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CHAPTER 1

Breakthrough

I'm gonna hunt you down like a rabid dog, Sloan.” Albert Marrano clenched his teeth on an e-cigarette as he concentrated on a tiny screen.

“Don’t joke. My sister’s pug just went rabid.”

“You’re kidding.” Marrano thumbed the controls of his handheld game console.

“Raccoon bite. They had to put Mr. Chips down. Her kids are still in therapy.” Mashing buttons on his own wireless console, Sloan Johnson sat in the nearby passenger seat. Then he let out a deep “Heh, heh.”

Marrano cast a look at him. Johnson had that Cheshire cat grin on his face again. “Shit . . .” Marrano tried to rotate his player around, but Johnson’s avatar was already behind him.

Double-tap. The screen faded.

“You really do suck at this, Al.”

“Goddamnit!” Marrano tossed the device onto the car’s stitched leather dashboard and pounded the steering wheel. “You have got to be kidding me. Worse than playing my goddamn nephew.”

“That’s two thousand bucks you owe me.”

“Best out of five?”

Johnson powered down his device. “It’s a lousy two K. What are you complaining about?”

Headlights swept across them as another car turned into the nearly empty parking lot of a gritty industrial building.

“Here we go.” Marrano pocketed his e-cigarette.

“Bout fucking time.”

They exited their parked Aston Martin One-77 as an older Mercedes pulled toward them.

“Jesus, look at this thing.”

“They go forever, though.”

“You ever get stuck behind one of these on the highway? Like breathing coal dust.” He motioned for the driver to pull up to them.

The Mercedes parked, and a distinguished, if disheveled, elderly South Asian man with spectacles and a full head of unconvincing jet-black hair got out. Slowly. He buttoned his greatcoat against the cold.

Marrano and Johnson approached, removing their leather gloves and extending hands. Marrano smiled. “Doctor Kulkarni. Albert Marrano. Thanks for coming out so late.”

“Yes.” They shook hands. “I don’t usually drive at night. But your CEO said this couldn’t wait.”

“That she did.” Marrano turned. “This is my colleague, Sloan Johnson. He manages the portfolio for Shearson-Bayers.”

They shook hands as well. “Pleased to meet you.”

“Likewise.”

Marrano pulled his lambskin glove back on. “So you’re our physicist. Princeton, right?”

Kulkarni nodded. “Yes, but I live close by in Holmdel. No one would tell me what this is about.”

Marrano grimaced. “Not over the phone, no. Legal says they already have you under contract, so I’m supposed to remind you about your non-disclosure agreement and noncompete clause.”

The elderly Indian nodded impatiently. “Fine, fine. Now what is this ‘physics emergency’ of yours?”

Marrano waved his arm to encompass the drab, windowless building before them. “Tech start-up. Run by a couple particle physicists developing chiral superconductors. The investment predates me, but these guys

claim they've made some big breakthrough. I'll be damned if I can understand a thing they're saying."

Johnson edged in. "We need you to evaluate their scientific claims. Tell us if they're on the level."

Kulkarni nodded. "Is there a business plan or lab report I can review?"

Both men exchanged looks. Marrano answered, "We can't part with printed material at this point, Professor. You'll have to review this firsthand."

"Then I'll need to speak with the founders. Tour the facility." Kulkarni eyed the darkened building.

"Oh, they're in there."

"This late?"

"Yeah. Blowing through thirty thousand dollars an hour in off-peak electricity."

An electrical hum became all the more noticeable from behind a nearby fenced transformer yard as he mentioned it.

"We were told not to leave this place or talk to anyone until we got confirmation from an expert. Apparently whatever these guys sent the egg-heads in New York turned some heads. Frankly, I have my doubts."

Johnson added, "We're supposed to have you confirm that it's for real."

Kulkarni adjusted his spectacles to keep them from fogging. "That *what's* for real?"

Marrano shrugged. "Like I said: I don't even understand it. Something about 'ionic lattices.' Follow me." He brought them toward a windowless steel door in a nearby brick wall, then tapped in a code at a keypad. The door beeped and unlocked. He ushered them inside.

The group walked down a narrow drywall corridor with a lofty ceiling. Ahead they could hear the echo of laughter in a cavernous space. A deep hum permeated the corridor, along with the smell of ozone. There was a loud bang somewhere, followed again by hoots of laughter and breaking glass.

"Is it safe?"

“Not sure, Professor.” Marrano walked onward.

Moments later, the trio came out into a large, darkened workspace, with a high, exposed girder ceiling. Work lights glowed from the center of the room, casting long shadows on the walls. Big as it was, the room was still cluttered—its edges lined with overflowing shelving units and banks of heavy-duty electrical capacitors. LED lights glowed on the equipment, digital readouts fluctuating widely. Rows of rubber-topped lab tables stood in their path, every inch piled high with circuit boards, oscillators, 3D printers, and heaps of electrical components. There were also origami geodesic models in all sizes. The place looked more like the attic of an eccentric hoarder than a laboratory.

Marrano halted them as he noticed shattered glass, broken furniture, and unknown liquids scattered across the concrete floor. A glance up also revealed dents and holes pounded into the wall behind them. They were downrange of something.

A burst of light in the center of the room drew their attention to a towering circular assembly. It was roughly ten feet in diameter and rose up to the thirty-foot-high ceiling. Thick electrical cables snaked through it, woven in and out of metal scaffolding and what appeared to be color-coded coolant piping. There were OSHA warning signs for high voltages, liquid gases, and corrosive chemicals. The assembly was clearly the focus of much organized activity, while the rest of the room had been allowed to go feral.

At the heart of the massive assembly was a concave stone or ceramic pedestal several feet in diameter—shaped like a lens—above which was an array of metal rods, their tips aimed at the center of an imaginary sphere. The open space that the sphere encompassed was roughly six feet in diameter. Other sensor arrays and test rigs were distributed around the platform as well—tubes, pipes, wires, cameras, and more inscrutable devices, all aimed at the empty space at the heart of the machine.

