

SUNSTORM

A TIME ODYSSEY: 2

ARTHUR C. CLARKE
AND STEPHEN BAXTER



BALLANTINE BOOKS



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TABLE OF CONTENTS

[*Title Page*](#)

[Part 1](#)

[Chapter 1](#)

[Chapter 2](#)

[Chapter 3](#)

[Chapter 4](#)

[Chapter 5](#)

[Chapter 6](#)

[Chapter 7](#)

[Part 2](#)

[Chapter 8](#)

[Chapter 9](#)

[Chapter 10](#)

[Chapter 11](#)

[Chapter 12](#)

[Chapter 13](#)

[Chapter 14](#)

[Chapter 15](#)

[Chapter 16](#)

[Chapter 17](#)

[Chapter 18](#)

[Part 3](#)

[Chapter 19](#)

[Chapter 20](#)

[Chapter 21](#)

[Chapter 22](#)

[Chapter 23](#)

[Chapter 24](#)

[Chapter 25](#)

[Part 4](#)

[Chapter 26](#)

[Chapter 27](#)

[Chapter 28](#)

[Chapter 29](#)

[Chapter 30](#)

[Chapter 31](#)

[Chapter 32](#)

[Chapter 33](#)

[Chapter 34](#)

[Chapter 35](#)

[Chapter 36](#)

[Chapter 37](#)

[Chapter 38](#)

[Part 5](#)

[Chapter 39](#)

[Chapter 40](#)

[Chapter 41](#)

[Chapter 42](#)

[Chapter 43](#)

[Chapter 44](#)

[Chapter 45](#)

[Chapter 46](#)

[Chapter 47](#)

[Chapter 48](#)

[Part 6](#)

[Chapter 49](#)

[Chapter 50](#)

[Chapter 51](#)

[*Afterword*](#)

[*About the Authors*](#)

[*Other Books by the Authors*](#)

[*Copyright Page*](#)

Part 1

A BALEFUL SUN



1: Return

Bisesa Dutt gasped, and staggered.

She was standing. She didn't know where she was.

Music was playing.

She stared at a wall, which showed the magnified image of an impossibly beautiful young man crooning into an old-fashioned microphone. Impossible, yes; he was a synth-star, a distillation of the inchoate longings of subteen girls. "My God, he looks like Alexander the Great."

Bisesa could barely take her eyes off the wall's moving colors, its brightness. She had forgotten how drab and dun-colored Mir had been. But then, Mir had been another world altogether.

Aristotle said, "Good morning, Bisesa. This is your regular alarm call. Breakfast is waiting downstairs. The news headlines today are—"

"Shut up." Her voice was a dusty desert croak.

"Of course." The synthetic boy sang on softly.

She glanced around. This was her bedroom, in her London apartment. It seemed small, cluttered. The bed was big, soft, not slept in.

She walked to the window. Her military-issue boots were heavy on the carpet and left footprints of crimson dust. The sky was gray, on the cusp of sunrise, and the skyline of London was emerging from the flatness of silhouette.

“Aristotle.”

“Bisesa?”

“What’s the date?”

“Tuesday.”

“The *date*.”

“Ah. The ninth of June, 2037.”

“I should be in Afghanistan.”

Aristotle coughed. “I’ve grown used to your sudden changes of plans, Bisesa. I remember once—”

“Mum?”

The voice was small, sleepy. Bisesa turned.

Myra was barefoot, her tummy stuck out, fist rubbing at one eye, hair tousled, a barely awake eight-year-old. She was wearing her favorite pajamas, the ones across which cartoon characters gamboled, even though they were now about two sizes too small for her. “You didn’t say you were coming home.”

Something broke inside Bisesa. She reached out. “Oh, Myra—”

Her daughter recoiled. “You *smell* funny.”

Shocked, Bisesa glanced down at herself. In her jumpsuit, scuffed and torn and coated with sweat-soaked sand, she was as out of place in this twenty-first-century London flat as if she had been wearing a spacesuit.

She forced a smile. “I guess I need a shower. Then we’ll have breakfast, and I’ll tell you all about . . .”

The light changed, subtly. She turned to the window.

There was an Eye over the city, a silver sphere, floating like a barrage balloon. She couldn’t tell how far away it was, or how big. But she knew it was an instrument of the Firstborn, who had transported her to Mir, another world, and brought her home.

And over the rooftops of London, a baleful sun was rising.

2: The Peak of Eternal Light

Mikhail Martynov had devoted his life to the study of Earth's star. And from the first moment he saw the sun, at the beginning of that fateful day, he knew, deep in his bones, that something was wrong.

"Good morning, Mikhail. The time on the Moon is two o'clock in the morning. Good morning, Mikhail. The time is two o'clock and fifteen seconds. Good morning . . ."

"Thank you, Thales." But he was already up and moving. As always he had woken to within a minute of his personal schedule, without need of Thales's softly spoken electronic wake-up call, a schedule he kept independently of the Houston time to which the rest of the Moon was enslaved.

Mikhail was a man of routine. And he would begin the day, as he began every day of his long solitary watches in this Space Weather Service Station, with a walk into the sunlight.

