* * * *

ANALOG SCIENCE FICTION AND FACT
Vol. CXXVII No. 9, September 2007
Cover design by Victoria Green
Cover Art by David A. Hardy

Stanley Schmidt Editor

Trevor Quachri Managing Editor

Click a Link for Easy Navigation

CONTENTS

* * * *

EDITORIAL: ADAPTING by Stanley Schmidt

For many years we've been hearing a growing chorus of voices—and data—warning us that the Earth as a whole is in a warming trend that has been going on for many decades. One of the loudest and most recent (as I write this) was the first 2007 report of the UN's Intergovernmental Panel on Climate Change, wherein scientists from 113 countries declared that global temperatures and sea levels are rising fast enough to cause humanity serious problems soon and for many decades, or even centuries, to come. The panel (which has been issuing progressively stronger reports since the early 1990s) also found that the warming trend is, with very high probability, largely a result of human activity, and therefore we have to do something about it.

What if we can't?

Oh, certainly there are things that we can do that should help to alleviate the problem—but how much can they do? The obvious actions individuals can take are things we've all been hearing for years: recycle, compost, drive less, use public transportation when available, insulate houses, replace incandescent light bulbs with fluorescents, buy energy-efficient vehicles and appliances, wear sweaters or use fans instead of running furnaces and air conditioners unnecessarily, use programmable thermostats to run them minimally when people are sleeping or away, favor local foods and biodegradable cleaning materials. You can easily extend the list for yourself.

Certainly these things can help, but many of us are already doing them (though others, such as many suburban SUV drivers and politicians who fly private jets to speaking gigs about conservation, are not). There are also obvious things that could be done in public places, such as stopping the widespread but illogical practice of expecting people to wear jackets and ties to work in hot, humid weather and then air-conditioning the daylights out of their workplaces to make them tolerable.

But the impact of all of these things, even taken together, is small compared to that of the huge underlying problem that hardly anybody wants to recognize, much less seriously try to do anything about: the fact that the population is so large and growing so fast. Unless and until that changes, it seems improbable that any lifestyle changes likely to happen in the real world will do more than slow the rate of warming. If everybody in the world reduces his or her energy use and greenhouse gas production by *m%,* as soon as the population increases by *m%* (which won't take long) we'll be right back where we started.

So we're probably going to be stuck with it, to at least some extent. How bad is it, and how much can we do about it? Some skeptics still shrug the whole thing off because estimates vary considerably, but that's hardly surprising and certainly doesn't disprove the principle. A planet is a very complicated system, and computer simulation is only beginning to be able to model it realistically. So it's not surprising that the latest estimates coming out of the IPCC range from 2 to 11 degrees Fahrenheit for the increase in average temperature by 2100 if we continue doing what we're doing, and 7 to 23 inches for the rise in sea level—with the caution that those last numbers may be low because recent observations indicate polar ice sheets are melting faster than we thought. None of the estimates are zero or negative; everybody doing the math is estimating enough rise in the two main variables to cause changes going well beyond two innocuous-looking numbers.

What kinds of changes? Well, any rise in sea level means some coastal real estate will be going under—and much of the most valuable real estate in the world is coastal. Depending on the actual amount of sea level rise, small to large amounts of cities like New York and Amsterdam will be submerged, meaning they will have to be either abandoned or radically (and expensively) rebuilt to deal with constant salt water flooding, wave action, tides, and storm surges. Any rise in temperature means that some plants and animals will no longer thrive where they now do, and the crops that are the

economic lifeblood of agricultural regions will no longer grow there. Weather will grow more violent, with an increase in droughts, wildfires, and destructive storms (of which the unprecedented 2006 Atlantic hurricane season may be a sample).

And if we do the best we can with getting greenhouse gases “under control” (as Seth Horenstein put it in an AP article)? The numbers get smaller—e.g., a temperature rise of 3° F instead of 11—but the principle is the same. Barring unforeseen alleviating factors (which can be neither ruled out nor counted upon), it looks like we have to plan on some significant adjustments. We can *hope* that the more optimistic estimates are the more accurate ones, and that the changes they demand will be relatively small.

But what if they aren't? Is it the end of the world if sea levels and temperatures rise a lot and huge areas of cropland become unusable?

Literally and emphatically, it is not. Sloganeers who shout, “Save the planet!” are indulging in melodramatic and anthropocentric hyperbole. What they really mean is, “Save *us!,"* which has a considerably less noble ring to it. The planet is (at least so far) in no danger from us. It has taken far more in the past than we're capable of dishing out, and will undoubtedly do so in the future. It will still endure quite a while; if we mess things up badly enough to destroy ourselves, the Earth will simply go on without us, striking a new (and, as always, temporary) balance with whatever is left over. It simply doesn't care whether we're part of that future.

So if *we* care, we shall have to take responsibility for ensuring our own place in it. And that means we must do some combination of two things: (1) minimize changes that would hurt us, and (2) learn to live with the changes we can't prevent.

That's one of the things we've always been best at. Adaptability is one of the most important characteristics of our species. We evolved in tropical Africa, yet we have found ways to live not only there, but in nearly every kind of environment found on this planet: deserts, wetlands, Arctic tundra, the extreme altitudes of the Andes and Himalayas.... Small numbers of us have even managed to live for significant periods in the very harsh climate of Antarctica and in an orbiting capsule, and some of us dream quite seriously of colonizing other planets or the Asteroid Belt. If we must, surely we can find ways that at least some of us could live with a climate altered from the one we've taken for granted.

For example, if it becomes too hot to live or grow corn in middle latitudes where we now do those things, it may become easier to do so in higher latitudes where it's now too cold—and corn country may become coconut or cactus country (and while it may not occur to some northerners, some cacti *are* food sources, even for humans). Farmers may be able to remain farmers, but only if they're willing to relocate or learn to grow new crops. They may even have to develop new crops: new varieties of plants and breeds of livestock better suited to new conditions. Some activities now concentrated in cities may simply disperse; a great deal of our current economy is centered on the exchange of information, and so much of that is done electronically that it little matters where the people doing it are physically located. Other activities, such as large-scale manufacturing and shipping, will probably still concentrate in cities; but if old cities like New York must be abandoned, new ones may grow to take their places much farther from the equator—e.g., on Hudson Bay or in Greenland.

There's no denying that all this would be inconvenient in the first degree. Our current civilization has massive investments of time, money, materials, and emotion in coastal cities, agricultural and industrial infrastructure, and the like. Comparable investments would be required to build replacements for them in remote new places. Vast numbers of lives would be torn up by the roots, and putting them back together in viable new ways would be a huge challenge physically, psychologically, and financially. It might even be that the new world, while it can still support *some* of our adaptable type, cannot support today's huge

numbers of us. I mentioned earlier that excessive population and population growth are the root causes of a great many of our problems, very likely including this one of global warming. It may turn out that that's a self-limiting danger: while we can't currently destroy the planet, we may be able to make it so uncongenial that our population crashes—in other words, a lot of people die. That solves the problem as far as the Earth is concerned, but it's a highly unsatisfying solution from our point of view.

For all these reasons, we need to take the UN panel's findings seriously and look for—and implement—ways to slow the observed increase in greenhouse warming as much as possible. But we—all of us, and science fiction writers in particular—need to also be looking beyond that, at what we can do to cope if the more pessimistic estimates turn out to be the more accurate. As an editor, I see a great many stories that are no more than cautionary tales, portraying a future in which the world has become ugly, harsh, and depressing, and the characters mope around bemoaning the loss of a beloved way of life because their ancestors (that's us) messed things up. A story that does no more than that serves little purpose; we already know that things can get ugly if we don't take measures to prevent it. What would be far more useful would be to suggest concrete, plausible ways to make sure that doesn't happen—or, if it does anyway, ways that the survivors could build a new world order that would again be worth living in.

Because we may turn out to need those ways, despite our best efforts to head off danger. Our best efforts may not be enough, or completely different events may create a similar situation—e.g., a change in the Sun's output, or a large asteroid impact or volcanic eruption. Climate changes are hardly new, and there's no reason to suppose they happened only in the past, even if we have no effect at all on them. The time scale of the changes we've been witnessing is geologically insignificant. There have been big climatic variations, some of them on a scale of decades or centuries, even in human history. There have been far larger ones on a longer scale, and for most of its history the Earth has been much warmer even than the levels we're currently worried about.