Next to it stood the silhouettes of four men in coveralls with an assortment of hard hats, lab goggles, and, on one, a black paintball mask. They were crowded around a flat-panel computer monitor perched on a cart. Cables ran from it back into the scaffolding tower. As they read the

contents of the screen, one of the researchers suddenly shouted, “Off-axis acceleration zero-point-nine-three-nine! Hell, yeah, baby!”

They high-fived one another, shouting with joy, and clinked together what appeared to be large bottles of beer. They danced around, arm in arm like devils before a fire, their shadows cavorting along the walls.

Marrano shouted, “Hey! What the hell, guys?”

The men stopped and looked to the doorway. The one with the paint-ball mask flipped it up to reveal a youthful bearded face. He smiled and raised a half-empty malt liquor bottle. “Marrano! Just in time. Check this out.”

Marrano sighed in irritation as he, Johnson, and Kulkarni gingerly navigated around broken glass and pools of liquid. He frowned. “This place is a mess, Mr. Grady.”

“Maid’s on vacation. Get on over here.”

The other researchers stood alongside Grady, all wearing blue coveralls with a white number forty-one embroidered over the chest pocket. Two were young Asian men—one of them plump but tall, the other wiry like a wrestler. Next to them was a scholarly looking Caucasian man in his seventies or eighties, wearing a sweater and necktie beneath his loose-fitting blue coveralls. He leaned on a cane, visibly guarded about the new visitors.

Marrano gestured as they made their way closer. “Jon Grady, this is Doctor Sameer Kulkarni, Princeton University plasma physics lab. He’s here to evaluate”—his eyes trailed up the towering assembly—“whatever the hell this is.”

“Doctor Kulkarni, great to meet you.” Grady waved them in with welding-gloved hands. He gestured to his team. “That burly guy over there is Raharjo Perkasa, postdoc out of Jersey Tech. That’s Michael Lum, our chemical engineer from Rutgers.”

Both the young men nodded.

“And over here—”

Kulkarni was distracted momentarily as he bumped against an origami polyhedron on a nearby table—but then he took notice of the fourth researcher. “Doctor Alcot. Bertrand Alcot.” He laughed. “What on earth are you doing here? How long has it been?”

The elderly Alcot smiled as they shook hands heartily. “A good five or six years, I think.”

Marrano and Johnson exchanged looks. “You know each other?”

Kulkarni nodded. “Doctor Alcot and I coauthored a paper on hydrodynamics long ago. While he was at Columbia. I thought you retired, Bert.”

Alcot nodded. “From the university, yes. I was encouraged to retire. So I did.”

Kulkarni seemed to be trying to recall something. “The last thing I read of yours was . . .” He hesitated. “Well, it was rather controversial, if I remember.”

“That’s diplomatic of you. It was a paper on modified Newtonian dynamics.”

There was an awkward silence.

Grady spoke as he tapped away at a computer keyboard. “Doctor Alcot’s career difficulties are my fault, I’m afraid. I’ve been told I’m a bad influence.”

“You *are* a bad influence.” Alcot gestured to Grady. “He’s been pestering me for years with his strange ideas.”

Grady snorted as he studied the numbers on his computer screen.

Alcot continued, “I tried mathematically disproving Jon’s theories but couldn’t.” He leaned back on his cane. “After Greta passed away, Jon convinced me to come join him here.”

“My condolences on Greta. I hadn’t heard. When did she pass, Bert?”

“About two years ago now.”

“So sorry to hear it.” Kulkarni glanced back to Grady. “Then Mr. Grady worked with you at Columbia?”

Grady shook his head, still studying the computer monitor. “Heh. I’m no scholar. I flunked out of a state college.”

Alcot added, “Jon has a master’s in physics.” He paused and somewhat sheepishly added, “An online degree.”

“Ah, I see. Then how did you two . . . ?”

“Jon’s been emailing me for years. Incredibly persistent. Got to the point I could no longer ignore him. It was either that or a restraining order.” Alcot gestured to the towering assembly. “This is the result.”

Kulkarni looked to Marrano, then back to Alcot. "Then it was Mr. Grady who formed the company?"

"Yes."

"With other people's money." Marrano picked up one of several origami geometric shapes from a nearby table. He gazed at the researchers meaningfully. "I haven't heard anyone mention chiral superconductors yet."

Grady answered as his fingers clattered at the keyboard. "Do you even know what chiral superconductors are, Mr. Marrano?"

"No, and it's not for lack of trying. But I do know the government invested in this place. So someone somewhere must understand it."

Grady smiled. "And thus marches Wall Street."

Marrano tossed the paper model aside and turned back to Kulkarni. "Can you please find out what's going on? I'd like to get back to the city."

Johnson eyed the large bottles of cheap beer in the researchers' hands. "You guys always drink while you're messing around with high-voltage equipment?"

Alcot gave the barest hint of a smile. "We're celebrating."

Again Grady barely looked up from his keyboard as he answered for Alcot. "Bert's right. Tonight is a special night. As you'll see." He finished typing, then looked up to regard them. "I'm guessing you'll all need a drink soon enough."

Marrano and Johnson exchanged unimpressed looks. "What's the forty-one stand for?" Marrano gestured to the number on the researchers' coveralls.

Grady tossed his paintball mask onto a nearby tool cart. He now looked like a BMW mechanic in blue coveralls. He pulled back his unruly, shoulder-length hair, wrapping it into a ponytail as he spoke. "Forty-one represents a starting point. Prime numbers are the atoms of mathematics. Viewed on an equilateral grid, the number forty-one appears at the very center of all the prime numbers below one hundred. And if we consider de Polignac's conjecture, the fractal nature of that numerical array has tremendous significance at higher scales."