He took a quick breakfast of fruit concentrate and water. He always drank the water pure, never polluted with coffee granules or tea leaves, for it was water from the Moon, the result of billions of years of slow cometary accretion and now mined and processed for his benefit by million-dollar robots; he believed it deserved to be savored.

He clambered briskly into his EVA suit. Comfortable and easy to use, the suit was the result of six decades' development from the clumsy armor worn by the *Apollo* astronauts. And it was smart, too smart, some said so smart it could go out Moonwalking by itself.

But smart suit or not, Mikhail worked cautiously through a series of manual checks of the suit's vital systems. He lived alone here at the Moon's South Pole, save for the electronic omnipresence of Thales, and everybody knew that low gravity made you dumb—the "space stupids," they called them. Mikhail was well aware of the importance of concentrating on the chores necessary to keep himself alive.

Still, it was only minutes before he was locked tight into the warm enclosure of the suit. Through the slight distortion of his wedge-shaped visor he peered out at his small living quarters. He was a man equipped for interplanetary space, standing incongruously in a clutter of laundry and unwashed dishes.

Then, with a grace born of long practice, he pushed his way out through the airlock, and then the small dustlock beyond, and emerged onto the surface of the Moon.

Standing on the slope of a crater rim mountain, Mikhail was in shadow broken only by sparse artificial lighting. Above him stars crowded a silent sky. When he looked up—he had to lean back in his stiff suit—he could make out dazzling splashes of light high on the crater wall, places the low polar sunlight could reach. Solar-cell arrays and an antenna farm had been placed up there in the light as well as the sun sensors that were the Station's main purpose.

This Space Weather Service Station, dug into the wall of a crater called Shackleton, was one of the Moon's smaller habitats, just a few inflatable domes linked by low tunnels and heaped over by a layer of charcoal-gray Moon dust.

Unprepossessing the hab itself may have been, but it was situated in one of the Moon's most remarkable locations. Unlike the Earth, the Moon's axis has no significant tilt; there are no lunar seasons. And at the Moon's South Pole the sun never rises high in the sky. There the shadows are always long—and, in some places, permanent. Thus the pool of darkness in which Mikhail stood had been unbroken for billions of years, save by humans.

Mikhail looked down the slope, beyond the low bulges of the Station domes. On Shackleton's floor floodlights revealed a complex tangle of quarries and lumbering machines. Down there robots toiled over the real treasure of this place: water.

When the *Apollo* astronauts had brought home their first dusty Moon rocks, the geologists had been dumbfounded that the samples contained not a trace of water, not even bound chemically into the mineral structures. It took some decades to unravel the truth. The Moon was no sister world of Earth but a daughter, created in the early days of the solar system when a collision with another infant world had smashed apart a proto-Earth. The debris that had eventually coalesced into the Moon had been superheated until it glowed blue-white, in the process driving off every trace of water. Later, comets had splashed on the Moon's surface. Out of the billions of tonnes of water delivered by these lesser impacts, most had been lost immediately. But a trace, just a trace, had found its way to the permanently shadowed floors of the polar craters, a gift of water to the Moon as if in recompense for the circumstances of its birth.

By Earth's standards the Moon's water was little enough—not much more than a respectably sized lake—but for human colonists it was a treasure beyond price, literally worth far more than its weight in gold. It was invaluable for the scientists too, as it bore a record of eons of cometary formation, and offered indirect clues to the formation of Earth's oceans, which had also been bequeathed by cometary impacts.

Mikhail's interest in this place was not lunar ice, however, but solar fire.

He turned away from the shadows and began to toil up the steepening slope of the rim mountain toward the light. The path was just a trail, beaten flat by human footprints. It was marked by streetlights, as everybody called them, small globe lamps hung from poles, so he could see what he was doing.

The slope was steep, each step an effort even in the Moon's gentle one-sixth gravity. His suit helped, with a subtle hum from exoskeletal servos and a high-pitched whir of the fans and pumps that labored to keep his faceplate clear of condensed sweat. He was soon breathing hard, and his muscles ached pleasantly: this walk was his daily constitutional.

At last he reached the summit of the mountain and emerged into flat sunlight. A small collection of robot sensors huddled here, peering with unending electronic patience at the sun. But the light was too brilliant for Mikhail's eyes, and his visor quickly opaqued.

The view around him was still more dramatic, and complex. He was standing on the rim of Shackleton, itself a comparatively minor crater, but here at its western rim Shackleton intersected the circles of two other craters. The landscape was jumbled on a superhuman scale: even the craters' far rims were hidden by the Moon's horizon. But with long practice Mikhail had trained himself to make out the chains of mountains, slowly curving, that marked the perimeters of these overlapping scars. And all this was thrown into stark relief by the low light of the sun as it rolled endlessly around the horizon, the long shadows it cast turning like clock hands.

The South Pole, shaped when the Moon was young by an immense impact that had bequeathed it the deepest crater in all the solar system, was the most contorted landscape on the Moon. A great contrast to the flat basalt plain of Tranquillity where Armstrong and Aldrin had first landed, far to the north close to the Moon's equator, would be hard to imagine.