So if humans think they're in for the long haul, they really need to be prepared to deal with climate changes—even big ones—whatever their cause. The current round of worries may provide just the motivation we need to think seriously about how to do that.

* * * *

Peter Kanter: Publisher

Christine Begley: Associate Publisher

Susan Kendrioski: Executive Director, Art and Production

Stanley Schmidt: Editor

Trevor Quachri: Managing Editor

Mary Grant: Editorial Assistant

Victoria Green: Senior Art Director

Irene Lee: Production Artist/Graphic Designer

Carole Dixon: Senior Production Manager

Evira Matos: Production Associate

Abigail Browning: Manager, Subsidiary Rights and Marketing

Julia McEvoy: Manager, Advertising Sales

Bruce W. Sherbow: VP, Sales and Marketing

Sandy Marlowe: Circulation Services

Advertising Representative: Connie Goon, Advertising Sales Coordinator, Tel: (212) 686-7188 N Fax:(212) 686-7414 (Display and Classified Advertising)

Editorial Correspondence Only: analog@dellmagazines.com

Published since 1930

First issue of *Astounding* January 1930 (c)

[Back to Table of Contents]

SOME DISTANT SHORE by DAVE CREEK

* * * *

It's a truism of science that the observer affects the thing being observed—but it works the other way, too.

* * * *

Afterward, watching the long spectacle of the debris of two star systems going their separate ways, Mike Christopher didn't think of the stupendous forces he'd witnessed as much as he thought of the dead. Even planetary collisions, he thought, don't affect the soul as profoundly as watching a loved one die.

* * * *

A month earlier

Mike Christopher called up a holo display of the planet the starcraft *Asaph Hall* was orbiting. The gas giant, called Heuri, was about eight AU out from its primary, Moruteb. Mike told Rosa Sandage, the *Hall*'s captain, “This planet's the Drodusarel's first goal—it's why they made sure to get here before us. Pretty natural for methane-breathers. It's similar to their homeworld. And it has an extensive series of rings, again, just like their homeworld."

Rosa spun her command chair toward Mike and asked, “Why are the rings important?"

"Primitive life—the equivalent of the first algae on Earth—arose in the Drodusarel system's rings. They, in turn, seeded the planet, letting life form within its atmosphere."

"How the hell did *that* happen?"

"No one knows. Correction—no *human* knows. But the Drodusarel would be drawn to that type of planet the way humans would be drawn to a terrestrial world with large oceans."

Mike called up a more detailed holo giving the planet's vitals—a year nearly twenty-four Earth years long, a day not quite nine hours, the typical bands of clouds, and an extensive ring system.

But as usual with such a world, the stats weren't as impressive as the sheer power of looking at its image on the viewscreen. The cloud bands covering Heuri ranged from tan to brown to red, dotted with dozens of storm systems. Those clouds were mostly hydrogen and helium, with minor components of ammonia, methane, and water.

Heuri's ring system wasn't as magnificent as Saturn's, but neither was it as tenuous as Jupiter's. Mike could make out at least four broad segments, and the system as a whole, though it was only a few hundred meters thick, still made a magnificent sight as the *Hall* drew closer.

Magnificent, perhaps, but also doomed, with the rogue star Neska drawing ever closer.

But that was weeks away at the earliest. Mike looked toward the main screen. The smooth silver surface of the Drodusarel craft *Dirat* was easily visible against a couple of the darker bands of Heuri's clouds. Its orbital path was a couple of hundred K lower than *Asaph Hall*'s. Soon it would pass below them and move ahead.

Rosa tilted her head in such a way that Mike knew she was listening to a transmission over her datalink. She said, “Codari says the *Dirat*'s not responding. What the hell are they doing?” Captain Codari was the commander of the Cetronen starcraft *Cerenam* and of their four-starcraft fleet that had spent five

months traveling to the Moruteb system. That system was made up of four worlds: Jilan, a vaguely Mars-type world; Heuri, a gas giant; Itherin, a smaller gas giant; and a smaller icy world, Risula.

Mike called up small holos and other readouts in front of him. “I've got Drodusarel shuttles passing through Heuri's atmosphere. I'd bet they're taking samples, probably inserting probes.” When he looked more closely at the readouts, though, he said, “Wait a minute. Look at these life-form readings. They've been down to the planet. Or, I should say, in its atmosphere."

Rosa nodded. “They got here first, and they're bringing life-forms up from Heuri. I thought this system didn't have any life-forms."

Mike said, “No *intelligences,* as far as we knew. These life-forms may not be intelligent. But I'd bet they're similar to the Drodusarel."

Rosa said, “Could they be mounting a rescue effort?"

"It's a pretty poor one if they are. They'd have brought a lot more ships to take off a significant portion of a planetary population. I'd like to take a shuttle over there. Try to find out what they're up to."

Rosa touched behind her ear to activate her datalink and spoke quietly. Then she said, “Codari approves. Take *Cosmic Egg*. And Linna. I think she can handle it."

"We'll be careful,” Mike said. He left the bridge to fetch Linna and make the *Cosmic Egg* ready to lift.

* * * *

Moments later, Mike was guiding the shuttle *Cosmic Egg* off the *Asaph Hall*'s hangar deck and toward the Drodusarel craft *Dirat*. Linna checked sensors and said, *"Dirat* still has a couple of shuttles out."

Mike opened a comm channel. “Captain Dresk, this is Mike Christopher aboard the *Asaph Hall* shuttle *Cosmic Egg*. Please respond.” No one replied. “Captain, my crew and I stand ready to help with any rescue operations."

Dresk's response was audio only. “Not greeting the human ones! Inappropriate curiosity. I *and* hive mind disapprove.” Then the connection was cut.

"That's it,” Mike said. He boosted the *Egg* into a higher orbit and started working on a trajectory back toward *Asaph Hall*.

"Wait a minute,” Linna said. “What do you mean, ‘that's it?’ It's that business with the hive mind, isn't it?"

"You bet it is,” Mike said. “And unless you want to be at the center of the biggest cluster event you've ever experienced, you'll be happy we're heading back."

Then Mike noticed an incoming transmission. He thought it might be Rosa, but when he accepted it the green-skinned, blunt-snouted image of the captain of the fourth ship of the little Sobrenian fleet formed before him.

Captain Syradok of the *Meradeus* said, “Mike Christopher. Linna Maurishka. It's unfortunate that the Drodusarel are such poor colleagues. I will state my purpose plainly. I wish to upstage them. Will you visit the *Meradeus?"*

Rosa's voice arrived over Mike's datalink. “Accept it, Mike. Maybe we can learn something useful."

Mike understood. Despite making the five-month journey to the Moruteb system together, the

motivations of the Sobrenians and Drodusarel in particular were still a mystery. Mike spoke over the channel open to *Meradeus:* “We came out here for one visit. We can certainly make another instead."

"We eagerly await your arrival,” Syradok said, and his image faded.

Mike altered *Cosmic Egg*'s course yet again, this time toward the *Meradeus*.

* * * *

To Mike, the interior of a Sobrenian starcraft was a familiar place—more dimly lit than most human craft, warmer, and more humid. He and Linna stepped out of the airlock into the *Meradeus*'s main corridor.

Syradok was there to greet them, with another Sobrenian at his side. A female, by the look of her—slightly shorter than her captain, shoulders not as broad, snout shorter.

As Mike expected, the *Meradeus* commander was wearing his blue robes with lines of green, red, and gold running through them. The top of Syradok's head came about to Mike's shoulders.

Syradok's eyes rolled independently in their sockets as they looked down his snout at the three humans, obviously taking their measure. “Is this not a better greeting than the one from our Drodusarel friends?"

Mike said, “This is a most welcome greeting, Captain."

Syradok raised a rough, green-skinned hand to present the other Sobrenian. “I must introduce you to my second-in-command, Govanek. She is also an explorer—a geologist."

Mike stared at Govanek with a sudden respect. Exploration isn't normally the Sobrenian way, he thought. For this Govanek, an explorer, to advance to being Syradok's second, is impressive.

But she only has a single line of fabric, red, through her robes. That puts her social status at odds with her status aboard this ship.