"Jesus . . ." Marrano and Johnson again exchanged looks.

Alcot interceded. "I'll grant you that Jon has some eccentricities,

gentlemen, but I've begun to realize that he simply has a different perspective on things."

Marrano gazed at the dozens of origami shapes scattered among electrical components on nearby tables. "That's a shocker."

Alcot picked up one of the shapes. "Non-Euclidean curved surface folding. Jon sometimes thinks through problems with his hands."

"It helps with certain problem sets." Grady approached them, apparently noticing the dubious look on the investor's faces. "It's fair to say I've strayed a bit from my business plan."

Marrano scowled. "Strayed? I can't even see your business plan from here. I've been going through your expenses. You've blown through half your annual budget in the last three months on utility bills alone."

"An opportunity cost." Grady gestured to the towering apparatus. "High energies are necessary to induce exotic states in baryonic matter. And exotic states are what we needed."

"I'm guessing your burn rate is the real reason we're here." Marrano gestured to the massive tower of equipment. "Is this your Hail Mary pass before you go under? And what the hell is baryonic matter?"

"Physical *stuff*—for our purposes at subatomic scales." He looked to Kulkarni. "Doctor Alcot and I have been studying the interaction of high-energy particles moving through doped graphene within superfluids like helium-4."

Kulkarni nodded uncertainly. "Okay. And how does that relate to chiral superconductors, Mr. Grady?"

There was a pause.

"It doesn't."

There was a tense silence.

"But I could get funding for chiral superconductors."

"That's fraud."

"*Fraud's* an ugly word. Anyone reading the business plan able to comprehend our mathematics would clearly understand what I was proposing."

"Like I said: fraud."

Grady looked unfazed. "Then it would make for the most boring

lawsuit ever. Besides, someone in government was evidently intrigued by my math.”

Kulkarni turned to Alcot. “Did you know about this, Bert?”

Alcot grimaced. “I was unaware of it for a time, but eventually I came to accept it as necessary.”

“Your professional reputation—”

Grady interceded. “The fault is mine. Not Professor Alcot’s. But as you’ll see, none of that matters now.”

Alcot held up a reassuring hand. “I’ll be fine, Sam.”

“I’m concerned that Mr. Grady has been trading on your academic credentials.”

“It’s not like that at all. Almost the opposite, in fact.”

Kulkarni turned back to Grady. “So what is it you’re doing with these superfluids?”

Johnson glanced between the physicists. “‘Superfluids.’ ‘Baryonic matter.’ It all sounds like bullshit to me.”

Grady took a swig from a forty-ounce beer, then wiped his beard with his gloved hand. “Superfluids are very real, Mr. Johnson. A superfluid is a state in which matter behaves like a fluid with zero viscosity and zero entropy. Looks like a normal liquid, but at ultralow temperatures flows without friction. Point is: In certain extreme environments the standard model of physics breaks down. Look . . .”

He approached a glass enclosure mounted to one side of the tower and slipped his arms through a pair of thick silvery gloves in its face. The others watched as inside the glovebox Grady unscrewed a smoking ceramic cylinder from the side of the monstrous assembly. He then grabbed a nearby glass beaker and carefully poured a clear, steaming liquid into it from the cylinder.

“This is helium-4 at slightly below two-point-one-seven Kelvin.” He held the beaker up and to the side. Even though the beaker was made of thick glass, the liquid inside dripped through the bottom as if it were a window screen. It hit the floor of the glovebox and quickly evaporated.

Johnson looked surprised. “Holy shit. It’s pouring through glass.”

“Exactly. In a quantum state strange things happen. It’s paring matter

down to its essence. Subatomic particles. Slipping between the cracks of standard physics.” He screwed the cylinder back in the monstrous assembly. “Each particle of helium-4 is a boson, by virtue of its zero spin. At the lambda point, its quantum effects become apparent on a macroscopic scale—meaning individual atoms are no longer relevant within the liquid. *Superfluid vacuum theory* is an approach in theoretical physics where space-time itself is viewed as a superfluid. The fluid of reality.”

Kulkarni frowned. “Superfluid vacuum theory? Why . . . What are you trying to do here, Mr. Grady?”

“We’re attempting to reflect gravitational waves, Doctor Kulkarni.”

Kulkarni was momentarily speechless. He turned to Alcot. “Is he serious, Bert? And you agreed to this?”

Alcot shrugged. “They say it’s important to stay active in retirement.”

Kulkarni turned back to Grady. “What on earth made you think this was feasible?”

“Because I can see it right here.” Grady pressed a finger against his head.

Kulkarni just stared.

Grady held up a hand. “All right, you’re skeptical. Fair enough.” He gestured to the tower. “A superfluid flows without friction. And superconductors allow electrons to flow without resistance. What we did was suspend a graphene coil within a superfluid.”

“Why graphene?”

“It’s a superconducting film. Replicates electrons moving through a near-perfect vacuum. Isolates particles from interference. Graphene also exhibits exotic effects under certain conditions.”

“I’m still not seeing how this relates to your goal, Mr. Grady.”

“Right. I needed a charged superconducting sheet. The quantum mechanical nonlocalizability of the negatively charged Cooper pairs, protected from the localizing effect of decoherence by an energy gap, causes the pairs to undergo nongeodesic motion in the presence of a gravitational wave.”

Marrano threw up his hands. “I told you, Professor, this guy is just stringing words together at random.”

Kulkarni held up a reassuring hand to Marrano and focused back on Grady. “Go on.”

Grady shrugged. “The surrounding *non-superconducting* ionic lattice is localized and so executes geodesic motion, moving along with space-time, while the Cooper pairs execute non-geodesic motion—thereby accelerating relative to space-time. The different motions lead to a separation of charge. That charge separation causes the graphene to become electrically polarized, generating a restoring Coulomb force. The back action of the Coulomb force on the Cooper pairs magnifies the mass supercurrents generated by the wave—producing a reflection.”

