01:47.

She almost laughed. Then she picked up the box and began.

She had mapped it so thoroughly by now that she did not need to think about the moves. Her fingers knew them. But she thought about them anyway, because thinking was the point, because she wanted to be present for every one.

The first configuration was the one her machine had found. Three over five: the five-bead necklace at the edge of the plasma, the designed island chain, the door that Wharfe-2 had knocked on by accident. She pressed the gold lozenge on the lid and slid it to the left, and felt the small precise click in her teeth.

The temperature in the room fell. Her breath smoked.

Five over eight. A panel on the eastern face rotated a quarter turn under her thumb and sank a millimetre into the body of the box. Somewhere inside, through a volume that was not there, gears turned over. On the wall

above her the plasma globe flickered, and all its filaments swung together and pointed at her hands.

Eight over thirteen. The northern face split along a hairline seam she had never been able to see and opened like a pair of tiny doors, revealing more gold beneath, more lines, a new tier of pattern. The shadows in the room began to lean. The shadow of the coil stack, the shadows of the bookcases, the shadow of her own hands on the bench: all of them swung slowly round until they pointed not away from the globe but inward, towards the box.

Thirteen over twenty-one. Frost bloomed on the inside of the window, branching ferns of ice racing across the glass, and through them the stars glittered and swam.

And far away, coming nearer, the bell began to toll.

Twenty-one over thirty-four. Thirty-four over fifty-five. The moves came faster now and smaller, the panels finer, the clicks so delicate she felt them more in her bones than in her fingers. And her bones were answering. She could feel it in her skull: a warmth, a tingling, spreading out across the vault of her cranium from a hundred small points at once. From every hole the myeloma had cut there. As if each one were a tiny bell, struck in sympathy with the great one tolling down the corridor of the night. As if her skull had been tuned.

Fifty-five over eighty-nine. The box was barely recognisable now. It had opened out and folded in on itself, its faces turned through angles that made her eyes water when she tried to follow them, layer after layer of gold unfolding inward towards a centre that kept receding. The bell was very loud. The room was very cold. She could no longer feel her feet.

And then she came to the bottom of the ladder, and there were no more fractions.

She had known it would be like this. She had worked it out weeks ago, on the back of an envelope, at three in the morning. You could walk down the Fibonacci convergents for ever, three over five, five over eight, eight over thirteen, each one closer to the golden mean, and never arrive. That was what it meant to be irrational. The golden surface could not be reached by any sequence of rational steps, however long. Every click of a detent, every

quarter turn, every discrete and countable move, was a fraction. And the last wall was not a fraction.

There was a final panel at the centre of the box, a tiny lozenge of gold no larger than her smallest fingernail. All the other panels had detents, little springs that caught them at each position, clicking them from one rational configuration to the next. This one did not. She had felt it in the dark a dozen times over the last weeks, and every time it had moved freely under her fingertip, smoothly, continuously, without stops. It was the only part of the mechanism that was not a lock.

To break the last surface, you did not take one more step. You stopped taking steps. You stopped approximating. You let go of the fractions and slid, in one smooth continuous motion, into the irrational.

She put her violet-painted fingertip on the last golden lozenge. She thought of Malham, the limestone cold under her back, the river of light falling towards her out of the dark. She thought of her mother holding fabrics to her face under the strip lights of Kirkgate Market. She thought of the islands blooming in the plasma on the night of shot 40117, and the bell, and the frost weeping off the window.

'All right,' she said aloud, to no one, to everyone. 'I'm ready.'

And she slid it.

The last wall broke without a sound.

There was no flash, no roar. There was only a change in the quality of the air, a deep and total silence as the bell stopped mid-toll, and then, in the space between her two tallest bookcases, the room opened.

The seam appeared the way a crack appears in ice: a thin dark line drawn suddenly from floor to ceiling, and then widening, its edges peeling back, fibrous and red and glistening like muscle seen through a wound. Blue-white light poured through it, cold as the light of a winter moon. It fell on the bookshelves and did not fade with distance. It fell on her hands and the purple satin of her sleeves and the black leather of her skirt, and every shadow in the room leaned in towards it.

The smell came next: lilies, and the butcher's cold store, and old blood, and something else beneath, something like incense, like the inside of a very old church.

Then chains. She heard them before she saw them, a slow dragging rattle from somewhere deep inside the seam, coming closer. And then they came out of the light, a dozen of them, two dozen, out of the seam and out of the walls and out of the air between the bookshelves, each one ending in a bright steel hook, and they swayed towards her like the heads of serpents tasting the air.

They did not strike. They hung there, waiting, gently swinging, their hooks catching the light.

And out of the light, between them, walked the priest.

He came slowly, his black robes moving about him, his long pale hands folded at his waist. The nails in his skull caught the blue glow and glittered like a crown of frost. Behind him, at the edge of the light, she could see the others standing in shadow, the woman with the opened throat and the one whose teeth never stopped, and others too, shapes she did not know, watching. But they did not come forward. Only he did.