And this peak was a special place. Even here among the mountains of the Pole, most places knew some night, as the passing shadows of one crater wall or another blocked out the light. But the peak on which Mikhail stood was different. Geological chance had left it steeper and a little taller than its cousins to either side, and so no shadow ever reached its summit. While the Station, only footsteps away, was in perpetual darkness, this place was in permanent sunlight; it was the Peak of Eternal Light. There was nowhere like this on tipped-over Earth, and only a handful of locations like it on the Moon.

There was no morning here, no true night; it was no wonder that Mikhail's personal clock drifted away from the consensus of the rest of the Moon's inhabitants. But it was a strange, still landscape that he had grown to love. And there was no better place in the Earth-Moon system to study the sun which never set from this airless sky.

But today, as he stood here, something troubled him.

Of course he was alone; it was inconceivable that anybody could sneak up on the Station without ~~hundred automatic systems alerting him~~. The silent sentinels of the solar monitors showed no signs of disturbance or change, either—not that a cursory eyeball inspection of their casings, wrapped in thick meteorite shielding and Kevlar, would have told him anything. So what was troubling him? The stillness of the Moon was an uncomfortable place to be having such feelings, and Mikhail shivered despite the comfortable warmth of his suit.

Then he understood. “Thales. Show me the sun.”

Closing his eyes, he lifted his face toward the glare.

When he opened his eyes Mikhail inspected a strange sun.

The center of his faceplate had blocked much of the light of the main disk. But he could make out the sun’s atmosphere, the corona, a diffuse glow spreading over many times the sun’s diameter. The corona had a smooth texture that always reminded him of mother-of-pearl. But he knew that the smoothness masked an electromagnetic violence that dwarfed any human technology—indeed, a violence that was a principal cause of the damaging space weather he had devoted his own life to monitoring.

At the center of the corona he made out the disk of the sun itself, reduced by the visor’s filters to a sullen, coal-like glow. He called for magnification and could make out a speckling that might be granules, the huge convection cells that tiled the sun’s surface. And just visible near the very center of the disk, he made out a darker patch—obviously not a granule, but much more extensive.

“An active region,” he murmured.

“And a big one,” Thales replied.

“I don’t have my log to hand . . . Am I looking at 12687?” For decades humans had been numbering the active regions they observed on the sun, the sources of flares and other irritations.

“No,” Thales said smoothly. “Active Region 12687 is subsiding, and is a little farther west.”

“Then what—”

“This region has no number. It is too new.”

Mikhail whistled. Active regions usually took days to develop. By studying the resonances of the sun, immense slow sound waves that passed through its structure, you could usually spot major regions on the far side, even before the star’s stately rotation brought them into view. But this beast, he seemed, was different.

“The sun is restless today,” Mikhail murmured.

“Mikhail, your tone of voice is unusual. Did you suspect the active region was there before you asked for the display?”

Mikhail had spent a lot of time alone with Thales, and he thought nothing of this show of curiosity. “One gets an instinct for these things.”

“The human sensorium remains a mystery, doesn’t it, Mikhail?”

“Yes, it does.”

Out of the corner of his eye Mikhail spotted movement. He turned away from the sun. When his faceplate cleared he made out a light, crawling toward him through the lunar shadows. It was a sight almost as unusual, for Mikhail, as the face of the troubled sun.

“It seems I have a visitor. Thales, you’d better make sure we have enough hot water for the shower.” He began to pick his way back down the trail, taking care to plan every step in advance despite his mounting excitement. “This looks like it’s going to be quite a day,” he said.

3: Royal Society

Siobhan McGorran sat alone in a deep armchair. She had her personal softscreen unrolled on her lap, a cup of rather bitter coffee on the occasional table at her side, and her phone clamped to her ear. She was rehearsing the lecture she was to give to an audience of her most distinguished peers in less than half an hour.

She read aloud, “ ‘2037 promises to be the most significant year for cosmology since 2003, when the basic components of the universe—the proportions of baryonic matter, dark matter, and dark energy—were first correctly determined. I was eleven years old in 2003, and I remember how excited I was when the results from the Wilkinson Microwave Anisotropy Probe came in. I suppose I wasn’t a very cool teenager! But to me, MAP was a robot Columbus. That intrepid cosmology probe was sent off in the hope of finding a dark-matter China, but en route it stumbled over a dark-energy America. And just as Columbus’s discoveries fixed the geography of Earth forever in human minds, so we learned the geography of the universe in 2003. Now, in 2037, thanks to the results we anticipate from the latest Quintessence Anisotropy Probe, we—’ ”

The room lights blinked, making her stumble in her reading.

She heard her mother tut. “And so on and so forth,” Maria said, her soft Irish lilt exaggerated by the phone’s tiny speaker. “In time, after a lot of technical guff about this old spaceship nobody remembers, I suppose you’ll grope your way back to the point.”

Siobhan suppressed a sigh. “Mother, I’m the Astronomer Royal, and this is the Royal Society. I’m making the keynote speech! ‘Technical guff’ is expected.”

“And you never were very good at analogies, dear.”