Kulkarni grimaced. “Mr. Grady, if this was so, why do Bose-Einstein condensates follow geodesics? I can drop them in a vacuum chamber, and they fall just like Galileo’s rock.”

Grady grabbed a piece of paper from a table and started making intricate folds as he talked. “Yes, but the deBroglie wavelength of the BEC is on the order of a millimeter, whereas the gravity field wavelength is effectively infinite—which means gravity can move it around. If the de Broglie wavelength can be made longer than the gravity wavelength, we can in principle isolate the BEC from the gravity wave.”

“Okay, but even so, it’s only true for time-varying fields—not static fields like this.”

“Agreed, but I had an idea about that, too.” He held up what was now a paper sphere—handily crafted. He waved his hand around it. “Neutron stars have massive magnetic fields. And superconductors—like this graphene—*exclude* magnetic fields. But a neutron star like Cassiopeia A—which has a proton superconductor at its core—nonetheless has a massive magnetic field.”

Kulkarni just stared.

“How is that possible, I wondered? It’s because superfluids containing charged particles are *also* superconductors. The combination has some extraordinary effects. Add a superfluid to a superconductor, and the superconducting boundary shifts, changing the value of kappa and causing truly exotic behavior at the new superconducting boundary.” He slapped the side of the massive assembly. “I had a theory about the distortion of gravitational waves at that superconducting boundary.”

Kulkarni sighed. “Mr. Grady, I don’t see how this could accomplish anything except waste money.”

Grady gazed at the professor. “Right . . .” He turned to the chubbier of the two Asian men. “Raj, bring the power up, please.”

“You got it.” Perkasa chuckled and moved toward the bank of capacitors on the edge of the room. He motioned to the visitors. “You guys may want to step back a bit. I’m about to pump fifty megawatts into this thing.”

Kulkarni snapped a look at Grady. “That could light a small city.”

Grady nodded. “Yeah, I know.”

Before anyone could object, Perkasa raised his hand over a glowing button. “Heads up! And three, and two, and one . . .” With a jab of his thick finger a deep hum settled over the lab. An eerie glow appeared in the sphere as motes of dust were ionized; then the glow faded.

Grady raised his beer bottle to the opening of a long clear tube that snaked down into the heart of the monstrous assembly. “Just watch.” He poured.

All eyes followed the beer as it coursed down the plastic tube and spilled out across the concave platform. . . .

At which point the liquid fell straight up.

Kulkarni removed his glasses and stared, mouth agape. “Good lord . . .”

As the liquid “fell” upward, it passed some invisible point where natural gravity returned, and then it spilled back toward earth again, like a fountain—only to be caught once more in the altered field. Soon the liquid began bobbing up and down, oscillating between ever narrowing high and low points until it reached equilibrium. Before long it was bubbling around like a domed membrane on the edge of both gravity fields, a seething polar “beer cap” on an invisible globe.

Kulkarni put his glasses back on. “My God . . . it’s a flux.”

Grady nodded. “Exactly. Gravitational fields follow the same shape as electromagnetic fields. Just as the flowing electrons in a plasma jet generate a magnetic field, we’re thinking these quantum fields interact with gravitation somehow.”

“*Antigravity?* You can’t be serious.”

“No. Not antigravity. What I think we’ve created is a machine that’s ‘shiny’ to gravity—a *gravity mirror*. Or perhaps refraction is more accurate. I’m not sure yet.”

Kulkarni pointed. “This is clearly some form of electromagnetism. Water is diamagnetic, and at these high-energy levels you could probably float a brick given just trace amounts of magnetic material. Surely you don’t claim you’re reflecting gravity?”

“Superconductors exclude magnetic fields, Doctor.” Grady pointed. “And you must admit our test results look promising.”

“But . . .” Kulkarni was speechless for a few moments as he watched the cheap malt liquor bubbling around in midair. “If you could bend gravity . . . it would mean . . .” His voice trailed off.

Grady finished for him. “It would provide compelling support for the existence of gravitational waves. Not to mention gravitons. And a few other things besides.”

Kulkarni groped for a chair, but all the nearby ones were in pieces. “My God . . .”

“It is pretty damn cool.”

Kulkarni started shaking his head again. “No. This must be electromagnetism. Even a nonferrous liquid—”

“You’re quite right to be skeptical. Our lab is open to you.”

“Because what you’re suggesting . . . well, the Standard Model of physics . . . this would create an entirely new form of astronomy. It would mean the Nobel Prize. And that’s just for starters.”

Alcot, Grady, and the technicians exchanged looks.

Grady laughed. “I hadn’t thought of that, Bert.”

Alcot raised his eyebrows. “It was the first thing I thought of.”

Marrano held up his hands. “Whoa! Guys. Hang on a second.”

They all turned to Marrano.

“Just an observation: You’re using enough energy to light a hundred thousand homes—to levitate a mouthful of malt liquor six feet off the ground. That’s about as cost-effective as using a Boeing 747 to clean a throw rug.”

Doctor Kulkarni was starting to ponder what he was looking at as he waved Marrano off. “You’re not realizing the potential significance of this discovery, Mr. Marrano.”

“Significance is great, but it’s not gonna make the economics work any better.”

“If what we’re really looking at is antigravity—or a gravity mirror, as you say, Mr. Grady—and we haven’t yet determined that . . .” Kulkarni started examining the computer screen as he spoke to Marrano. “The potential impact would be enormous, it could reveal . . . well, the warp and weft in the fabric of the universe. It would help us understand the structure of space-time itself. So far, gravity is the only force that hasn’t conformed to the Standard Physics Model. No, this is potentially the most significant discovery of the century. Of perhaps any century. It could unlock untold scientific advances. Even a grand unified field theory.”

The moneymen exchanged looks.

“Okay, and the commercial potential for that is . . . ?”

It was the scientists’ turn to look at one another.