He stopped a little more than an arm's length from her, and looked at her for a long time with his black eyes. At the purple satin and the black leather and the crystal drops at her ears and the red of her mouth. At her face. She sat very straight on her stool, the open box on the bench beside her, and let him look.

'You have dressed,' he said at last.

'For the occasion. My mother always said purple and black.'

'Your mother was a woman of discernment.'

'She could tell silk from polyester blindfolded by the sound.' Amanda lifted her chin. 'You said I'd open it with my eyes open. Knowing what I was asking for. So here I am. I've opened it. And my eyes are open.'

'So I see.' Something moved in his face, at the corner of the mouth. 'And I have never seen it before. Not once, in all my years. They come weeping, or slavering, or babbling prayers. They come drunk, or mad, or so bored with their own lives that they would welcome anything at all. They come with no idea what is behind the door, only that they want it.' He tilted his head, and the nails glittered. 'You came by the long road. By arithmetic. You

walked down the ladder of fractions all the way to the bottom, and then you let go of the last rung. Do you know how long it took Lemarchand to understand that the last panel had no stops?'

'No.'

'He never did. He built it from a design he did not understand, given to him by those who did.' A pause. 'You are the first who has understood it since the one who drew it.'

The chains swayed.

'Speak, then,' he said quietly. 'What is it that you ask of us? Speak precisely. We give what is asked. No more. No less.'

Amanda had rehearsed this. She had written it out, crossed it out, written it again, lying awake in the narrow bed with the box on the table beside her. Now that the moment had come, she found she did not need any of it.

'I don't want the hooks,' she said. 'Not like Haldane. I don't want to be taken apart for the sake of the sensation. I've had more than enough sensation this past year to last me.' She drew a breath of the freezing air. 'I want to join you. I want to be what you are. And I want to see the stars die.'

The silence went on so long that she thought she had made some terrible error.

Then he said: 'The stars.'

'The last of them. A hundred trillion years from now. The end of the age of stars. I want to see the last light the universe ever makes. No one else ever will. There won't be anyone left. It'll go out in the dark with no one to see it, and I think that's a waste. I think someone should be there.'

'The Order does not look outward,' he said slowly. 'We study the flesh. Its thresholds. Its limits. What it can be made to feel and what it can be made to become. That is our discipline. We have pursued it for longer than your nation has existed. The stars are... nothing to us.'

'Then you've been studying the wrong scale,' Amanda said. 'Stars *are* flesh. They're the biggest flesh there is. They're born out of clouds of gas, and they burn, and they age, and they die, and when they die they come apart. Some of them come apart so violently they outshine a whole galaxy. Every atom of iron in your blood, every atom of iron in those nails in your head, was made in the heart of a star that died and tore itself open and scattered its insides across space. You're made of dead stars. So am I. So was

Haldane.' She held his black gaze. 'You've spent three hundred years studying what flesh can feel. You've never once looked up to see where it came from.'

Behind him, in the shadows, the woman with the opened throat made a sound that might have been a laugh. The teeth of the other one clicked faster.

The priest did not laugh. But he was looking at her the way she had once watched the islands bloom in the plasma: as if he were seeing something that should not be possible, and had not yet decided whether it was terrible or beautiful.

'You ask for a great deal,' he said. 'Ascension into the Order is not mine to grant. It is Leviathan's. And Leviathan has granted it to very few.'

'Then ask Leviathan.'

'And what shall I tell it? Why should it give this to you?'

She had thought about that too.

'Because I understand what I'm asking for,' she said. 'Because I came by the long road, as you said. And because I've done it before.'

He waited.

'I was remade once,' Amanda said. 'Twenty-six years ago. In a clinic in Brighton, by a surgeon with warm hands. Before that it was years of endocrinology and paperwork and people telling me I didn't know my own mind. I knew exactly what I was asking for. I paid for it. It hurt, and I've never regretted it for one second.' Her voice was steady. 'I know the difference between something done to your body and something you choose for it. Most of the people who open your box have never once in their lives chosen their own flesh. They just lived in what they were given. I didn't. I made myself, out of what I had. I'd like to do it again.'

The priest was very still.

'When I opened the box,' he said at last, so quietly that she almost did not hear, 'I did not choose. I thought I did. I had come back from the war with nothing left in me that could feel anything, and I went looking for anything at all that might, and I found the box in a market in Basra and bought it for a few coins. I asked for experience. I did not know what I was asking. And what I became, I became because I asked without understand-

ing.' The black eyes held hers. 'You understand. That is rarer than you know. I think, perhaps, that Leviathan will find it interesting.'

He raised his hand, very slowly, and held it near her face, as he had done in Haldane's flat. This time he touched her. His fingertips were cold as stone and impossibly gentle. They rested on her temple, and then moved, slowly, over her short curls, feeling through them to the skull beneath.

'The configuration,' he murmured. 'It is cut into you. Every hole your sickness has made lies on one of its lines. Your own body has been solving the box for months.' Something that might have been wonder came into his voice. 'You have been coming to us since long before you found it.'