Govanek said, “I would like to accompany you, Mike Christopher, on one of your explorations."

Mike blinked. “Really? May I ask why?"

Syradok spoke up. “This mission was decided upon at the last moment. The *Meradeus* is not an exploratory vessel. I would consider it a favor to me to take Govanek with you sometime—perhaps to the Moruteb planet Jilan. It is an interest of hers."

"I'd be honored, Captain."

After a few more pleasantries, it was clear that no refreshments or offer to tour the *Meradeus* was forthcoming. We've taken all of about five steps out of the airlock, Mike thought. He begged the Sobrenians’ forgiveness, explaining that they had to get back to *Asaph Hall*. Then it was back through the airlock, and Mike undocked the *Cosmic Egg* and headed for home. He told Linna, “So what did you think of them?"

Linna said, “Both Syradok and Govanek seemed sincere. Govanek's legitimately excited about the idea of exploring with us.” Linna was an empath, able to read emotions, not thoughts.

She and Mike were shipmates—a couple who remained faithful whenever they were aboard the *Hall*. It was a relationship more than lovers, less than spouses. In fact, because Linna was an empath, they'd never roomed together. She could not turn off her empathic resources and had to spend much of each day alone to avoid “burning out” on the constant flood of emotional radiation from Mike and everyone

else on the ship. Linna continued: “I *did* perceive that Syradok looks upon Govanek with ... let's say, amusement."

"That would fit Sobrenian culture,” Mike said. “They're usually so focused on weaponry as an art form, and on conflict, that someone who wants to be an explorer might seem a little strange."

Rosa spoke over the datalink again. “Hope you two are ready for your third visit of the day. Head toward the Cetronen ship. Codari wants to talk to you. In person."

* * * *

The Cetronen had made the initial discovery that the Moruteb and Neska systems would have a catastrophic encounter, and they'd named both stars and all the worlds.

Moruteb was about the same size as Sol, .98 its mass, but was older, having formed nearly seven billion years previously. By all accounts, it should've been halfway through its lifetime, a healthy, mature star, loyal guardian of its four planets and countless smaller worlds.

The intruder, Neska, carried along two planets, Pantor and Lasira, the only survivors among several other worlds that likely had spun away in the course of Neska's wild journey. No one knew how it had begun; perhaps it had burst out of a star-forming nebula ages ago, or was one component of a double star that had spun apart.

What was certain was that Neska was approaching, slowly, but the two systems were already affecting one other gravitationally. The encounter was inevitable. If the two systems had been closing more swiftly, it could've been a glancing blow. Instead, their mutual attraction was drawing them into a potential cataclysm. Gravity is a weak force, but a patient one.

Mike docked *Cosmic Egg* with the mushroom-shaped Cetronen craft. A *Cerenam* crewmember named Natai greeted Mike and Linna.

Cetronen were paired symbionts. The larger of the two, called the major, was about two and a half meters tall, with reddish fur, and represented the pair's physical strength. He held the smaller minor in his arms. A hump on the major's belly served as a seat, and a thick muscular tail helped counterbalance the minor's weight. Majors rarely initiated actions and generally followed their minors’ unspoken commands.

Minors were much smaller, thinner, and represented the pair's brains. “It's a pleasure to meet you,” Natai's minor said. “I am also an explorer. I hope to share a journey with humans someday."

We're going to have to start handing out applications, Mike thought. “I'd look forward to that,” he said. He and Linna followed Natai to Codari's quarters. Introductions all around, then Natai excused himself.

Codari's two-and-a-half-meter-tall major carried the smaller, thinner minor in his arms. There was nowhere to sit, and the only decorations in the room were holos showing images from the Cetronen homeworld—the Plain of Itherin, which gave one of Moruteb's worlds its name, the Sorrowful Mountains—and other landscapes.

The minor's pointed ears waggled and the protective membranes in his nostrils were opening and closing rhythmically. Those nostrils were flat against Codari's face; Cetronen had no noses, and their eyes were deep set beneath a jutting brow. “The Sobrenians had a proposal for you—cooperation."

Mike asked, “How do you know that?"

"Not all of my discoveries are astronomical. Some are political. I also know that moments earlier, the Drodusarel had a very different proposal—that you boost as far away from them as you could, as

quickly as you could."

Mike smiled. “That's a clever way of putting it."

"Cleverness is not my goal, only understanding. This time is unique for all our species. We will observe and record an astronomical event, the nature of which none of us has seen before."

"To witness something like this will be a time of much wonder. It's why I became an explorer."

"Each Galactic species has its own motivations for being here. Not all are as pure as your own. I presume Cetronen and human motives are the closest. We explore these colliding systems physically and intellectually. And the other Galactic species culturally and, perhaps, philosophically."

"We would agree with that."

"Four species here. We're far from the area of the galaxy where we predominate. We're far from our superiors. Here's where our true natures are revealed."

"Perhaps,” Mike suggested, “that's our most important discovery."

"And potentially, the most dangerous. I urge you to accept the Sobrenian invitation to take one of their crew with you. In fact, I would like all the crews to trade personnel during this mission."

"I don't want to be considered a spy."

Codari said, “You're an explorer. You see and hear things. You learn. Cetronen-Sobrenian alliances constantly shift. Currently they do not favor us."

Linna said, “But you'd like that to change."

"With your help, yes."

Mike told Codari, “We'll be honored, Captain."

"Very good. Now, about the Drodusarel. As we speak here, they're moving on from Heuri to the smaller gas giant, Itherin."

"I wonder what they found at Heuri,” Mike said.

"You may never know unless you travel there yourself. I'd like you to take Natai—you just met him—to Heuri after your jaunt with the Sobrenian to Jilan."

"I'll be pleased to."

"You understand the potential danger the Drodusarel represent. Always remember that, no matter how many times they ‘Greet the human ones,’ or some such phrase. They either enjoy playing the buffoon or do not realize how their translations sound. Either way, one can easily forget how different they are from oxygen breathers."

"I'll remember."

"We're finished here,” Codari's minor said, and Natai appeared at the doorway to escort them back to the *Egg*. Natai's minor said, “I assume Captain Codari asked if I may accompany you on a mission to Heuri."

"We'll go soon," Mike reassured Natai. He couldn't help noticing that the Cetronen stood at a viewport and watched the whole time as Mike eased *Cosmic Egg* out of *Cerenam*'s hangar deck.

* * * *

Once back at *Asaph Hall,* Mike walked Linna back to her quarters. They paused at the doorway. Mike knew she was reading every subtlety of his emotions, every frustration and anxiety, every bit of his concern for her.

"I'm sorry," she said.

"Sorry? Why?"

"It's more and more difficult to be around you." She took his hands in hers and gazed into his eyes. "Not because I care about you any less. But I feel it *all*. You're worried about me right now, and that used to be reassuring, even charming."

"But now?"

Linna said, "The way my empathy is, I can barely stand it."

It seems humans aren't meant to have empathic powers and remain happy, Mike thought. An empath who lived around the same people constantly found the flow of emotions becoming easier over time—like a stream eroding a deeper, straighter channel through rock. And that stream could not be slowed. The genetic engineering techniques that had made Linna and a handful of other humans into empaths or telepaths had been abandoned decades ago—too many of them had gone mad, some committing suicide.

Linna was actually one of the more stable ones. One of the luckier ones.

Linna continued: "It's too intense. It's not just you, it's everyone on the ship. Outwardly, there are the smiles, the jokes, or at least some sense of being up to any task required of them. But underneath, they're all a mass of anxieties. Feeling unloved or incompetent. I can feel them holding back anger and saying the 'right' thing instead. Or not daring to tell someone how they really feel about them. They *ache."*

Mike said, "I don't know what to say. Except what you've never allowed me to say."

That got a smile from Linna, one Mike eagerly returned. It was an old exchange between them, that Linna never wanted Mike to tell her he loved her. "You know what I always tell you," she said.

"Yeah. To an empath, it's either a lie or redundant."

"I *do* want to be with you, Mike. That's always. But being able to bear it..." Linna's expression was stricken. "That, I may not be able to do."

Hearing that, it was Mike who ached now, knowing that only added to the intensity of Linna's emotions. What must it be like, he thought, to deal with this doubling of emotions, someone else's sorrows, someone else's grief? I've been Linna's shipmate for six years, he thought, and considered that question over and over. And never discovered a good answer.