Grady handed the bottle of malt liquor to Kulkarni—who steadied himself by taking a swig. Meanwhile Grady answered Marrano’s question. “Probably not much initially; as you mentioned, it requires huge amounts of energy to induce these exotic particle states—even for just a tiny area. To commercialize it you’d need nearly unlimited energy—”

Alcot added. “Unlimited cheap energy.”

“Yes, unlimited cheap, portable energy. Assuming that, you could create reflective gravity devices. But as you mentioned, there are more practical ways to make things fly—”

Johnson motioned to the bubbling liquid, still floating in the sphere. “So then you’ve created the world’s most expensive lava lamp. Don’t get me wrong—it’s impressive—but at fifty megawatts . . .”

Kulkarni stepped between them. “You’re not appreciating how important this could be to science.”

“We brought you here as the voice of reason, Doctor. You’re starting to sound like a nerdy kid at the museum.”

Grady took the bottle back. “Yeah. I was that kid, too.”

Kulkarni regained his serious bearing. Nodding, he turned again to Alcot. “Bert, prove to me this isn’t simply some form of electromagnetism. Does it work in a vacuum, for instance? Can we rule out ionic lift?”

Alcot leaned on a cane. “We’ve produced the same results in a vacuum

chamber and with nonmagnetic materials.” He turned to Grady. “Jon, show Sam the field manipulation experiments.”

“Right.” Grady pointed at the floating membrane of malt liquor. “Look at the shape of the field. It’s one reason why I’ve always believed electromagnetism and gravity were linked—albeit in different dimensions.”

Kulkarni was hesitant. “If it looks like an electromagnetic field, and acts like one . . .”

“It’s not magnetism. Any baryonic matter with mass that you place in that field will experience the gravitational effects. Literally anything.”

“Do you expect me to believe that with just fifty megawatts of power you’re *exceeding* the gravity well of the entire Earth? Without creating miniature black holes or—”

“No, no. Again, We’re not *creating* gravity at all. Remember: We’re *reflecting* gravity. A gravity mirror. And that high-energy mirror can be manipulated to refract gravity in various directions.”

“You mean like photons?”

Grady considered this as he ran fingers through his mangy hair. “Perhaps. I’m not certain yet. But the reason I say it’s like a mirror or a prism is we can only reflect the gravitational field that’s already present. We can’t increase the strength of gravity no matter how much electrical energy we pump into the field. If there’s one Earth gravity present, then that’s the maximum we can reflect. But since gravity is also acceleration, we should also be able to mirror the increased g-forces experienced in acceleration—in effect canceling out higher g-forces. Which could be a very interesting application.”

“Theoretically.”

“Yes. Theoretically. Here . . .” Grady approached his computer monitor and pointed at a series of sensor readings. “We can diffuse the effect, too. We’re using the gravitational equivalent of Halbach spheres to create the gravitic field, which means we can manipulate the gravity field much the same way you can manipulate an electromagnetic field with a Halbach array. We can modify its shape—exerting either an equal flow in all directions . . .” He adjusted the knobs.

Suddenly the polar cap of beer poured downward and balled up into a

glistening globule at the very center of the imaginary sphere—still hovering in midair but precisely spherical.

Kulkarni muttered to himself. “My God. Zero gravity.”

“Actually an equal flow of microgravity. The gravitational field is focused in toward a central point.”

“An equilibrium then.”

“Right. Or we can focus it in any single direction. Change the direction of descent—essentially change which way is ‘down’—to any vector in space . . .” He moved a joystick, and the beer suddenly hurtled out of the apparatus and “fell” across Marrano and Johnson, soaking them both.

“Goddamnit, Grady!”

“What the hell are you doing? This is a four-thousand-dollar suit!”

“Sorry, guys.”

Kulkarni was already looking around at all the debris on the floor. The dents and holes in the walls. “I’m beginning to understand why the lab’s a mess.”

“Had to test it.”

Kulkarni was cogitating, clearly trying hard to disprove it. “But if this is truly gravity you’re reflecting, then all baryonic matter should interact with the field. Not just diamagnetic materials but literally anything.”

Grady nodded. “Yes. Exactly. Even in a vacuum. And it does.” He picked up a hardcover copy of Isaac Newton’s *Principia* and, after holding it up, nudged it into the gravity field, where it floated eerily.

“What I don’t understand is why the altered gravity field doesn’t seem to propagate outside the sphere, as one would predict if gravity were flowing in a straight path.”

Kulkarni considered this. “And gravity propagates over any distance . . .”

“Right. If we were creating a gravity field as powerful as Earth’s, it should propagate outward. I think what’s happening is we’re causing a distortion, an eddy in the flow of gravitation.” He threw up his hands. “I’m just not sure yet.”

Kulkarni stood in wonder as he contemplated this. “We should do Newtonian motion experiments.”

Grady dragged a bucket of golf balls from a nearby lab table. “Already have . . .”

Moments later, Kulkarni was shouting joyfully as he hurled golf balls through the center of the test rig. The balls curved as they interacted with the gravity well of the apparatus, then arced off to ricochet against the lab walls.

Kulkarni shouted, “Did you see that?” He pointed. “Like an asteroid slingshotting past Earth’s gravitational field.”

Marrano was still wringing out his jacket. “Jesus Christ, I smell like a damned hobo.” He gestured to the humming apparatus. “And would you please kill that power? No wonder your burn rate is insane.”

Kulkarni glared at him. “Do you have any idea how important this discovery might be?”

“All I know is an investment has to make economic sense. Mr. Grady, have you filed patent applications yet?”

Grady exchanged looks with Kulkarni. He shrugged. “No. But look, there’ll be time for patents. And anyway, we shouldn’t patent the discovery itself.”

“Why the hell not?”

“Because it’s a fundamental insight into the nature of the universe. That would be like patenting electromagnetism. We need to share this information. There’s no telling how many innovations might spring from it. And it’s those innovations we can patent.”