“You could be a *bit* supportive.” She sipped her coffee, taking care not to spill a drop on her beige suit. “I mean, look where your little girl is today.” She flicked on her phone’s vision options so her mother could see.

These were the City of London Rooms in the Royal Society’s offices in Carlton Terrace. She was immersed in rich antiquity, with chandeliers overhead and a marble fireplace at her side.

“What a lovely room,” Maria murmured. “You know, we have a lot to thank the Victorians for.”

“The Royal Society is a lot older than the Victorians—”

“There are no chandeliers *here*, I can tell you,” Maria said. “Nothing but smelly old people, myself included.”

“That’s demographics for you.”

Maria was in Guy’s Hospital, close to London Bridge, only a few hundred meters from Carlton Terrace. She was waiting for an appointment concerning her skin cancers. For people who had grown old under a porous sky it was a common complaint, and Maria was having to queue.

Siobhan heard raised voices in the background. “Is there a problem?”

“A ruckus at the drinks machine,” Maria said. “Somebody’s credit-chip implant has been rejected. People are a bit excitable generally. It’s a funny sort of day, isn’t it? Something to do with the odd sky, maybe.”

Siobhan glanced around. “It’s not much calmer here.” As the start of the conference had approached, she had been grateful to be left alone with her coffee and a chance to run through her notes, even if she had felt duty-bound to call her mother at Guy’s. But now everybody seemed to be crowding at the window, peering out at the odd sky. It was an amusing sight, she supposed, a clutch of internationally renowned scientists jostling like little kids trying to glimpse a pop star. But what were they looking at?

“Mother—what ‘odd sky’?”

Maria replied caustically, “Maybe you should go take a look yourself. You are the Astronomer

Royal, and—” The phone connection fizzed and cut out.

Siobhan was briefly baffled; that *never* happened. “Aristotle, redial, please.”

“Yes, Siobhan.”

Her mother’s voice returned after a couple of seconds. “Hello? . . .”

“I’m here,” Siobhan said. “Mother, professional astronomers don’t do much stargazing nowadays. Especially not a cosmologist like Siobhan, whose concern was with the universe on the vastest scale of space and time, not the handful of dull objects that could be seen with the naked eye.

“But even you must have noticed the aurora this morning.”

Of course she had. In midsummer Siobhan always rose about six, to get in her daily quota of jogging around Hyde Park before the heat of the day became unbearable. This morning, even though the sun had long been above the horizon, she had seen that subtle wash of crimson and green in the northern sky—clearly three-dimensional, bright curtains and streamers of it, an immense structure of magnetism and plasma towering above the Earth.

Maria said, “An aurora is something to do with the sun, isn’t it?”

“Yes. Flares, the solar wind.” To her shame, Siobhan found she wasn’t even sure if the sun was near the maximum of its cycle right now. Some Astronomer Royal she was proving to be.

Anyhow, though the aurora was undeniably a spectacular sight, and it was very unusual to be so bright as far south as London, Siobhan knew it was nothing but a second-order effect of the interaction of solar plasma with the Earth’s magnetic field, and therefore not particularly interesting. She had continued her jogging, not at all motivated to join the rows of slack-jawed dog walkers staring at the sky. And she certainly wasn’t sorry she missed the brief panic as people had assailed the emergency services with pointless calls, imagining London was on fire.

Everybody was still at the window. It *was* all a bit strange, she conceded.

She set aside her coffee and, phone in hand, walked up to the window. She couldn’t see much past the shoulders of jostling cosmologists: a glimpse of green from the park, a washed-out blue sky. The window was sealed shut to allow the air-conditioning to work, but she thought she could hear a lot of traffic noise: the blaring of horns, sirens.

Toby Pitt spotted her at the back of the pack. A big, affable bear of a man with a strangulated Home Counties accent, Toby worked for the Royal Society; he was the manager of the conference today. “Siobhan! I won’t make jokes about the Astronomer Royal being the last to show any interest in the sky.”

She showed him her phone. “No need. My mother’s already been there.”

“It’s quite a view, though. Come and see.” He extended his massive arm around her shoulders and with a skillful combination of physical presence and smiling tact, managed to shepherd her through the crowd to the window.

The City of London Rooms had a fine view of the Mall, and of St. James’ Park beyond. The grass of the park glowed lurid green, no longer a native specimen but a tough, thick-leaved drought-resistant breed imported from southern Texas, and the relentless sprinklers sent sprays of water shimmering into the air.

But the traffic in the Mall was jammed. The smart cars had calmly packed themselves up in an optimal queuing pattern, but their frustrated drivers were pounding at their horns, and heat haze rose in a shimmer in the humid air. Looking up the road Siobhan saw that the traffic control lights and lane guides were blinking, apparently at random: no wonder the traffic was snarled.

She looked up. The sun, riding high, flooded the cloudless air with light. Even so, when she shielded her eyes she could still make out a tracery of auroral bands in the sky. She became aware of a noise beyond the blare of the traffic in the Mall, a softer din, muffled by the thick sealed window. It was a growl of frustrated driving that seemed to be rising from across the city. This snarl-up wasn’t local then.