Mike's silent reverie ended when Linna cupped her hand on the back of his neck and pulled him close. She kissed him, her lips barely touching his, then again, more firmly this time.

Mike held Linna close and said, "I wish we could stay like this all night."

"But we can't," Linna said. "At least, *I* can't. It all moves on. Everything changes."

"That's a lesson we'll learn all over again at the Moruteb system," Mike said. A final kiss and he left Linna alone.

* * * *

A couple of weeks later, *Asaph Hall* took up an orbit around Jilan, which circled 1.2 AU from Moruteb. Soon Mike was piloting the *Cosmic Egg* down toward the planet, with Linna next to him in the copilot's position. The Sobrenian geologist, Govanek, sat behind Linna.

Their trajectory took them within a few thousand K of one of Jilan's moons, Reulo. They flashed past it within a few moments, catching only a glimpse of a small world, pockmarked and barren, just a few hundred kilometers across. It would barely appear as a perceptible disk from Jilan's surface. The planet's other moons, Nilanu and Tyaila, just as small, orbited on the opposite side of the globe, out of sight.

Just before the *Egg* entered Jilan's thin atmosphere, Mike launched a horde of nanobots designed to map and holograph the planet, take air and soil samples, and generally gather as much information as they could.

For now, though, Mike had to concentrate on getting down to Jilan safely. He could sense the first stirrings of Jilan's atmosphere against the *Egg*'s skin.

Govanek had requested a landing next to deeply furrowed cliffs on the side of a mountain near Jilan's equator. With the nanoprobes gathering as broad a picture of the planet as they could, Govanek insisted upon seeing this specific feature for herself.

Cosmic Egg broke beneath the cloud cover. Below them, mountains and low ridges alike cast broad shadows across the lightening plain—Mike had timed the *Egg*'s landing for local dawn. He said, "It looks as if a lot more water once existed here than does now."

Govanek said, "You speak correctly. See those riverbanks—their waters barely fill them. Once, though, rapidly flowing waters often rushed over those banks. And those seas in the far distance once filled those mostly dry basins."

The *Cosmic Egg* descended toward the foot of the mountain, which stood nine hundred meters tall. To the west, it rolled lazily down toward a plain covered with thick vegetation. Its eastern side, however, made a precipitous drop toward a dusty, barren valley.

Time to find a landing site, Mike thought. We've got some pretty rough terrain down there. It looks like the face of an old, grizzled man.

Mike brought the shuttle down slowly and steadily, hovering over a potential landing spot. "That looks like ... marble," he said.

"More evidence of water," Govanek said. "A turbulent stream creates these channels and holes in the hard surface."

Govanek's enthusiasm is infectious, Mike thought. And she's obviously knowledgeable.

Under Mike's guidance, the *Egg* settled down onto the hard, rough ground. Mike cut its gravitics and inertials, and Jilan's lighter grav of .65 Earth asserted itself.

Govanek got up and started putting on her spacesuit. Mike and Linna had an easier process—touch their palm with the left middle finger and a nanotech protocol instantly formed a lifesuit around their bodies,

with a bubble helmet protecting their heads.

They cycled through the *Egg*'s airlock. Mike made the first step onto Jilan's surface, easing gingerly onto the edge of one of those dark rocky ridges. Here, examining those furrows more closely, Mike thought they resembled not so much an old man's wizened face as his gnarled hands, reaching with gray fingers across a smooth black landscape.

He checked his wrist sensor. Temperature just below freezing, but things would warm up as the day went on. The atmosphere was too thin and not nearly rich enough in oxygen to be breathable to human or Sobrenian. They stood under purple skies that would ease toward a deep blue close to noon.

Moruteb, barely over the horizon behind them, shone full upon the mountain before them. Mike looked up at the nine-hundred-meter-tall cliffside. The deep furrows running vertically down the cliff face looked almost too regular to be natural. He asked Govanek, “Just what's so interesting about this mountain?"

The Sobrenian said, “According to detailed sensor scans I performed aboard the *Meradeus* before coming here—*life*. Small animals we call cliff dwellers."

Not a terribly evocative name, Mike thought, but it'll have to do.

Govanek continued: “They live about halfway up the cliff. They have marvelous abilities to climb, and they have tough shells that protect them from predators. Their young live in chambers they dig within those furrows."

"But they don't create the furrows?"

"They're natural,” Govanek said. “The result of thin streams of water flowing down rock that dissolves easily."

Linna said, “The same thing happens on Earth, in basalt and limestone formations. China, Hawaii, any number of other places."

Great, Mike thought. Five months and hundreds of light-years for something I could see just about anywhere on Earth. All the same, I do find this place oddly affecting. I wonder why. There's no sentient life here. No intelligences will die. It's just rocks, vegetation, and some primitive lifeforms. Just...

His hand moved, without thought, to his lifesuit's wrist sensor. Its results made his heart beat faster, gave him a shot of adrenaline.

Life was closer than he'd realized. Beneath his feet, in fact.

He knelt and started digging the loose top layer of dirt with his gloved hands, ignoring Linna's and Govanek's stares.

The object he sought lay only a few centimeters down. A nearly perfect sphere about nine centimeters across. He examined the thin striping of blue and gold that made the object resemble a tiny model of a planet. Kind of looks like Itherin, he thought. One of those odd synchronicities of nature.

Linna apparently couldn't hold in her curiosity any longer. “So are you going to tell us what you've found?"

Mike's mouth formed a wide grin. “It's a fish."

"A fish? Here? How?"

Mike laid the small creature onto the dirt and took a more detailed sensor reading. “This outer sphere is its shell. It's made up of overlapping pieces that let it contain a reservoir of water. In fact, most of its interior is water. The creature inside's quite small."

Linna took her own reading. “And in hibernation?"

"Looks like. I'd bet it lives off the oxygen and nutrients in the water it's retaining—then waits for the next flow of water off the cliffs."

Govanek said, “That water would represent a rich chemical environment—more so than many standing bodies of water."

"All the same,” Mike said, “they must have a high mortality rate."

Linna looked up from another sensor scan. “They're buried all around. Hundreds of them. They must reproduce like crazy."

Over the next several hours, Mike and Linna took more samples of the spherical fish. Govanek concentrated on gathering up some of the cliff dwellers, since their relationship with their rocky environment particularly fascinated her as a geologist. They turned out to be six-legged creatures, mostly tan or brown, with thin, dartlike bodies and an odd bulge on their backsides.

Then daylight began to fade and it was time to leave. Moruteb descended through the deep blue skies, minutes from disappearing behind the broad cliff. Govanek walked up to Mike. One of her eyes looked toward him as the other swiveled toward the sun, Moruteb. “It's good we're packing up,” Govanek said.

"Why's that?” Mike asked.

"You'll see."

Within a few minutes Mike, Linna, and Govanek finished stowing all their equipment and samples and sat in the *Egg*'s cockpit in their previous positions. Moruteb eased behind the cliff top. To the north and south, its light still illuminated the sides of distant mountains and jagged scarps, but immediately in front of the *Egg*, a dark translucent curtain appeared to lower over the landscape.

Mike twisted in the pilot's seat to look back at Govanek. “What now?"

"We wait,” the Sobrenian said.

They didn't have to wait long. The first *pop* from the cliffside came seconds after Govanek spoke. A small plume of dust rose from the ground several meters in front of the *Egg*.

"What the hell!” Mike exclaimed.

Another pop, another plume. And another, and another.

Linna said, “It looks like the cliff is shooting at us."

"Not at us,” Govanek said. “At the fish. It's the cliff dwellers. Their bodies build up a small amount of methane gas that propels them out of their small, narrow homes on the cliffside."

"That was the bulge on their butts!” Mike said.

"Confirming what I suspected from the sensor scans I made while still in orbit. The cliff dwellers shoot themselves down onto their prey—the spherical fish. The fish, in turn, burrow deeper once they hear and

feel the cliff dwellers striking the surface. Individuals of each species live or die. The ecology maintains its balance."

Linna asked, “Why didn't you tell us all this earlier?"