“So basically you’re telling me we invested millions of dollars so you guys could win the Nobel Prize? You’d better get a lawyer, Mr. Grady.”

Kulkarni stared at the spinning golf balls and smiled. He looked amazed as he gazed up at the massive assembly. “Your discovery could change everything, Mr. Grady. It could change literally *everything*.”

Grady shrugged. “Well, I don’t know about that, Professor, given the energy requirements for the effect. But it certainly opens up some interesting possibilities.”

“Is there a landline where I can make a call?”

“Sure.” He pointed to the back wall. “The offices are through the door there.”

“Thanks.”

Marrano looked up. “Who you calling, Professor?”

Kulkarni spoke without turning. “The fund’s technical advisers in New York, Mr. Marrano. I don’t expect you’re capable of describing what we saw here today.”

“Tell them we’ve got the situation under control.”

Suddenly a billiard ball bounced across the floor and narrowly missed Marrano’s head.

“Heads up!”

Sameer Kulkarni moved through the unimpressive lab offices. What décor there was had faded from decades of exposure to fluorescent lights. Still, he examined the rooms with something approaching reverence.

This is where it happened.

Low-rent space with unused filing cabinets pushed into a corner. Racks of cheap computers busy processing something. All so . . . ordinary.

He noticed another origami geodesic dome on a nearby filing cabinet. He stopped to examine its precise, intricate structure.

Innovation was a curious thing. It never failed to amaze him.

And yet this place confirmed what they’d long known: that truly disruptive innovation rarely came from the expected sources. They’d had so much more luck investing in eccentric B and C students. The rationale was simple: Those heavily invested in the status quo had difficulty thinking outside of it—and were often tainted by it. Especially when success and peer approval beckoned. One did not accidentally graduate from top-tier schools. One strove to get in and to maintain grades once there, and to do that, one usually needed to be a master at conformity. To excel in all the accepted conventions.

No, the truly different thinkers often went unnoticed. Kulkarni’s organization had much luck along those lines in the Third World—eccentric geniuses reinventing infrastructure with small technological improvements: water filters, solar, optics. The trick, as always, was separating the wheat from the chaff. Finding the usefully crazy people among the

seriously crazy ones. And that was something Kulkarni's organization did better than Silicon Valley ever could.

The track record of Valley venture capitalists showed the pattern. A new, sexy tech idea would come along, and then every dollar would be chasing the same thing. Staffers from the original firm would be poached to launch rival firms—until the market became glutted with variations of the same craze. Valuations would skyrocket, and finally, the bubble would burst—the market plummeting. Then a fallow season. Then the cycle began all over again.

And for what? The development of the *railroad* blew away the Internet when it came to disruptive innovation. Interchangeable parts? Likewise. No, mainstream tech innovation was no threat to the status quo.

Kulkarni's organization didn't follow that model at all. It was one reason their investments were seldom near the tech hubs. They wanted the geniuses they identified to remain uninfluenced. It resulted in lots of failures, but then truly useful knowledge was often pried from the cold dead fingers of failure. It made those once-in-a-generation breakthroughs all the more valuable. The breakthroughs that would one day change the course of the human species.

On a day like today, for example.

Kulkarni slowed as he noticed whiteboards in the conference room. They were slathered with complex mathematical equations. He stood in the doorway as he studied the notations, nodding as he followed their logic—but then was lost. Grady had gone somewhere Kulkarni could not follow.

“Very clever, Mr. Grady.” Kulkarni realized Grady's insights would never have occurred to him. Not in a million years. And neither had it occurred to other great minds of the age—biological or synthetic. Grady's innovation was one of the rare “virgin births”—never conceived of before.

Kulkarni sat on the edge of the conference table near a desk phone. He just stared at the whiteboards and contemplated how differently Grady must see the universe from most people. And how beautiful that must be.

He sighed. It pained him to do this. It really did. But it was necessary. Deep down he knew it was. But doubt came with the job. After a moment Kulkarni clasped his hands together and spoke to the empty room as if in prayer. “Varuna, I need you now.”

A calm, disembodied female voice answered inside his head. “Yes, *Tīrthayātrī*. How may I assist you?”

“I am at incubator sixty-three.”

“I see you.”

“What is the status of this facility?”

“*Simulations of incubator sixty-three experimental designs are inconclusive.*”

“And if those designs were validated?”

“*Successful implementation of incubator sixty-three designs would result in a tier-one branch event.*”

Kulkarni took another deep breath. “A tier-one.”

“Correct.”

“I see.” He paused for a moment. “What is the ETA for a harvester team at my location?”

“*Harvester assets are already standing by.*”

Kulkarni was taken aback. “Then you were expecting this?”

“*If validated, the disruption risk is high. What are your findings, Tīrthayātrī?*”

He steeled his resolve. “I can confirm that a tier-one branch event has occurred at incubator sixty-three. Incident imagery and supporting measurements submitted at eleven, three-nine, GMT.”

“*Stand by for confirmation.*” A brief pause. “*Submitted materials confirm that a tier-one incident has occurred.*”

“Have there been any communication leaks from this location in the past seventy-two hours?”

“*Checking.*” A pause. “*There have been forty-seven emails and eight voice messages intercepted—along with fourteen submissions to social media. All were contained or rerouted to the Decoy Net, with simulated responses from recipients.*”

“Has word of this discovery escaped this facility?”

“No data concerning the tier-one event has escaped incubator sixty-three’s IP enclosure.”

Then it was still his to decide. “Recommended course of action?”

The response was nearly instantaneous. *“Intellectual containment. Deploy harvester assets.”*

Kulkarni nodded to himself. “I concur. Initiate containment. Record the time.”

“Time noted. Harvester assets inbound. Nonoperations personnel, please clear the area . . .”