She reached up, before she could think better of it, and laid her own fingers against his scalp.

The nails were cold and smooth, their heads slightly domed, and the flesh between them was cold too, and taut, and she felt him go still beneath her touch the way a startled animal goes still. She ran her fingertips across the grid, row by row, counting.

'Eight rows,' she said softly. 'A square lattice. About two centimetres on a side. Someone measured you very carefully.'

'Someone did.'

'Was it you?'

A long pause. 'In a sense.'

They stayed like that for a moment, her hand on his skull and his on hers, in the cold blue light, while the chains swayed gently around them and the stars burned beyond the frosted window.

'Elliot,' she said.

'No one has called me that in a hundred years.'

'What would you like me to call you, then?'

And for the second time, something moved deep in the black eyes. 'No one,' he said, 'has asked me what I would like in a hundred years either.'

He stepped back. His hand fell away from her hair. And from somewhere beyond the seam, beyond the light, from a distance that could not be measured in metres, there came a sound she felt more than heard: a vast slow pulse, like the turning of some enormous mechanism, like the beat of a heart the size of a world.

The priest turned his head towards it, listening. Then he turned back to her.

'It has heard,' he said. 'Leviathan will receive you.'

He held out his hand.

'It will hurt,' he said. 'More than anything you have known. More than the sickness. More than Brighton. I will not lie to you about that. I have never lied to anyone who opened the box.'

'I know,' Amanda said. 'I'd like to be awake for it.'

'You shall be. That I can promise you. You will feel all of it, and know all of it, and understand all of it, every moment. You will not sleep, and you will not forget.' His voice dropped. 'And you will never again stop thinking.'

She looked round the room one last time. The bookcases, double-stacked, crammed with forty years of reading. The old coil stack in the corner, waiting for Rhiannon. The plasma globe on the wall, its violet filaments still pointing at the box. The drawer with the letters in it. The tall window, and the frost ferns on the glass, and through them the cedars of Roundhay Park black against the stars, Orion on his side, Betelgeuse orange at his shoulder, the light of a star that would explode within a hundred thousand years and that she might, she thought, now get to see.

She stood up. Her spine did not hurt. She was not sure it ever would again.

She took his hand.

The chains came to her then, gently, the way a lover's hands come, and the first of the hooks touched the purple satin at her shoulder, and paused there, as if asking, and she said, 'Yes,' and it went in.

9
IOTA

THE PAIN WAS exactly as he had promised, and she was awake for every moment of it.

The first hook went in through the trapezius above her left shoulder blade, through the purple satin and the skin and the muscle beneath, and drew tight. The second took her right shoulder. The third, the fourth, the fifth, through the flesh of her back and her arms and her thighs, each one pausing at the surface as if to ask, each one entering when she said yes. She felt them as a physicist feels anything: she noted the angle of entry, the sharp bright onset, the spreading heat, the sense of tension as the chains took her weight. And then the chains drew back into the light, gently, unhurriedly, and lifted her off the floor of the billiard room, and carried her through the seam.

She had expected to lose consciousness. People did, under that much pain. The brain had its own fuses. But the fuses did not blow. Whatever had been promised to her was being kept, and the pain went on arriving, wave after wave of it, and she went on receiving it, clear and lucid and entirely present, the way you might stand on a beach in a storm and feel each breaker hit you and not be knocked down.

The seam closed behind her. The last thing she saw of her own world was the plasma globe on the wall of the billiard room, its violet filaments all pointing at her, reaching after her like the hands of children.

The Labyrinth was grey.

That was the first thing. Grey stone, endless grey stone, walls rising on either side of her into a height she could not judge, corridors branching and branching again in every direction at once, including directions she did not have names for. The stone was cut in great smooth blocks without mortar, so precisely fitted that she could not have slid a sheet of paper between them, and it was cold, colder than anything she had felt, cold that went into the marrow and stayed there.

The geometry was wrong in ways she could feel before she could describe them. Corridors that ran parallel converged. Corridors that diverged met again. A passage she glimpsed to her left seemed to run downhill and arrive above her. The angles at a junction of three corridors did not sum to what they should. It was, she realised with a jolt of pure professional delight that cut through the pain like a lamp through fog, a space of negative curvature, hyperbolic, the kind of space where triangles were thin and parallel lines fled from one another. Or not quite. Its curvature varied. It was lumpy, the way the universe was lumpy on the scale of galaxy clusters. It was a space with mass in it.

And above it, where a sky should have been, there was Leviathan.

She had seen it in dreams, a vast bright shape turning like a lighthouse lens. The dreams had not prepared her. It hung over the Labyrinth at a distance she could not estimate, so large that it filled a quarter of the sky: an elongated diamond, two great pyramids joined base to base, eight facets of something that was not stone and not metal and not glass, rotating slowly about its long axis. As it turned, a beam of light swept out from it across the Labyrinth like the beam of a lighthouse across a dark sea. Except that the beam was not light. It was the absence of light, a blade of absolute black that passed over the grey stone and left it, for a moment, invisible.