"Basic science. I didn't wish to prejudice your responses, in case we discovered something open for interpretation.” She pointed a thick green finger at the cliffside. “As it turns out, this is all refreshingly straightforward."

Two of the cliff dwellers spattered against *Cosmic Egg*'s forward viewport. “Damn,” Mike said. “I hate seeing that. Let's lift.” Mike made a quick preflight check and lifted the *Egg* toward orbit. As the shuttle cleared cloud cover, Linna told Mike, “You look thoughtful."

"Maybe just thinking about ... life. We find it everywhere."

"A tiny fish in a shell? An almost-as-tiny creature that launches itself out of a cliff by shooting methane out its ass?"

Mike said, “Not particularly dignified life, perhaps. But still marvelous in its own way."

"They don't have awareness. They can't know they won't live another month. Hell, some of them didn't live out the day."

"All the same, it's something rare. And precious. Left to itself, who knows what might rise up on this world one day? Become aware? Learn ... to love one another."

Linna said, “I think I understand."

Govanek spoke up. “You humans! You think the galaxy revolves around you and what you think important."

Mike turned toward her. This was the first glimpse he'd seen of Sobrenian condescension toward him because he was human. “And Sobrenians don't?"

"Sobrenians think it *should,"* Govanek said. “But we know it does not."

Mike had nothing to say to that. He guided the *Egg* toward the *Meradeus,* where Govanek would rejoin her crew. Then it was back to the *Asaph Hall,* where Linna, with barely a word to Mike, retreated to her quarters.

* * * *

That night, as Mike sat in his room, he opened up the detailed holos of the Moruteb system. The *Asaph Hall* was set to go back to Heuri in a few days, and he wanted to study the planet in more detail. Jilan had shown him how much there was to discover in this system, and he was all too aware of how little time their little fleet had.

Those thoughts flew away as Linna called on his datalink. “Mike? Am I disturbing you?"

Mike's face broke out in a broad smile, one he hoped his voice reflected. “Never."

"I'm sorry I couldn't stay with you when we got back."

"Are you all right?"

"Uh ... fine."

"Don't bullshit me. You don't sound fine."

"Well ... maybe I'm not."

"I suppose coming up to see you would just make things worse."

"I'm growing more sensitive every day. I'm going to have to move down farther into the ship, maybe close to engineering. There's a room there next to the new-space regulators...."

"What the hell are you talking about?"

"Mike, everyone on the ship is closing in on me."

"Maybe when we get back to human space...."

"I may have to be sedated before then. Or put into cold sleep."

"Don't talk that way."

Linna's voice grew somber. “Normally I'd come to you. We could talk. You could hold me. Maybe we'd make love. But all that's closed to me now."

"Tell me what I can do. I'll help you if I can, Rosa will, we all will."

Silence.

"Linna?"

More silence for a time, then: “I have faith in you, Mike. And in Rosa. But I think it's going to take more than that to help me."

"It's a challenge for you, isn't it? To talk to someone when it's not in person."

"Too far away to use the empathy, you mean?"

"Yeah."

"It's one I could do without. But I admit it *is* intriguing."

"See?” Mike said. “We came here to learn about Moruteb. About the other galactic species with us. Now we're learning more about each other."

"And ourselves."

"Yeah. And ourselves."

"Good night, Mike. Don't worry. We'll do this in person sometime soon, I hope."

"So do I. G'night.” After a moment, Mike opened up the holofiles on Heuri again. His thoughts, however, remained close to Linna.

* * * *

Days later, as previously arranged, *Asaph Hall* had returned to Heuri and Mike picked up the Cetronen explorer Natai in the *Cosmic Egg*. Linna wasn't along on this trip. She wanted to “save up” the time she could stand to be around others for when her empathic powers were needed. In the seat behind the copilot's position sat Luther Kindred. He was genetically engineered for strength, with broad, solid

shoulders and hands that looked as if they could crush a bulkhead. Mike trusted him every bit as much as Linna in a tough situation.

Mike was glad the Cetronen paired symbiont was smaller than their species' norm; otherwise they'd have had a difficult time fitting into the *Cosmic Egg*. The red-furred Natai major, with the minor cradled in his arms, were a tough fit in the *Egg*'s copilot's seat. The minor's deep-set eyes looked out at Heuri with the same fascination Mike had seen in countless other explorers. His wide, pointed ears flicked at every sound, no doubt due to being on an unfamiliar craft.

The tough part was the major's tail, which was curled up into what looked like a very uncomfortable position behind and beside him. If trading crewmembers among species becomes common, Mike thought, we're going to have to make better physical accommodations for one another.

Among the tasks they'd set themselves were looking for clues as to why the Drodusarel had gathered up lifeforms from the planet, and why they'd already moved on to the planet Itherin.

Who knows what kind of beings live there? he thought. The Drodusarel certainly gathered some kind of life-forms there. Could they be intelligent? Even be related to the Drodusarel in some way? The methane breathers have been so secretive about their interests all along on this journey.

Luther said, "Look just beyond the planet—that bright star and two fainter ones next to it."

"I see them," Mike said. "Neska and her two planets?"

"Yes."

Natai's minor said, "They'll enter this system within a month. Current projections say one of Neska's planets could strike Heuri head on."

The ringed gas giant Jilan and its bands of clouds dominated the shuttle's forward screen now. Luther said, "It resembles Saturn."

Natai's minor asked, "Is that a planet in the human home system?"

Mike said, "Yes, a ringed world much like Heuri. And it points up something about gas giants—it's easy to look at them and imagine they're all alike. But they have just as much variation as any other type of world. You just have to look more closely."

"Please explain, Mike Christopher. I'm only a beginning explorer."

"Well, Heuri's only about half the size of Saturn. It's only a little larger than either Uranus or Neptune—other smaller gas giants in Earth system. But the surface of Uranus looks like a solid blue globe—very few surface features. At Neptune you can see cloud features and even storms along its surface. But it doesn't have the cloud bands that Heuri does."

Luther said, "Don't forget the rings."

"That's right. Both Uranus and Neptune have ring systems, but nothing as extensive as Heuri. Another similarity it has with Saturn, though it's much smaller."

Natai's minor said, "Then Heuri combines qualities of worlds you are already familiar with."

"Exactly."

"And that experience helps you interpret your findings on new worlds."

"Or in this case," Mike said, *"into* new worlds. Look, we're coming up on the rings."

Again Mike saw the four main sections of rings. He looked in vain for structures similar to the braiding present in parts of Saturn's rings—that phenomenon had always fascinated him. Heuri's rings, however, were much more "solid" looking. That was an illusion, as they were composed of chunks of ice ranging from the size of marbles to small moons.

Natai's minor leaned forward to initiate a sensor scan, then said, "I understand those rings may have intrigued the Drodusarel—since life on their planet initially came from their own rings."

Luther said, "Our scans from the *Asaph Hall* didn't find any. Of course, there's no reason life should exist there anymore. Although the idea could be what drew the Drodusarel to Heuri to begin with."

"And," Mike said, "it seems they found something."

Natai said, "Or someone."

"That's right." Mike guided the *Egg* past the plane of the rings and down toward Heuri itself. "Let's see what—or who—we can find."

Within half an hour *Cosmic Egg* was skirting Heuri's upper atmosphere. Skies above were still dark enough to reveal stars, although in some areas reddish wisps of hydrogen clouds obscured both the heavens and the lower cloud layers.

Look directly overhead, and Heuri's rings were a gigantic arch, lording over the sky so effectively that Mike felt an urge to duck, his instincts telling him that something so large yet so insubstantial *had* to be about to fall at any moment. The rings narrowed as they arced down toward the horizon and, along with the wisps of cloud, turned pinkish just before reaching it.

Mike took the *Egg* down into a lower level of clouds. With more atmosphere roiling overhead, the sky turned a dark blue, and all but the brightest stars faded out. So did most of Heuri's dozen moons, none of which was large enough to be visible from the planet as more than a swiftly moving point of light.

He saw both Natai and Luther working on sensor scans. "Anything?"

"No," the Cetronen minor said.

"Yes," Luther said.

Mike asked, "Which way?"

Luther transferred some coordinates from his console to Mike's. "There."

Mike headed the shuttle in that direction, about two thousand K to starboard, and another few hundred deeper into Heuri's clouds.