CHAPTER 2

The Winnowers

Jon Grady watched a collection of billiard balls revolving around one another in wild orbits within the gravity modification field. It looked like a tiny solar system, except that the orbits slowly eroded in the drag of air. He laughed as the young lab techs, Raharjo Perkasa and Michael Lum, tossed more billiard balls into the gravity well created by the towering apparatus in the center of Grady's lab.

Leaning on his cane, Bertrand Alcot stood next to Grady. "Well, it looks like the universe is as crazy as you are, Jon."

"That's a frightening thought."

"Agreed. And yet you succeeded."

"You mean *we* succeeded. You know I couldn't have done this without you."

Alcot waved this aside. "I spent years trying to convince you why your ideas would never work." He gazed at the orbiting spheres. "And I was wrong. As I was wrong about most things in my life."

Grady turned with concern. "What you did was challenge me, Bert. Force me to refine my theory. To change it. And change it again. And then change it again." He laughed as he gripped Alcot's shoulder. "There's no way I could have done this without you. Don't you realize that?"

Alcot pondered this. After a few moments of silently observing the

orbiting billiard balls he said, “The truth is I had nothing else to do. My own work has come to nothing. Greta and I . . . all our lives we looked forward to my retirement. Now with her gone . . .”

“You’re definitely needed. I need you.”

Alcot seemed to be grappling with complex emotions. Eventually he looked up. “Your parents will be very proud of you.”

“And I’m sure your children will be proud of you. You should reach out to them.”

“I barely know them.” Alcot squeezed the handle of his cane. “Listen to me. You have to promise me something, Jon.”

“Okay. What?”

“Don’t do what I did.”

“I love my work, too, Bert. There’s nothing wrong with that.” He gestured to the gravity mirror. “That’s why we succeeded.”

“You need to love more than work. You need to have people who care about you—otherwise what’s the point?” He stared without seeing. “That girl of yours—what’s her name?”

“Well . . . Libby.”

“What happened to her?”

“She met someone at yoga class. She’s already pregnant. They’re happy.”

Alcot nodded to himself.

Grady took another glance at the wondrous gravity mirror on display before them. “This is not the conversation I thought we’d be having right now, Bert. This is a historic discovery. We should enjoy it.”

Alcot turned to face Grady. “Life waits for no one.”

“Is this not life?”

“Just promise me you’ll live outside your head as well as you live inside it.” Alcot gripped his shoulder hard. “Promise me.”

Grady could tell his mentor was serious. He finally looked Alcot in the eye and nodded. “I promise, Bert. Now would you shut up and start thinking about your Nobel acceptance speech, please?”

Alcot grimaced and then gave Grady a slap on the back. “This ridiculous hair. You know, the first time I met you, I told Greta that a dirty hippie was stalking me.”

Grady laughed. “Hey, hair is nature’s calendar.”

Just then Grady noticed forms moving out of the shadows at the back of the darkened lab. He straightened up. “Who the hell is this?”

Alcot turned as well. Perkasa and Lum looked up from their miniature solar system. Close by, the visiting investment advisers, Albert Marrano and Sloan Johnson, stopped trying to dry their suit jackets over a space heater and with curious looks came to join Grady and his team.

A dozen intruders moved into the light—men dressed in reflective crocus-yellow jumpsuits emblazoned with Jersey Central Power & Light logos. But along with hard hats they wore black gas masks and carried work lights and tools. They silently and efficiently fanned out through the room, deploying equipment, acting as if the research team weren’t there.

A glance toward the fire exit showed a dozen more coming in from that direction.

“What’s going on here, guys? Hey, guys! If it’s about the power consumption, that’s normal. We have permits for all this.”

Marrano, Johnson, and the others turned to Grady with confused looks on their faces.

“You don’t need the gas masks.” Grady pointed up at an alarm panel and a row of green lights. “There are no chemical leaks.”

Grady noticed one of the workmen had a large, older video camera on his shoulder; the red light indicated it was recording. A bright light suddenly illuminated him.

“Hey! Turn that off! What are you filming us for? You have no right to film in here. This is a private facility. How did you get in here, anyway?”

A man emerged from among the intruders. Unlike the others he wore simple work clothes—flannels and jeans with work boots. He was tall and handsome, with blue eyes and dirty-blond hair and a Donegal-style beard running along his broad jaw. He was athletically built with a charismatic, compelling look—like some rustic fashion model. And he had a vaguely familiar appearance. Grady felt certain he’d seen him somewhere before.

Grady eyed the man warily. “Are you the foreman for these idiots? What’s going on?”

The man stood before the camera, gazing into its lens. Then he turned

and raised an accusatory finger at Grady as he spoke in a booming voice. “His judgment be upon you, Jon Grady!”

“Judgment? What the hell are you talking about?”

“In Proverbs it is written that the wise winnow out the wicked.”

“Who’s wicked?”

“Your research robs us of our humanity—creating a hell of this earth. We have come to return mankind to our natural state. To bring us back into harmony with God’s creation!”

Grady felt a sinking feeling as the intruders surrounded them. “You guys aren’t with the power company.”

“There is but one power.”

Marrano shouted, “All right, that’s it! You guys are trespassing. I’m calling the police.” He raised his smartphone and started tapping.

The gas-masked men around him leveled pistol-like weapons that resembled black plastic toys.

“Whoa, whoa!” Marrano held up his hands, still clutching the phone. “What is this? Wait a second.”

Several Taser darts struck Marrano. The clicking shocks that followed could barely be heard against the larger electric hum of the nearby capacitor bank. Marrano fell and twitched on the ground as they continued to shock him.

He screamed, “Stop! Please stop!”

Johnson held up his hands. “For chrissakes! What do you people want?”

Several Taser darts struck Johnson as well. He went down screaming, disappearing from view as men in power company jumpsuits and gas masks surrounded him, looking down without pity as the investment bankers pleaded for mercy. The shocks continued.