She timed its rotation without meaning to. Ninety-seven seconds, near enough. She would refine it later.

She would have time for that now. She would have time for everything.

They brought her to a chamber where the corridors met.

It was round, domed, and the chains that held her came down from the apex of the dome, so that she hung in the centre of it with her arms spread and her feet a little way off the floor. The others stood around the walls in the grey half-light: the woman with the opened throat, the one whose teeth never stopped, and others, many others, a whole congregation of the re-made, each one a variation on a theme of flesh opened and displayed and decorated with steel. They watched her in silence. She looked back at them, one by one, and found that she was not afraid of any of them. She was curious. She wanted to know how each of them worked.

The priest stood before her. He had brought instruments: a tray of fine bright steel on a stone plinth, scalpels and needles and hooks of every size, clamps and retractors and wire, laid out in rows with the neatness of a theatre sister. And beside them, she saw, the opened box, its gold faces glowing with the same cold light as Leviathan.

'You may stop me,' he said, 'at any moment. Until it is done. After that, there is no stopping.'

'I know,' Amanda said. Her voice came out cracked and raw, but it came out. 'Go on.'

He began with the sickness.

He laid his cold palm flat against her breastbone, over the purple satin, and pressed, and the satin parted under his hand as if it had been waiting to, and so did the skin beneath, and so did the bone. She felt her sternum open like a book. She felt the cold air of the Labyrinth on the inside of her own chest. And she felt, deep in the red marrow of the bone, something stir.

It was the choir. The ten thousand million voices. The malignant clone, the plasma cells that had turned on her, that had spent four years eating her skeleton from inside and pouring their single useless antibody into her blood. She felt them now not as a disease but as a presence, a crowd of tiny identical selves crammed into every hollow of her bones, all singing their one note, all wanting only one thing, which was to copy themselves again and again for ever.

'Shall I cut them out?' the priest asked quietly.

She thought about it. It was the first decision she had made in this place, and she wanted to make it well.

'No,' she said. 'They're mine. They've been carving me for four years without permission. Let them go on carving.' She drew a breath through the cold, through the pain. 'But on my lines. Not theirs.'

And he smiled. It was the first time she had seen him truly smile, and it changed his whole face, the long pale fine-boned face of the officer he had once been, and she thought: there you are.

He did something then that she could not follow, with his hands inside her open chest and one long finger resting on a panel of the box. She felt the choir change its note. Felt ten thousand million cells hesitate, and listen, and turn, the way a shoal of fish turns all at once. They did not stop singing. But they sang now in harmony with something else, with her, with the shape of her own intention. For the first time in four years her own body was not arguing with her.

It was the most extraordinary sensation of her life, and she had felt a great many extraordinary sensations. It was the feeling she had had at twenty-five, waking in Brighton, the long calculation coming out at last, multiplied a thousandfold. Correctness. The draft accepted. The hypothesis confirmed.

She was weeping, she discovered. She had not known she still could.

Then the remaking began in earnest, and for a long time there was no more room in her for anything but pain.

She would never afterwards be able to say how long it took. Time in the Labyrinth ran as it pleased, and the black beam of Leviathan swept over them again and again and again, and she lost count of its rotations after the first few thousand. She remembered fragments, the way you remember a fever. But she remembered them precisely, because she had been promised that she would, and the promise was kept.

She remembered her skull. The priest had laid his fingers on it again and felt for the holes the myeloma had made, the hundred clean-edged lesions that her own cells had cut into the vault of her cranium over the past year, every one of them lying on a line of the configuration. And into each one, with infinite care, he had set a point of light.

Not a nail. She had asked, at the start, and he had considered her for a long time and agreed. A point of light, smaller than a grain of rice, violet-white and fierce. She had not understood what they were until she felt them begin to burn. Each one was a plasma: a few micrograms of ionised gas, stripped of its electrons, hotter than the surface of the Sun, held in a twisted bottle of field no larger than a lentil. A hundred tiny stars. A hundred tiny stellarators, each one turning its own small knot of magnetic field, set into her skull along the lines of the last frame of shot 40117. A crown of confined stars, laid out in the pattern of the key.

She remembered the coils. He had taken the gold from the box, the impossible gold with its copper older than any ore on Earth, and drawn it out into wire as fine as hair, and wound it around her. Around her skull, threading between the points of light. Around her throat, in twisted loops that rose and fell and rose again. Around her ribs, where her chest had been opened and held back with bright steel like his own. Each coil was a different shape, warped and non-planar, like the petals of an iron flower, and they repeated around her body in a five-fold symmetry that she recognised with a laugh that came out as a sob. They were the coils of Wharfe-2. Fifty modular coils, scaled down and wound into her flesh, producing a field with a rotational transform that she could feel inside her like a spine.