Natai's minor said, "I see the readings now. They're life-forms. And I can see why the Drodusarel would be interested in them."

"Methane breathers?"

"Doubtful. Not enough of that in the atmosphere. But living as the Drodusarel do in a planetary atmosphere, which is a rarity, would attract them. We understand this. Cetronen, too, are a rarity. We are the only sentient species not made up of singletons." Natai's minor stood in the major's lap and said, "Do not be embarrassed. I don't share the prejudices of some Cetronen, regarding singleton species."

Mike said, “Well. I'm glad."

Natai's minor sat down on the major's hump again.

Luther worked his controls, pointed out the front viewport, and said, “There!"

Excitement welled up within Mike. This is why I'm so many hundreds of light-years from home, he thought, to make such discoveries. And again, life! Sometimes it seems there's hardly a place in the galaxy where it isn't present. “Can you get us a visual?” he asked.

On the center viewscreen appeared an image of a wall of dark clouds hanging before them. At first he had no sense of scale and wondered whether he should throttle back to keep the shuttle from entering that roiling wall that stretched from one horizon to the other. A quick sensor check and the cloud wall's true distance revealed itself. Not to worry—it was nearly seventy kilometers away.

It seemed to move so quickly, though, that Mike realized the forces that wall must be wielding. It looks like the eyewall of a hurricane, he thought. A hurricane that could swallow up Earth's moon.

And before that wall floated a series of ... ribbons. They were flat beings of a dark purple that was nearly black, each of them about three meters long. Over a dozen strong, they undulated “sideways” across Heuri's skies at a leisurely pace.

"I've seen snakes trace paths just like that across a desert,” Mike said. “How do they do that?"

Natai's minor said, “It appears they're not very massive. I suspect they're gliding over layers of air currents we can barely detect."

"Do you think these are the same beings the Drodusarel were interested in? They're not very similar to them."

"Only in being atmosphere-dwellers. That may be enough."

Mike made a quick sensor check. “They're each about four and a half meters long. I can't tell if they're gliding along with the prevailing winds or trying to tack against them."

"Look at their spines,” Luther said.

Mike focused the viewscreen more closely on one of the creatures. Sure enough, a thin ridge was visible down its back. They all appeared to have barely visible segments every few centimeters. Their bodies flared out at either end before forming a rounded tip that resembled an arrowhead. “These beings are just large enough to imply others are here, too. Either something they prey on or something that preys on them."

Luther said, “Look just ahead, at ten o'clock—another pack, or herd, or whatever you'd like to call them."

"Well, I'd like to call this species ‘ribbons.’ So I'd say ‘herd’ is good enough. ‘Pack’ makes them sound like something that comes in a box.” He glanced back and saw Luther's dour expression. “Okay, so ‘ribbons’ isn't that clever. You got a better one?"

"Not just yet,” Luther said.

Natai's minor asked, “Can we go closer?"

"Perhaps a little bit,” Mike said. “But I don't want to take the chance of harming them."

"Remember," Luther said, "the Drodusarel took some of them along in the *Dirat."*

"Yeah. Maybe to dissect them."

"We could pull a maneuver I used to see on whale-watching cruises."

"Excuse me—whale *watching?"*

Natai's minor asked, "What is a whale?"

Mike said, "Earthly ocean-dwelling being. Air breather."

"How can a being who lives in the ocean breathe air?"

"Don't you have such beings on your world?"

"Of course not. How would they breathe?"

"They spend a lot of time on the surface."

"That seems unlikely, not to mention inefficient."

Mike said, "Please—just accept it for now." He turned to Luther. "Okay—why would anyone just watch whales? Why not talk to them?"

Luther said, "Not all humans have datalinks, you know. And I saw this when I was about eleven. Humans weren't talking to whales yet."

"So what's the maneuver?"

"We go ahead of the ... *ribbons* ... God, I hate that."

Mike raised his eyebrows at Luther. "Something better?"

"Not yet. Anyway, we get ahead of them and sit right in their path."

"So we don't interfere with them, but we still get a good look. I like it. We'll try it."

Mike guided the *Egg* leisurely around the ribbon herd and eased the shuttle into position about half a kilometer from them, directly in their path.

And waited. The ribbons drew nearer, undulating effortlessly through Heuri's skies. Luther said, "It looks as if some of them form subgroups within the herd."

Mike said, "I'll have the comp ID each individual and track them. We'll see which ones stay together as they go around us."

Natai's minor said, "What if they don't go around?"

"Don't worry. I'm not going to let them get closer than a few meters. Then I'll back off."

The herd of ribbons approaching the *Egg* didn't change course right away. When it was about twenty meters away, however, the individuals within it angled around to form a straight line, as if they were an arrow pointing directly at the *Egg*. At about four meters, the individual ribbons separated again, each in a slightly different path as they slid past the shuttle.

When all the ribbons were past, Mike flipped the shuttle around to get a glimpse of them as they departed. “They seem none the worse for wear,” he said. “I wonder what that maneuver was about."

Luther said, “Maybe they have prey—or a predator—that gets confused when they do that."

Natai's minor rose on his major's hump once again and stretched his arms and rolled his neck in an oddly human manner. As he sat down again, he said, “What seems clear is that these beings are not similar to the Drodusarel. If they're searching for beings like themselves, perhaps that's why they've gone ahead to Itherin."

"I don't know. These are just the first life-forms we've found. The Drodusarel were only here a matter of days. You can't explore a planet in that short a time."

"We're attempting to explore an entire system in a matter of a month."

Mike couldn't help his bitter tone. “That's only because of delays in getting this mission together."

Luther muttered, “Delays that weren't humanity's fault."

"Nor were they the fault of Cetronen,” Natai's minor said. “It was ... others ... to blame for that."

"The Drodusarel?” Mike asked.

"No. If anything, they were too eager to go."

"Then ... it must have been..."

"Yes. The Sobrenians.” Natai's reluctance in saying that was apparent even across the datalink translation.

"Codari said Cetronen-Sobrenian alliances don't favor you right now."

"That's something we learned only during negotiations for this exploratory mission."

"And it meant enough to try to change that, so you delayed the mission."

The Natai minor said, “Perhaps I've said more than I should. I will focus on exploration now."

Well, that subject's closed, Mike thought. Once a Cetronen moved his focus from one topic to another, that was it. Then he looked down at his sensor readout and his eyes went wide. “Drodusarel shuttle, ten K behind us, approaching rapidly.” He opened a comm channel. “Drodusarel ship, please identify yourself."

No response. Mike whipped the shuttle around again, this time to face the oncoming Drodusarel craft.

"Mike,” Luther said, “maybe you want to power up weapons."

Mike said, “Passive sensors don't show them powering up."

"I'd hate to be the one to shoot second."

"I don't want to shoot at all. These are supposed to be our colleagues."

Natai's minor said, “Colleagues would identify themselves when asked."

Mike opened the channel again. “Drodusarel ship, please respond."

Luther put the image of the Drodusarel craft on the main screen. “It's silver, and it's an oval. Big surprise.” Like every other Drodusarel craft humans had encountered, its form gave no hint of its function. Drodusarel military ships looked like cargo craft, which looked like passenger vessels.

Mike said, “And it's got the *Egg* outclassed when it comes to its drive, weapons, shroud—you name it. They can do whatever they want to us."

The Drodusarel craft approached to within half a kilometer, then slowed in relation to the *Cosmic Egg*. Ribbons eased their way around it as they had the human craft minutes earlier. “At least we get a good look at that trick from the outside,” Mike said. “It's quite pretty, actually."

The Drodusarel craft held its position just long enough that Mike went back to studying the ribbons—he was just starting to notice that the various herds appeared to be converging on a single point in the far distance when the Drodusarel ship rose through the upper layers of Heuri's atmosphere until it was out of sight.

"Hmph,” Mike said. “Not even a goodbye."

Natai's minor said, “I wonder who they were more interested in—the ribbons or us."

"No way of knowing. But Drodusarel shuttles don't have stardrive. That means the *Dirat* has to come back from Itherin at some point to retrieve it."

Luther said, “That gives them less time to explore there—not to mention any other worlds they might be interested in."

"Most of the rest are ‘dirt worlds'—they couldn't care less. But it makes me wonder what they're doing—what they think is so interesting here that they leave that shuttle while *Dirat* heads for Itherin."