For the first time that day she felt a flicker of unease. She thought of her daughter, Perdita, at college today. Perdita, twenty years old, was a sensible young adult. But still . . .

There was a new silence, a shift in the light. People stirred, perturbed. Glancing over her shoulder Siobhan saw that the room lights had failed. That subtle change in the ambient noise must mean that the air-conditioning had packed up, too.

Toby Pitt spoke quickly into a phone. Then he held up his hands and announced, “Nothing to worry about, ladies and gentlemen. It isn’t just us; the whole of this part of London seems to be suffering from something of a brownout. But we have a backup generator that should be coming online soon.” He winked at Siobhan and said softly, “If we can persuade the ratty old thing to start up in the first place.” But he raised his phone to his ear again, and concern creased his face.

In the heat of the June day, thirty-plus degrees Celsius, the room was already warming up, and Siobhan’s trouser suit was starting to feel heavy and uncomfortable.

From beyond the window there was a crumpling noise, a series of pops, like small fireworks, and a din of wailing car alarms. The cosmologists gasped, a collective impulse. Siobhan pushed forward to see.

That queue of traffic on the Mall was just as stationary as before. But the cars had lurched forward, each smashing into the one in front like a gruesome Newton’s cradle. People were getting out of the vehicles; some of them looked hurt. Suddenly the jam had turned from an orderly inconvenience into a minor disaster of crumpled metal, leaking lubricants, and scattered injuries. There was no sign of police or ambulances.

~~Siobhan was baffled. She had literally never seen anything like it. All cars nowadays were individually smart. They took data and instructions from traffic control systems and navigation satellites, and were able to avoid cars, pedestrians, and other obstacles in their immediate surroundings. Crashes were virtually unheard of, and traffic deaths had dwindled to a minimum. But the scene below was reminiscent of the motorway pileups that had still blighted Britain during her childhood in the 1990s. Was it possible that *all* the cars' electronic guidance systems had failed once?~~

Light flared, dazzling her. She flinched, raising her hand. When she could see again, she made out a pall of black smoke, rising from somewhere to the south of the river, its origin lost in murky smoke. Then a shock wave reached the Society building. The tough old structure shuddered, and the windows creaked. She heard a more remote tinkle of glass, the blaring of alarms, and screams.

It had been an explosion, a big one. The cosmologists murmured, grave and apprehensive.

Toby Pitt touched her shoulder. His face had lost all its humor now. "Siobhan. We've had a call from the Mayor's office. They're asking for you."

"Me? . . ." She glanced around, feeling lost. She had no idea what was happening. "The conference—"

"I think everybody will accept a postponement, in the circumstances."

"How can I get there? If that mess outside is typical—"

He shook his head. "We can videoconference from here. Follow me."

As she followed his broad-shouldered form out of the City Rooms, she raised her own phone. "Mother?"

"You're still there? All I heard was chattering."

"That's cosmologists for you. I'm fine, Mother. And you—"

"So am I. That bang was nowhere near me."

"Good," Siobhan said fervently.

"I phoned Perdita. The line was bad, but she's all right. They're keeping them at college until things settle down."

Siobhan felt huge, unreasonable relief. "Thank you."

Maria said, "The doctors are running everywhere. Their pagers seem to be on the blink. You'd think casualties would be coming in but I've seen nobody yet . . . Do you think it was terrorists?"

"I don't know." Toby Pitt had reached the door and was beckoning her. "I'll try to keep th

connection open.” She hurried from the room.

4: Visitor

The rover reached the Station long before Mikhail had clambered his way back down the trail. The visitor waited at the hab entrance with an impatience the surface suit couldn't disguise.

Mikhail thought he recognized the figure just by his stance. Though its population was scattered around its globe, on the human scale the Moon was a very small town, where everybody knew everybody else.

Thales confirmed it in a whisper. “That is Doctor Eugene Mangles, the notorious neutrino hunter. How exciting.”

That cursed computer-brain is teasing me, Mikhail thought irritably; Thales knows my feelings too well. But it was true that his heart beat a little faster with anticipation.

Encased in their suits, Mikhail and Eugene faced each other awkwardly. Eugene's face, a sculpture of planed shadows, was barely visible through his visor. He looked very young, Mikhail thought. Despite his senior position Eugene was just twenty-six—a maverick boy genius.

For a moment Mikhail was stuck for something to say. “I'm sorry,” he said. “I don't get too many visitors out here.”

Eugene's social skills seemed even more underdeveloped. “Have you seen it yet?”

Mikhail knew what he meant. “The sun?”

“The active region.”

Of course this boy had come here for the sun. Why else visit a solar weather station? Certainly not for the crusty, early-middle-aged astrophysicist who tended it. And yet Mikhail felt a foolish, quite unreasonable pang of disappointment. He tried to sound welcoming. “But don't you work with neutrinos? I thought your area of study was the core of the sun, not its atmosphere.”

“Long story.” Eugene glared at him. “This is important. More important than you know, yet. I predicted it.”

“What?”

“The active region.”

“From your studies of the core? I don’t understand.”