She remembered her heart. Or the place where her heart had been. He had opened her chest and folded back the ribs and held them with steel, as his own was held, so that whoever looked at her would see inside. And in the cavity he had made, within the cage of gold coils, there now burned a star. A real one, or near enough: a torus of plasma the size of a fist, twisting through its own five field periods, violet at the edges and white at the core, hot enough to fuse, held in perfect confinement by the coils that wound through her flesh. It did not beat. It hummed. And she could feel, in its steady humming, the field lines winding round and round and round, every one of them lying on a flux surface, every flux surface nested in the next, an onion of order, and at its edge, keeping the whole thing from leaking away into chaos, a five-bead necklace of islands.

She had spent eleven years and two billion pounds building a star in a munitions shed in Yorkshire. Now she carried one in her chest.

PLEASE DO NOT TOUCH THE STAR, she thought, and laughed, and the laugh hurt more than anything else that had been done to her, and she did not care.

She remembered her skin. The purple satin and the black leather had not been taken from her. They had been joined to her. The silk had been laid along her arms and shoulders and grafted there, stitched to her skin with fine black thread along the seams so that it would never come off, and the leather had been fitted to her from waist to calf and fused to her as if it had grown there. She could feel through both now. She could feel the liquid weight of the satin as part of her body, its sheen a kind of sense, the way a cat feels through its whiskers.

'The earrings,' the priest had said, at one point, his fingers near them.

'They stay. They were my mother's.'

And they stayed.

She remembered her eyes. That was the last thing, and the most painful, and the best. He had laid his thumbs over her closed lids and pressed, and she had felt something change in the deep machinery behind them, in the retina and the optic nerve and the visual cortex, and when he took his thumbs away and she opened her eyes, she saw.

She saw everything.

She saw in colours that had no names. She saw the infrared glow of the warm bodies around her and the cold radio hiss of the stone. She saw the gamma-ray flicker deep in her own chest where the deuterium fused. She saw the magnetic field lines of her own coils, threading through her body in shimmering ribbons of force, and she saw, faint and everywhere, filling the whole sky behind Leviathan, a dim and perfectly even glow at a temperature of less than three degrees above absolute zero, which she recognised, with a shout of joy that echoed through every corridor of the Labyrinth, as the cosmic microwave background: the light of the Big Bang itself, stretched and cooled across thirteen point eight billion years, and she was seeing it with her own eyes.

The congregation of the remade drew back from her. Some of them had never heard anyone shout for joy in that place.

When it was done, they let her down.

The chains lowered her gently to the stone floor of the chamber, and the hooks withdrew from her flesh one by one, and where they had been there were wounds that did not bleed and did not close, but stayed open, neat and dark, part of her design. She stood. Her spine did not hurt. Nothing hurt in the way things had used to hurt. The pain was still there, enormous and continuous, but it had changed its nature. It was no longer a signal of damage. It was simply information, arriving at a bandwidth she had never imagined, and she found she could read it the way she had once read the data streaming off the Wharfe-2 diagnostics: the temperature, the density, the confinement time of her own new flesh.

That, she understood, was the secret of the Order. Not that pain and pleasure were the same. That both were only sensation, felt at the very limit of what a body could carry, and that at that limit they became something else: pure perception. The world arriving all at once. Knowledge, felt in the flesh.

She would have liked to tell Tomasz. She thought he might have called it grace.

The priest stood before her. He looked at her for a long time. At the hundred violet stars in her skull, and the gold coils threading her throat, and the opened chest with its humming star inside, and the satin and the leather grown into her skin, and her mother's crystal drops at her ears, throwing their tiny rainbows across her face in the light of her own heart.

'In the Order,' he said, 'we leave our names behind us. What shall you be called?'

She had known the answer for weeks.

'Iota,' she said.

He waited.

'In a stellarator,' she said, 'the twist in the field lines is called the rotational transform. We write it with the Greek letter iota. The smallest letter

in the alphabet. It's a small number, usually. Less than one. But without it there's no confinement at all. The plasma leaks away to the walls and the star goes out. It's the little twist that holds everything together.' She smiled, and found that her mouth was still red. 'It seemed appropriate.'

'Iota,' the priest repeated, slowly, as if tasting it.

And from far above, from the vast turning diamond in the sky, the black beam of Leviathan swept down across the Labyrinth and passed over her. She felt it go through her. It was like being weighed. It was like being read, every line of her, every coil and star and stitch. For one long moment the whole immense attention of the god of the Labyrinth rested on her, and she looked back up at it with her new eyes, through the faint glow of the microwave background, and did not look away.

The beam moved on.

'It is pleased,' the priest said quietly. 'It has never had a natural philosopher.'

She looked at her own reflection in his black eyes: the crown of confined stars, the gold, the violet light. She looked, she thought, rather magnificent. She looked like something her mother would have approved of. Purple and black. Never pastels.

When she spoke again, she found to her delight that she still sounded like Leeds.

'Right,' said Iota. 'Now. About those stars.'

IO

MILKOMEDA

MARCUS FENBY LET himself into the house on Roundhay Park at nine o'clock on Thursday morning, to drive Dr Hariette-Scott to St Gemma's, and found the billiard room door standing open and the room beyond it as cold as a church in winter.