Natai's minor said, “It is a risk Cetronen would be reluctant to make."

Mike looked up toward Heuri's thick clouds as if he could still spot the Drodusarel craft. “Humans too. But something here must have been worth it."

* * * *

Six hours later, back aboard *Asaph Hall,* Mike grabbed a quick sandwich in the ship's commons, intending to sit just a moment, then catch a nap. Then hands began rubbing his shoulders. He recognized the touch and the smell of her skin.

Linna.

He put down his sandwich and let himself relax into the chair as she worked her way across his shoulders and down his upper back. “Oh, that's great."

Lips brushed the back of his neck, and Linna whispered into his ear, “My quarters. Right now."

When they got there and Mike started to speak, Linna covered his mouth with her hand. “Not yet. The time to talk is in a few minutes.” And she led him to the bedroom.

Linna was as responsive as ever as they undressed and embraced—how could she not be, when she felt Mike's building excitement along with her own? But her lovemaking held an urgency Mike had seldom experienced with her.

When they were done, Linna turned her back to Mike and said in a tense whisper, “Hold me, while I can

still stand it."

Mike cuddled against her. “It's getting that much worse, is it?"

"So much I wonder how much longer I can endure being on this ship."

"It's been home for you for eleven years."

"That's why I knew I should tell you as soon as I decided. I'm going to leave."

Mike's stomach clenched. His mouth went dry. He held Linna tighter. “What can I do? How can I make things better for you?"

"You can't. And you can't go with me, either. I need to be alone."

"This goes beyond me, beyond the *Asaph Hall*. Will you have to ... go into exile?"

"Maybe somewhere quiet back home near Kyoto. Somewhere I can mostly be alone. Maybe have a dog. Don't you miss having a dog?"

"Never had one. You live in institutions, then foster homes, then you're a spacer—never had the chance. Gosh, how long has it been since I've been back to Earth? Let's see ... twenty-two years."

"Maybe things have changed there. Maybe they're ready to accept an artificial human."

Mike mulled that over a moment. “Or maybe it's gotten worse."

"I know it was tough ... the foster homes...."

"The beatings. Nearly getting *killed* more than once."

"It *is* time, then. Whether it's to see me or not. So you can see what it's really like. Wouldn't you like that better than just assuming things?"

"Let's not get too far ahead of ourselves. We're still out here, for now. A *damn* good many light-years away."

"And still together,” Linna said.

"Yeah. Still together."

"Only..."

"Yeah?"

Linna rolled over, still in Mike's grasp. A quick kiss and she said, “I've got to ask you to leave."

I'm feeling that ache again, Mike thought. And passing it on to her with each second I'm here. “When can I see you again?"

"Probably when Rosa has us working together."

"You know what I mean."

"Like this? No way to tell you."

Mike kissed Linna's shoulder, her neck, her lips. Then he got out of bed and started dressing. He didn't say anything else, didn't even consider trying to tell her he loved her.

* * * *

About a week later, Mike guided the *Cosmic Egg* across the icy surface of the Moruteb system's outermost planet, Risula, at about one kilometer's height. A flyover was all Rosa, Syradok, or Codari had authorized. This time the Sobrenian Govanek was in the right-hand seat, with *Asaph Hall*'s Operations Chief Alice Nicholson sitting behind her. Mike was trying to spread the joy of exploration to as many crewmembers as possible.

Mike turned his attention to Risula's surface. The planet, he knew, was named after a mythical Cetronen being who sacrificed herself to set the seasons in place and ensure the annual renewal of the world after the depths of winter.

Either the naming was arbitrary, Mike thought, or they picked pretty damn poorly. Risula was a world that seemed literally frozen in time—dark ice covered its entire surface. And Mike saw little evidence, even through detailed scans, of enough internal heat to crack that icy surface open anywhere on the planet. Its icescape featured shallow craters and occasional ice spires that barely reached fifty meters tall and were the remnants of hills eroded away over the centuries. Risula was only three AU distant from Itherin, the planet next in to Moruteb, and was suspected to be a world that Itherin had captured and brought into the system.

Risula's frozen surface was pitted and pockmarked with dark dust from meteor impacts. Lighter colored ice was visible in places where a particularly large meteor had struck the planet's surface, punching through the surface ice to reveal the newer, fresher ice beneath.

The scary part, Mike thought, is looking into the sky. Neska is *so* close. The star and its two planetary companions still only appear to be bright stars. Knowing what they are, though, it's easy to imagine them rushing into view and filling the viewscreens at any moment.

Govanek said, “I'd like to land."

Mike nearly did a double take. “Land! We're lucky that Rosa and Codari—not to mention Syradok!—approved this fly-by. Do you realize how much more work the gravitics are doing, and the nav unit? And the comp! This is a planet that's liable to be inside Neska within a week."

"I'm aware of that."

"Thank you."

"I want to land."

"Why?"

"I'm a follower of the Giver."

Alice spoke up. “The Sobrenian moral god."

"That's right. As opposed to the Shaper, who created all things."

Mike asked, “What does that have to do with landing on Risula?"

"I want to spend a moment on this world that soon will no longer exist. I don't care about ice samples or how the planet formed or anything else. I just want to stand there for a few moments."

"Govanek, you're putting me in a hell of a position."

"If you're worried about the danger—"

"I'm more worried about the ass-chewing my captain's going to give me!"

"Sorry? That must have been a failure to translate properly."

Alice said, “You know, now that you mention it, I might be interested in how difficult nav is within all these conflicting gravity fields."

"Dammit,” Mike said, “How's that smooth plain to the west look?"

Alice made a quick sensor check. “It's nice and stable, just like most of the planet."

"Then here we go."

"Shouldn't we let *Asaph Hall* know what we're doing?"

"We will—soon as we set down."

But they didn't even get a chance to wait that long. Even as Mike was positioning the *Cosmic Egg* over that smooth plain, Rosa called: *"Asaph Hall* to *Cosmic Egg*. Are you declaring an emergency?"

Mike was settling the shuttle down onto Risula's icy surface. Alice responded, “Negative, *Asaph Hall*. We'll explain in a few minutes.” When she cut the connection, Mike said, “By ‘we,’ I imagine you mean *me."*

"That's right,” Alice said, grinning.

"Fine,” Mike muttered and eased the *Cosmic Egg* down onto Risula's surface.

Govanek rose from the copilot's chair and put on her spacesuit. She stood there holding her helmet in her rough green hands. “Mike, I'd like you to come along."

"Me? Why?"

"You were kind enough to allow this. We're here to learn about one another as much as about this doomed system."

Mike told Alice, “We'll be right back. Keep the home fires burning. And I love that mock-exasperated look you're giving me."

"It's not so ‘mock.’”

Time to go, Mike thought, and pressed his left middle finger into his palm to activate his lifesuit. He followed Govanek into the airlock, and they stepped out onto Risula's dark rough surface. Mike made his first steps onto the icescape—tentative ones in the planet's .27 grav. “Not at all slippery,” he said.

Govanek said, “This ice has been battered so many times, its surface has much rock mixed in with the ice. I'd love to know its composition, to—"

"I thought you weren't going to concern yourself with such things."

"Apologies. Ever the geologist, I suppose."

"Just a minute. Alice?"

Over the datalink, Alice replied, “Yes, Mike?"

"While we're here—"

"A few samples. I was listening. I'll get the *Egg*'s protocols started up."

Govanek said, “Thanks to you both."

Mike had made sure to land in an area where it was just past local dawn. Looking across the dark pitted icescape to the east, Moruteb was still rising. Risula's day was nearly thirty hours, so local noon would be some hours in arriving.

"Look just above and to the right of Moruteb,” Govanek said. She was pointing to a large star, brighter than any others.

"That can't be Neska. It's on the other side of the planet."

"You're correct. It's Itherin."

"Ah. Where the Drodusarel are."

"I heard about your encounter with them at Heuri. It must have been interesting."

"On my world,” Mike said, “‘interesting’ is sometimes used as a curse."

"Then what is about to happen here on Risula will truly be interesting."