“Of course you don’t,” Eugene said, apparently careless of any offense he might cause. “I logged my predictions with Thales and Aristotle, date-stamped to prove it. I’ve come here to confirm the data. It’s come to pass, just as I said it would.”

Mikhail forced a smile. “We’ll talk it over. Come inside. You can see as much data as you want. Do you like coffee?”

“They have to listen,” said Eugene.

They? . . . “About what?”

“The end of the world,” Eugene said. “Possibly.” He led the way into the dustlock, leaving Mikhail standing openmouthed.

They didn’t talk as they worked their way through dustlock and airlock into the hab. Every human on the Moon was still a pioneer, and if you were smart, no matter what was on your mind, as you moved from one safe environment to another through seals and locks and interfaces and in and out of EVA suits, you concentrated on nothing but the life-preserving procedures you were going through. If you weren’t smart, of course, you would be lucky if you were forcibly shipped out before you killed yourself, or others.

Mikhail, slick with daily practice, was first out of his EVA suit. As the suit slithered to its cleaning station—somewhat grotesquely, its servos dragging it across the floor like an animated flayed skin—Mikhail, in his underwear, went to a sink where he scrubbed his hands in a slow trickle of water. The gray-black dust he had picked up handling the suit, grimy despite the dustlock’s best efforts, had rubbed into his pores and under his nails, and was burning slowly with his skin’s natural oils, giving off a smell like gunpowder. The Moon’s dust had been a problem since the first footsteps taken here: very fine, getting everywhere, and oxidizing enthusiastically whenever it got the chance, the dust corroded everything from mechanical bearings to human mucous membranes.

Of course it wasn’t the engineering problems of Moon dust that were on Mikhail’s mind right now. He risked a look around. Eugene had taken off boots and gloves, and he lifted his helmet away, shaking his beautiful head to free up thick hair. That was the face Mikhail remembered, the face he had first glimpsed at some meaningless social function in Clavius or Armstrong—a face fresh and hardened into manhood, but with the symmetry and delicacy of boyhood, even if the eyes were a little wild—the face that had drawn him as helplessly as a moth to a candle.

As Eugene stripped off his spacesuit Mikhail couldn't help dwelling on an old memory. "Eugene, have you ever heard of *Barbarella*?"

Eugene frowned. "Is she at Clavius?"

"No, no. I mean an old space movie. I'm something of a buff of pre-spaceflight cinema. A young actress called Jane Fonda . . ." Eugene clearly had no idea what he was talking about. "Never mind."

Mikhail made his way to the dome's small shower cubicle, stripped off the last of his clothing, and stood under a jet. The water emerged slowly, in big shimmering low-gravity droplets that fell with magical slowness to the floor, where suction pumps drew in every last precious molecule. Mikhail lifted his face to the stream, trying to calm himself.

Thales said gently, "I've brewed some coffee, Mikhail."

"Thales, that was thoughtful."

"Everything is under control."

"Thank you . . ." Sometimes it really was as if Thales knew Mikhail's moods.

Thales was actually a less sophisticated clone of Aristotle, who was an intelligence emergent from a hundred billion Earth-side computers of all sizes and the networks that linked them. A remote descendant of the search engines of the late twentieth century, Aristotle had become a great electronic mind whose thoughts crackled like lightning across the wired-up face of the Earth; for years he had been a constant companion to all humankind.

When humans had begun their permanent occupation of the Moon at Clavius Base, it had been inconceivable that they should not take Aristotle with them. But it takes light more than a second to travel from Earth to the Moon, and in an environment where death lurks a single error away, such delays were unacceptably long. So Thales had been created, a lunar copy of Aristotle. Thales was updated continually from Aristotle's great memory stores—but he was necessarily simpler than his parent, for the electronic nervous system laid across the Moon was still rudimentary compared to that of Earth's.

Simpler or not, Thales did his job. He was certainly smart enough to justify the name he had been given: Thales of Miletus, a sixth-century Greek, had been the first to suggest that the Moon shone not by its own light but by reflection from the sun—and, it was said, he had been the first man to predict a solar eclipse.

For everybody on the Moon, Thales was always there. Often lonely despite his stoic determination, Mikhail had been soothed by Thales's measured, somewhat emotionless voice.

Right now, thinking wistfully of Eugene, he felt he needed soothing.

He knew that Eugene was based at Tsiolkovski. The huge Farside crater was host to an elaborate underground facility. Buried in the still, cold Moon, undisturbed by tremors, shadowed from Earth

radio clamor and shielded from all radiation except for a little leakage from trace quantities in the lunar rocks, it was an ideal location for hunting neutrinos. Those ghost-like particles scooted through most solid matter as if it weren't even there, thus providing unique data about such inaccessible places as the center of the sun.

But how odd to come all the way to the Moon, and then to burrow into the regolith to do your science, Mikhail thought. There were so many more glamorous places to work—such as the big planet-finder telescope array laid out in a North Pole crater, capable of resolving the surfaces of Earth-like planets orbiting suns spread across fifty light-years.

He longed to discuss this with Eugene, to share something of his life, his impressions of the Moon. But he knew he must keep his reactions to the younger man in appropriate categories.