The windows were streaming. Meltwater ran down the bookshelves and pooled on the floor. The narrow bed had not been slept in. On the bench beneath the window lay the box, its six black faces closed, every golden panel returned to its starting place, and beside it the drawer stood a little open, with a stack of envelopes inside addressed in a neat slanting hand.

There was no one in the room. There was no one in the house.

He rang Ifeoma Okafor, and then he sat down on the bottom stair in the hall and did not get up again until she came.

Ife walked through the billiard room very slowly, touching nothing. She looked at the empty bed and the streaming windows and the drawer of letters. She looked at the plasma globe on the wall, which was still switched on. Its violet filaments, which for forty years had reached towards whatever hand came near, were all pointing straight up, at the ceiling, at the sky beyond it, and they stayed that way however close she came.

She opened the envelope with her name on it. It held a single sheet.

Ife. I've gone to see something. Don't let them close the licence. Wear the good coat. A.

Ife read it four times. Then she folded it into the inside pocket of her camel coat and turned back to the bench, meaning to do something about the box, she did not yet know what.

The box was gone. Where it had been there was a perfect square of frost on the wooden bench, nine centimetres to a side, and as she watched, it melted.

That Sunday, Tomasz Wilk went to the ten o'clock mass at St Anne's Cathedral and lit a candle at the side altar, and knelt there for a long time.

At the consecration the altar server rang the sanctus bells: three bright little peals, silver and quick. Tomasz braced himself, as he had braced himself every Sunday since November, for the other bell beneath them, the deep bronze tolling with its minor third.

It did not come. There were only the little bells, ringing out clear and high over the bowed heads, and then silence, and the smell of wax and incense, and the winter light coming grey through the high windows.

He wept, and did not know whether it was grief, and found after a while that it did not matter.

At St James's, in a consulting room on the fourth floor of the Bexley Wing, Ananya Rao opened a small envelope that a tall woman in a camel coat had left at the desk for her. She read it at her desk between patients. Then she put it in her handbag, and blew her nose, and called in the next one.

A woman was reported missing in Leeds that week. The police found no trace of her. A detective sergeant who had met her once, on a haematology ward, noted in his file that she had been terminally ill and that her doctors had not expected her to live beyond the spring, and that in his experience people in that condition sometimes chose to go somewhere quiet. He did not believe it, and he wrote it down anyway, because there was nothing else to write.

In the archives of the Yorkshire Post, nobody connected her to a captain of the King's Own Yorkshire Light Infantry who had gone missing from his

lodgings in Holbeck in the spring of 1921, or to a financier who had vanished from Leeds Dock the winter before.

In the Labyrinth, there were no Sundays.

There was the grey stone, and the corridors, and above them Leviathan turning, its black beam sweeping across the maze once every ninety-seven seconds, near enough. Iota refined the figure over what might have been weeks, or years. Ninety-seven point three one four. She made a note of it. She made notes of everything.

She walked the corridors with her new eyes open and her new star humming in her chest, and she measured. She measured the curvature of the stone and found it varied as you moved through the maze, lumpy and uneven, the way the universe was lumpy where galaxies clustered. She measured the corridors themselves, and found that they moved: not quickly, but steadily, the whole vast maze drifting and wheeling slowly about Leviathan, each passage on its own path, like stars orbiting the centre of a galaxy.

So she did what any astronomer would have done. She watched the corridors drift, and read the Doppler shift of the grey light off their walls, and measured the spread of their velocities along her line of sight. She estimated the radius of the system. And then, standing at a junction of seven passages with the black beam passing over her, she worked out the mass of Leviathan from the oldest formula in her textbook, the one she had first learned at fifteen from a second-hand book bought in Kirkgate Market: the mass is roughly the radius times the square of the velocity dispersion, divided by the gravitational constant.

She checked it three times.

'Ten to the fifteen solar masses,' she told the priest, when she found him. 'Give or take. That's the mass of a rich cluster of galaxies. A thousand trillion suns. And there's nothing here that shines. The stone doesn't. You lot don't. Leviathan's light isn't light.' She looked up at the turning diamond with something like affection. 'Seventy to ninety per cent of the mass of every galaxy cluster in the universe is dark matter. Nobody's ever found

out what it is. I don't suppose you'd know whether there's a Labyrinth behind every one of them?'

The priest regarded her for a long moment. 'I have never thought to ask.'

'No,' said Iota. 'I don't suppose you have.'

And for the first time, she heard him laugh.

She learned the Labyrinth as she had learned everything else: by asking questions until the answers ran out, and then by making up new questions.

The priest showed her its ways. He took her down passages where the stone was older than the Solar System, cut from the same quarry, she suspected, as the lead in the box's solder. He showed her the chambers where the others pursued their disciplines, and she watched them with honest interest and asked them how their bodies worked, and some of them were so astonished to be asked that they told her. The woman with the opened throat explained, in her wet whistling voice, the precise mechanics of the wire that held her open. The one whose teeth never stopped could not explain anything, but Iota sat with him for a long time, listening to the rhythm of the chattering, and eventually told him it was a Fibonacci sequence, and he stopped chattering for almost a minute, which the others assured her had never happened before.