Grady shouted, “What the hell are you doing?” He turned to the blond man. “If you’re so against technology, why are you using it?”

The man intoned for the camera lens while keeping his finger pointed at Grady. “His winnowing fork is in hand to clear the threshing floor. But He will burn up the chaff with unquenchable fire!”

Several darts hit Grady, too. A teeth-gnashing jolt coursed through

him as all his muscles contracted. Before he knew it, he was on the ground. Screaming in pain. Between shocks he pleaded, “Not Bert! Bert’s got a pacemaker!”

Another shock. Then the leader’s face loomed over Grady. He carefully stepped over a Taser wire and came in close. “Your research is an affront to God. Your inquiry into His works an abomination. Humanity must live in humble gratitude. Just as we came into His world.”

Grady craned his neck up, straining to speak. “There are security cameras . . . covering . . . this place.”

The man looked up without fear. “Let them see my face so that they know the Lord’s Winnower, Richard Louis Cotton, has claimed you.”

A further shock coursed painfully through Grady’s body. As his consciousness ebbed, he was dimly aware of voices coming in over a nearby radio.

“Commencing evolution two.”

“Copy that, Harvester Nine inbound . . .”

Grady regained his senses sometime later, only to find himself held in place with ropes. Glancing around, he could see that he was lashed to the tangled piping of the gravity mirror tower by impressively complex knots. Whoever had tied them had literally lashed down his individual fingers. There was no longer any electrical hum from the capacitor banks. The intruders must have powered everything down. Strange that antitech militants would even know how to do that.

Grady then noticed Alcot tied next to him, head slumped to the side. The old man’s face was covered in sweat, eyes closed. Marrano was tied up on Grady’s other side, with the ropes leading off in both directions. The whole team appeared to be lashed to the perimeter of the gravity tower. Grady struggled to squeeze his wrists through the bonds, but his efforts only tightened them.

That familiar voice: “You should pray for redemption.”

Grady noticed several gas-masked men nearby silently attaching wire leads to fifty-five-gallon chemical barrels arrayed across the floor, linked

by wires. They looked like enormous batteries. “What are you doing? What are those?”

The man named Cotton walked into view and knelt next to Grady. “Thirty percent ammonium nitrate fertilizer mixed with gasoline.” On Grady’s uncomprehending stare, he added. “It’s a bomb, Jon Grady—powerful enough to flatten this entire building. To return this infernal machine of yours from whence it came. Along with the people who built it.”

Alcot’s voice answered. “It’s men like you who keep dragging us back to the Dark Ages.” He was awake after all.

Cotton turned to face the old man. “The Dark Ages are what you’re bringing us toward, Doctor Alcot. Advanced technology holds no answers for mankind—only regrets for when we play at being God . . . and fail. Creating a hell of His earth—the earth that He bequeathed us.”

“And what are you doing if not playing God? Deciding who lives and who dies. Murder is a mortal sin.”

“Not in defense of His creation.” Cotton looked to gas-masked men preparing the explosives. They nodded back, apparently ready.

Cotton turned and smiled as he scraped a wooden match across a pipe fitting. The match lit with a puff of smoke. He held it to the tip of a fuse, which began to sputter and spark. “You will winnow them. The wind will pick them up, and a gale will blow them away. But you will rejoice in the Lord and glory . . .” He looked to them. “Your judgment is at hand. Your bodies will return to the soil. Whether your souls enter into eternal torment lies with you. Use what time remains to determine your fate.”

Cotton walked toward the large, old-fashioned video camera—which was now set up on a tripod, its red light glaring. Judging by the collection of jerry-rigged radio antennas sticking out of it, it was apparently taping their victims’ demise and beaming it off-site. All of the equipment looked old. None of this made sense. It was as though the group were a branch of militant Amish who had settled on the mid-1980s as their permissible technological level.

Cotton shouted to his camera. “The day of the Lord is coming—a cruel day, with wrath and fierce anger—to make the land desolate and destroy the sinners within it! For a fire will be kindled by His wrath, one

that burns down to the realm of the dead below! This is His judgment against those who violate creation!”

With that, his followers swiftly departed. Cotton gave one last look back at the doorway and made an almost apologetic shrug before exiting.

Grady was momentarily puzzled by Cotton’s parting gesture, but one glance at the sputtering fuse got him struggling against his ropes once more. They only bit tighter into his wrists.

Marrano quietly wept beside him. “Not this. Not this.”

Alcot’s weary voice spoke: “It won’t help, Jon.”

Grady looked up at the fuse and realized just how short it was. Barely a foot or so remaining unless there was more to it than he could see. It was impossible to say how much time they had—so no reason to give up yet. “Bert. Can you get your hands free?”

Alcot shook his head sadly. “I’m sorry you won’t get to enjoy this triumph.”

“We’ll get out of here. Hang on,” Grady shouted. “Can anyone get a hand free?”

Lum’s frightened voice came from the other side. “No. I’m trapped, Jon.”

“Me, too!”

“Christ! Does anyone have a Swiss Army knife or something? How about a phone?”

Johnson’s voice could be heard from the far side. “They took everything . . .”

The prisoners sat in silence for a few moments, listening to the fuse hiss.

Alcot laughed ruefully. “We really did do it, though. Didn’t we, Jon? We took a peek behind the curtain of the universe.”

“Yes. Yes, we did.” Grady nodded as he scoured his field of view for some means of escape.

“We probably would have won the Nobel Prize. Now someone else will discover this someday . . .” Alcot looked up at Grady again. “At least we know we were first.”

Grady nodded. The burning fuse neared the top of a barrel. If that was all the fuse there was, it wouldn’t be long. Just seconds left.

“Jon?”

“Yes, Bert?”

“Good-bye.”

“Good-bye, Bert.”

The fuse disappeared into the barrel, and a white light enveloped Grady.

He felt nothing more.



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