Since his teens, when he had become fully aware of his sexuality, Mikhail had learned to master his reactions: even in the early twenty-first century, homosexuality was still something of a taboo in Vladivostok. Discovering in himself a powerful intellect, Mikhail had thrown himself into work, and had grown used to a life lived largely alone. He had hoped that when he moved away from home, his career took him through the rest of the sprawling Eurasian Union as far as London and Paris, and then, at last, off the Earth entirely, he would find himself in more tolerant circles. Well, so he had; but by then it seemed he had grown too used to his own company.

His life of almost monastic isolation had been broken by a few passionate, short-lived love affairs. But now, in his midforties, he was coming to accept the fact that he was never likely to find a partner to share his life. That didn't make him immune to feelings, however. Before today he had barely spoken two words to this handsome boy, Eugene, but that, evidently, had been enough to develop a foolish crush.

He had to put it all aside, though. Whatever Eugene had come to Shackleton for, it wasn't for Mikhail.

The end of the world, the boy had said. Frowning, Mikhail towed himself dry.

5: Emergency Management

Siobhan was taken to the Council Room on the first floor of the Royal Society building. The room's centerpiece was an oval conference table large enough to seat twenty or more, but Siobhan was alone.

here save for Toby Pitt. She sat at the head of the table uncertainly. On the wall was a slightly surreal Zulu tapestry, meant to show symbolically the rise of science, and portraits of former fellows—most dead white males, though the more recent animated images were more diverse.

Toby tapped at the table's polished surface, which turned transparent to reveal a bank of embedded softscreens. The screens lit up, variously showing scenes of disaster—crashes on the road and rail systems, raw sewage spilling from a pipe onto a beach somewhere, what looked horribly like the wreck of a plane plowed into a Heathrow runway—and concerned faces, most with softscreens in the backgrounds and earpieces clamped to their heads.

One serious-looking young woman seemed to be calling from a police control room. When she caught Siobhan's eye, she nodded. "You're the astronomer."

"The Astronomer Royal, yes."

"Professor McGorran, my name is Phillippa Dufлот." Perhaps in her early thirties, alarmingly well-spoken, she wore a slightly disheveled business suit. "I work in the Mayor's office; I'm one of his PAs."

"The Mayor—"

"Of London. She asked me to find you."

"Why?"

"Because of the emergency, of course." Phillippa Dufлот looked irritated, but she visibly calmed herself; considering the strain she was evidently under, Siobhan thought, her self-control was impressive. "I'm sorry," Phillippa said. "All this has hit us so suddenly, over the last couple of hours or less. We rehearse for the major contingencies we can think of, but we're struggling to cope today. Nobody anticipated the *scale* of this. We're trying to find our feet."

"Tell me how I can help you."

Formally Phillippa was calling on behalf of the London Resilience Forum. This was an interagency body that had been set up following the upsurge in terrorism at the turn of the century. Chaired from the Mayor's office, it contained representatives of the city's emergency services, transport, the utilities, the health services, and local government. There was a separate body responsible for London emergency planning, which also reported in to the Mayor. Above such local bodies were national emergency planning agencies, which reported to the Home Office.

Siobhan learned quickly that most of these agencies were talking shops. The real responsibility for emergency responses lay with the police, and right now the key figure in touch with the Mayor was the chief constable. It was the way things were done in Britain, Siobhan gathered; there was a lack of central control, but a local flexibility and responsiveness that generally worked well. But now that Britain was thoroughly integrated into the Eurasian Union there was also a Union-wide emergency management agency, based on the Americans' FEMA, under whose auspices, some years earlier, firefighters from London had been sent in response to a chemical plant disaster in Moscow.

And today this network of disaster management agencies was buzzing with bad news. London was afflicted by a whole series of interconnected problems, whose root cause Siobhan at first couldn't guess at. Suddenly, all at once, everything was falling apart.

The most immediate problem was the collapse of the power grid. Phillippa bombarded Siobhan with data on areas of brownout and blackout, and images of the consequences: here was an underground shopping mall in Brent Cross, its lights doused and elevators and escalators stalled, thousands of people trapped in a darkness broken only by a ruddy emergency glow.

Phillippa looked doleful. "The very first call we logged today was from a man trapped in his hotel room when the electronic lock jammed up. Since then it's just mushroomed. Every transport system has ground to a halt. People are stranded on planes ramped up on runways; others are trapped in planes that can't land. We don't even have numbers yet. We don't dare think how many people are just trapped in lifts!"

The power system was the problem. Electrical power originated in generating stations—these days mostly nuclear, wind-generated, tidal, and a few fossil-fuel-burning relics. The generators sent out rivers of current in transmission cables at high voltages, more than a hundred thousand volts. They were stepped down at local substations and transformers and sent out through more lines, eventually reaching the level of the few hundred volts that reached businesses and homes.

"And now it's all failing," Siobhan prompted.

"Now it's failing."

Phillippa showed Siobhan an image of a transformer, a unit as big as a house, shaking itself to pieces as its core steel plates crashed and rattled. And here were power lines sagging, smoking, visibly melting, and where they touched trees or other obstacles powerful arcs sparked fires.