And the priest told her about the war. About the mud at the Somme and the wire and the long nights in flooded trenches, about the men he had sent forward who did not come back, about the day in a Basra souk when he had seen a black lacquered box on a merchant's stall and felt something inside him, something that had been dead for two years, stir and lift its head. About the lodgings in Holbeck, and the cold spring of 1921, and his fingers on the panels in the dark.

She told him about Harehills. About the market and the bolts of cloth, about Malham, about the river of stars falling towards her across the sky. About Brighton, and the surgeon's warm hands, and waking into correctness. About shot 40117 and the islands blooming and the bell.

They walked for a long time, side by side through the grey corridors, talking. She thought it was probably the longest conversation either of them had had in a very long while.

At some point, she did not afterwards know when, he stopped in a narrow passage under the sweeping black beam and turned to her and lowered his head. She understood. Among the grid of nails across his skull, one, near the crown, was very old: pitted and dark and loose in its socket, a nail that had been there, she guessed, since 1921.

She drew it out, gently, with her violet-painted fingers. He did not flinch. And into the hole it left, with the same infinite care with which he had remade her, she set one of her own small stars.

Afterwards he carried it always: one point of fierce violet light among the dull grey heads of the nails, held in its own small twisted bottle of field, burning. And she carried, in a fold of the satin over her heart, an old pitted nail from 1921.

That was as near as the Order came to marriage. It was, Iota thought, considerably more than most people managed.

'I walked to the end once,' the priest said.

They stood at the head of a corridor that she had not seen before. It ran away from them, straight and grey and narrowing, for a distance her eyes could not resolve. Its walls were pierced, at irregular intervals, by openings: tall narrow windows in the stone, and through each one a different light.

'The Labyrinth runs alongside every moment,' he said. 'This passage follows the moments forward. I walked it, long ago, out of curiosity. Or what was left of curiosity in me then. I walked until the windows went dark. There was nothing at the end, Iota. Only black. I turned back.'

'You walked too fast,' she said. 'And you didn't know what you were looking at.' She held out her hand. 'Come on. We'll go slowly. I'll tell you what everything is.'

He looked at her hand for a long moment. Then he took it.

They walked.

Through the first windows they saw the world she had left. Leeds, glittering on its seven hills. The Aire running brown under Crown Point. A fusion plant rising on the banks of the Wharfe, and another in Lagos, and another in Lima, built from the drawings she had given away. She stood at that window a long time. The priest did not hurry her.

Further on, the Earth grew hot, and the oceans boiled away, and the Sun swelled red and vast and swallowed Mercury and Venus, and its outer layers washed over the scorched cinder of the Earth, and Iota watched it go with dry eyes. She had always known. Leeds had been built on a planet, and planets ended. She had chosen to see the end. She could not choose to look away from the parts of it that hurt.

Further on still, Andromeda filled the sky. The coin came up heads: the two great spirals fell into each other over a billion years, their stars streaming out in long tidal tails, their gas clouds colliding and igniting a firestorm of new stars, their two central black holes spiralling in towards each other and merging in a flare of light that outshone everything for a hundred million years. When it was over there was one galaxy where there had been two. Milkomeda, she told the priest, and explained the joke, and he did not laugh, but she thought he understood it.

And beyond Milkomeda, the sky emptied. The other galaxies of the Local Group fell in and were eaten. The galaxies beyond them, the great clusters, the superclusters, the whole cosmic web her textbook had described, slipped away one by one beyond the horizon as the expansion accelerated, their light stretched redder and redder until it was gone. A hundred and fifty billion years from the night she had opened the box, an astronomer in Milkomeda, if there had been one, would have looked out and seen only darkness beyond her own galaxy.

A trillion years on, Iota looked at the sky with her new eyes and could no longer find the cosmic microwave background. The light of the Big Bang had been stretched until its waves were longer than the observable universe. The cosmos had forgotten its own beginning.

'Nobody will ever know there was a Big Bang now,' she said quietly. 'Not from inside. Any physicist born after this would think the universe was one galaxy floating in nothing, for ever. They'd have no evidence other-

wise. They'd be wrong, and they'd never be able to find out.' She looked at him. 'Except us. We remember.'

They walked on.

The gas ran out. The last star-forming clouds in Milkomeda thinned and stilled. No new stars were born. The bright ones died: the giants exploding, the Sun-like stars swelling and shrinking to white dwarfs. The galaxy reddened, aged, its light dimming to the dull crimson of the small, long-lived red dwarfs, burning their hydrogen with infinite thrift.

At ten trillion years Iota stopped at a window and caught her breath.

One of the red dwarfs was turning blue.

'Look,' she whispered, and pulled the priest to the window. 'Look. That's a blue dwarf. That's a kind of star that has never existed before. Not once, in the whole history of the universe until now. The universe has never been old enough to make one.' The little star burned blue-white in the crimson swarm, hotter and brighter than it had ever been, using up the last of its hydrogen. 'It's spent ten trillion years mixing its whole body, burning nearly everything it had, and now it's nearly out of fuel and it's going hotter and bluer, the way a fire does just before it goes out. Nobody's ever seen this. Nobody ever will, except us.'