This was called magnetostriction, Phillippa said. "The engineers know what's happening. It's just that the GICs today are bigger than anything they've seen before."

"Phillippa—what's a *GIC*?"

"A geomagnetically induced current." Phillippa eyed Siobhan with suspicion, as if she shouldn't have had to explain; perhaps she wondered if she was wasting her time. "We're in the middle of a geomagnetic storm, Professor McGorran. A huge one. It came out of nowhere."

A geomagnetic storm: of course, a storm from the sun, the same cause as the beautiful aurora. Siobhan, her brains clogged in the room's gathering heat, felt dull not to have grasped this at once.

But her basic physics was coming back to her. A geomagnetic storm, a fluctuation of Earth's magnetic field, would induce currents in power lines, which were simply long conductors. And as the induced currents would be direct, while the generated electrical supply was alternating, the system would quickly be overwhelmed.

Phillippa said, "The generating companies are wheeling—"

“Wheeling?”

“Buying in capacity from outside. We have exchange deals with France, primarily. But the French are in trouble, too.”

“There must be some tolerance in the system,” Siobhan said.

“You’d be surprised,” Toby Pitt said. “For fifty years we have been growing our power demand but have resisted building new power stations. Then you have market forces, which ensure that every component we do install barely has the capacity to do the job that’s asked of it—and all at the lowest possible cost. So we have absolutely no resilience.” He coughed. “I’m sorry. A hobbyhorse of mine.”

“The worst single problem is the loss of air-conditioning,” Phillippa said grimly. “It isn’t even noon yet.”

In a 2030s British midsummer, heat was a routine killer. “People must be dying,” Siobhan said, wondering; it was the first time it had really struck her.

“Oh, yes,” Phillippa said. “The elderly, the very young, the frail. And we can’t get to them. We don’t even know how many there are.”

Some of the softscreens flickered and went blank. This was the other side of the day’s problem, Phillippa said: communications and electronic systems of all kinds were going down.

“It’s the satellites,” she went on. “The comsats, navigation satellites, the lot—all taking a beating up there. Even land lines are failing.”

And as the world’s electronic interconnectedness broke down, the smart systems that were embedded in everything, from planes to cars to buildings to clothes and even people’s bodies, were also failing. That poor man stuck in his hotel room had only been the first. Commerce was grinding to a halt as electronic money systems failed: Siobhan watched a small riot outside a petrol station where credit implants were suddenly rejected. Only the most robust networks were surviving, such as government and military systems. The Royal Society building happened still to be connected to central services by old-fashioned fiber-optic cables, Siobhan learned; the venerable establishment had been saved by its own lack of investment in more modern facilities.

Siobhan said uncertainly, “And this is another symptom of the storm?”

“Oh, yes. While our priority is London, the emergency isn’t just local, or regional, or even national. From what we can tell—data links are crashing all over the place—it’s global . . .”

Siobhan was shown a view of the whole world, taken from a remote Earth resources satellite. Over the planet’s night side aurorae were painted in delicate, heartbreakingly beautiful swirls. But the world below was not so pretty. Darkened continents were outlined by the lights of the cities strung along their coasts and the major river valleys—but those necklaces of lights were broken. As each outage triggered problems in neighboring regions, the blackouts were spreading like infections. Power utilities were in some places trying to help each other out, but, Phillippa said, there was conflict

Quebec was accusing New York of “stealing” some of its megawatts. In a few places Siobhan saw the ominous glows of fires.

All this in a couple of hours, Siobhan thought. How fragile the world is.

But the satellite imagery was full of hash, and at last it broke down altogether, leaving a pale blue screen.

“Well, this is dreadful. But what can I do?”

Phillippa again looked suspicious. *You need to ask?* “Professor McGorran, this is a geomagnetic storm. Which is primarily caused by problems with the sun.”

“Oh. And so you called an astronomer.” Siobhan suppressed an urge to laugh. “Phillippa, I’m a cosmologist. I haven’t even thought about the sun since my undergraduate days.”

Toby Pitt touched her arm. “But you’re the Astronomer Royal,” he said quietly. “They’re out of their depth. Who else are they going to call?”

Of course he was right. Siobhan had always wondered if her royal warrant, and the vague public notoriety that came with it, was worth the trouble. The first Astronomers Royal, men like Flamsteed and Halley, had run the observatory at Greenwich and had spent most of their time making observations of the sun, Moon, and stars for use in navigation. Now, though, her job was to be a figurehead at conferences like today’s, or an easy target for lazy journalists looking for a quote—and it seemed, an escape route for politicians in a crisis. She said to Toby, “Remind me to quit when this is all over.”

He smiled. “But in the meantime . . .” He stood up. “Is there anything you need?”

“Coffee if you can get it, please. Water if not.” She raised her own phone to her face; she felt a spasm of guilt that she hadn’t even noticed it had lost its signal. “And I need to speak to my mother,” she said. “Could you bring me a land line?”

“Of course.” He left the room.

Siobhan turned back to Phillippa. “All right. I’ll do my best. Keep the line open.”

6: Forecast

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