The priest stood beside her and looked at the blue star for a long time. She watched his face in its light: the long pale fine-boned face, the black eyes, the grid of nails and the single point of violet among them. Something was happening in that face that she did not think had happened in a hundred years.

He was looking outward.

At a hundred trillion years, they came to the last window.

The corridor beyond it ran on, but the windows ended. Beyond this one there would be nothing to see. Only the dark, and the cooling embers of the dead stars, and the black holes swallowing what was left, and the slow evaporation of everything into a thin cold haze over spans of time so long that even Iota, with her new mind, could not hold them.

Through the window, in the black, there was one star left.

It was very small. A tenth of the mass of the Sun, born late, from the collision of two brown dwarfs that had wandered together in the dark after trillions of years of missing each other. It had lived its whole long life as a red dwarf, and then gone blue, and now it was fading, its core running down, its last hydrogen nearly gone. It was the last star in the universe that was still fusing. Every other star in Milkomeda, every other star in the whole of the observable cosmos, had gone out already, and become a white dwarf, or a neutron star, or a black hole, or nothing.

Iota stood at the window with the priest's cold hand in hers and watched it.

She could see, with her new eyes, down into its heart. She could see the last few protons in its core, jostling in the heat and pressure, fusing in ones and twos now, the proton-proton chain grinding to a halt. She could feel, through the gamma sense in her chest, each fusion as it happened. Each one sent out a neutrino, a tiny ghost particle that fled outward at nearly the speed of light into the dark, and she counted them. A thousand. A hundred. Ten.

'What will you call it?' the priest asked softly.

She had not known she would be asked. But she found that she knew the answer.

'Mary Ann Holroyd,' she said. 'Aged three years.'

He looked at her.

'She's in a public grave in Beckett Street Cemetery in Leeds,' Iota said. 'With twenty-one other people nobody remembers. She died of cholera, I think, or typhoid. In 1849, or thereabouts. Nobody will ever know her name except the people who read that stone, and the stone's worn almost smooth. And the stone's gone now. Leeds is gone. The Earth's gone.' Her voice was steady. 'Somebody should remember her. Somebody should be there at the end. I'd like the last star in the universe to have her name.'

The priest said nothing. But his hand tightened on hers.

In the heart of Mary Ann Holroyd, aged three years, two protons came together, and fused, and sent out a single neutrino into the dark.

Iota felt it go. She followed it with her new senses as it fled outward from the dying star, a speck of almost nothing, carrying away the last en-

ergy that fusion would ever release anywhere in the universe. She waited for another. She waited for a long time.

There was no other.

The last star had stopped. Its surface would glow on for a while yet, red, then dim, then dark, a white dwarf cooling over a quadrillion years into a black cinder. But nothing in it was burning any more. Nothing anywhere was burning any more. The age of stars was over. The last fire in the cosmos had gone out, and it had not gone out in the dark, unwitnessed, unremembered. Someone had seen it. Someone had given it a name.

Iota stood at the last window, with tears running down her face over the gold wire at her throat, and found that she was not sad at all.

It had been worth looking. All of it. Every moment of it, from Malham to here.

And then she noticed the light.

The window had gone dark. The corridor beyond was black. But the passage where they stood was not dark at all. It was full of a soft violet radiance, falling on the grey stone, on the priest's pale face and his black robes, on her own hands and the purple satin grown into her skin. She looked for its source, and found it, and understood.

It was coming from her. From the hundred tiny stars set into her skull, each burning in its small twisted bottle of field. From the fierce violet torus humming in her opened chest, held in its cage of gold coils, still fusing, still confined, still burning steadily, because she had built it to. And from one point of violet light among the nails on the priest's head, which she had given him.

The last stars in the universe were hers.

She began, very quietly, to laugh.

The priest turned to her in the violet light. He looked at the crown of stars in her skull, and at the star in her chest, and at her face. Then, slowly, as if asking permission, he raised one long pale hand towards the burning torus at her heart.

She thought of a filling shed in Thorp Arch, and a laminated sign above a bank of screens. PLEASE DO NOT TOUCH THE STAR.

'Go on,' said Iota. 'I don't mind.'

He touched it. His fingers passed into the violet light, and it burned him, she knew, and he did not draw them back. He held them there, against the last star in the universe, feeling the heat of it and the hum of it and the field lines winding round and round through their nested surfaces, every one of them lying on its place, order holding against chaos at the edge of everything.

'I did not know,' he said at last, very quietly, 'that it would be beautiful.'

'Neither did I,' Iota said. 'That's why you have to look.'

She took his hand from her heart, and held it, and turned with him to face the long dark corridor ahead, where the black holes waited, and the slow evaporation, and the last cold haze at the end of time. Ten to the hundred years, give or take. She had done the sum already.

She thought they might stay for that, too.