Mike knew what Govanek meant. The very idea of standing on a world that soon wouldn't exist filled him with amazement at the capabilities of the universe. I understand now why Govanek wanted to stand here at this unique moment, he thought. Neska has been pulling at Risula for months already—gently at first, but more and more as it grows closer. If Risula really is pulled into that star, it's going to be an amazing sight. That's the unspoken motivation for coming here, at least for us humans. Deep down, part of us craves spectacle.

About a dozen meters away was a shallow crater with rounded rims. Those were the norm here; the heat of an impact by an asteroid or meteorite would turn surface ice into water that splashed, then flowed across Risula's surface, leveling the nearby icescape before freezing within moments. Water would partially fill the crater, making it shallow.

Mike stepped gingerly to the crater's edge, still aware this *was* ice, however gritty, still aware of the .27 grav. The crater was nearly fifty meters wide, but he knew if he were so daring (so stupid!) as to jump into it, he'd still be able to jump high enough to wave to Govanek.

He thought of Govanek and turned to see what she was doing. The Sobrenian was where he'd left her, standing stock-still, both her hooded eyes staring at the stars.

No, Mike thought. Not at them. *Into* them. As if she's losing herself out there.

Now's when I need Linna here. What's Govanek experiencing? Religious ecstasy? Is that even an emotion distinct from other forms of euphoria? Or is this another example of the Sobrenian “calm” they can turn on at will?

Mike returned to Govanek. He only approached to within about ten meters of her, not wanting to disturb

her. Although, he thought, we've got to leave sometime soon. Rosa's patience may be wearing thin. Not to mention Syradok's or Codari's.

Finally, he said, “Govanek?"

The Sobrenian's gaze fell from the stars and both her eyes looked directly at Mike. “Yes?"

"I'm sorry, but we have to go."

Govanek looked around at her surroundings as if becoming aware of them again. “Do you know that thoughts of the Giver fill me with an unmatched awe?"

"I ... don't know what to say."

"Humans have their gods, do they not?"

"Many of us do. I'm not one of them."

"How do you bear the sadness?"

"It doesn't cause me sadness."

Govanek said, “I wonder what Linna would say to that."

"One day I'll have to ask her."

"You are intimate sexually, are you not?"

"Well, uh ... *yeah*."

"Then other intimacies should come naturally to you."

Mike asked, “Are you an expert in human psychology, now?"

"I apologize. I was overly curious."

"Not at all. I'm curious about some things, too."

"Such as?"

"Why the Sobrenians are so interested in this system."

Govanek's eyes looked away again, the left one staring out toward the stars, the right one peering across the icescape. “My people do not appreciate such questions. I have not interrogated you about human motivations."

Mike spread his hands wide. “Which are very clear. We want to learn about this system and about other galactic species."

"Including Sobrenians."

"Yes."

"That's one of two reasons we were reluctant to go on this mission."

"What was the other reason?"

"The Cetronen would not allow us to lead it."

Mike said, “You dislike having ‘pre-sentients’ in charge, don't you?"

Govanek's eyes turned toward Mike again. “I've never used that word to refer to you or any other human."

"Then I apologize."

"You caught me at an opportune time, Mike. My reaction to the stars ... to standing on this world that will soon no longer be here ... I perhaps spoke more freely than I should have."

"I won't ask anything more,” Mike said. “We should get back to the shuttle."

Govanek led the way back inside, but Mike paused at the bottom of the ladder leading into the airlock. Everything's transient, he thought. Nothing lasts. This world, so solid, so perfectly formed, will be random ice and dust within a week.

* * * *

A week and a half later, Rosa called Mike to her quarters when the rogue star, Neska, was only about a day and a half from its closest approach to Risula, the Moruteb system's outermost planet.

As Mike entered, Rosa was standing in the middle of her main room, but motioned Mike to the nearest chair. “Anything to drink?"

"No, I'm fine."

Rosa was still standing silently, apparently deep in thought. Mike asked, “Everything okay?"

The *Asaph Hall* captain looked at Mike. “What's that? Oh, as much as it's going to be, I suppose. I might as well go ahead and tell you."

"Uh oh."

"Govanek—and more importantly, Syradok—want you aboard the *Meradeus* when Neska approaches Risula."

"Oh,” Mike said. “I imagined a much worse fate."

"Such as what?"

Mike shrugged. “It was indeterminate. But still pretty bad."

"Don't be complacent. That's not all. The next encounter is at Itherin, and you can watch it here. But for the one after that, you have another invitation, from Codari himself. He wants you aboard the *Cerenam* for what will probably be Heuri's destruction.” That was the world where the Drodusarel had gathered up life-forms and taken them into the *Dirat,* where he and Luther and the Cetronen Natai had discovered the ribbons.

Mike said, “I'm going to be a busy boy."

"Busier than you might think. Codari also wants Linna along."

"I hope she can handle it."

"Do you doubt she'll make herself handle it?"

Mike couldn't argue with that.

"Codari told me he wanted me to keep an eye out for anything important—and let him know about it."

"I'd have done the same thing in his place."

Mike squirmed in his seat. “Ask a crewmember of another ship—of another *species*—to spy on everyone else?"

"Not spy. Keep an eye out.” Rosa paused for an instant, then went on. “Have you told him anything?"

"Not a thing. And I've told you *everything."*

"As it should be."

"I'm confused,” Mike said. “I thought you said you'd have done the same thing in Codari's place."

"I would have. To find out if I could trust that person. Anyone who would report back to me before his own captain *couldn't* be trusted."

Mike said, “So maybe I passed a test with Codari."

"Which is why he wants you along on that trip to witness the end of Heuri. But listen—Codari's the leader of this mission, and he's done an excellent job. But I only trust him so far. When it comes down to it, he'll look after his own ship and his own people first."

Mike grinned. “He gave me similar warnings about the Sobrenians and the Drodusarel."

"Fine advice. But guess what?"

"It applies to us, too?"

"Got it the first time,” Rosa said.

* * * *

Things happened quickly once Mike guided the *Cosmic Egg,* with Linna aboard, to dock with the water drop-shaped Sobrenian ship *Meradeus*.

Govanek met them at the hangar deck, wearing her familiar robes that featured the single line of red running through their fabric. She extended a green, rough-skinned hand to each of the humans in turn, saying, “It's an unusual custom to touch someone immediately upon meeting them. But I see that it could be comforting."

And I'll take whatever comfort I can get right now, Mike thought. “We're glad to be here,” he said, not altogether lying.

Govanek said, “Captain Syradok would like you to come to our bridge immediately,” then led the way there. With Mike's first step onto the bridge, he found himself squinting and raising his hand against blinding light in all directions.

I knew Sobrenians can withstand brighter light than most humans, he thought, but I've never seen an interior of one of their ships illuminated so intensely.

Then he heard Syradok speak: “Mike Christopher and Linna Maurishka! What a pleasure to see each of you again."

As Mike's eyes adjusted to the light, he could make out Syradok, who stood with his back to an oval table of some sort in the center of the bridge. A quick glance around and he saw viewscreens and holos in every direction, each centered on one of the ships of the fleet or one of the worlds of the Moruteb system. As many as a dozen crewmembers bustled around the various sections of the bridge.

Syradok's blue robes rustled as he waved the humans closer to the table. Mike stared down at it, Linna taking a position immediately to his right, and he realized he was seeing a display of the dark, pitted surface of Risula. “Look closely,” Syradok said as he stood on the opposite side of the display from the humans. “This is the last glimpse any galactic intelligences will have of Risula."

The light was harsh and bright on this display as well, but that was from the proximity of the rogue star Neska to the planet. Though the display didn't show the star itself, its light thrust sharp shadows across Risula's surface. The lighter portions of the icy world, indicative of meteor strikes, stood out even more now.

The display switched to another view, focusing on the side of Risula toward Neska. Already ice was vaporizing from the planet's surface, revealing dark earth and rock beneath. Giant cracks the size and length of rivers were spreading across what remained of Risula's icy surface.

Has any human witnessed anything like this? Mike wondered. He imagined the destruction of the landscape he and Alice and Govanek had visited on their brief trip to that world—the shallow craters splitting apart, the fifty-meter-tall ice spires crumbling or vaporizing. Alice had told him earlier that she'd already gained some insights into the interactions of bodies large and small coexisting within conflicting gravity fields. She was proud that her rationalization for landing on the icy world had actually turned out to have practical value.

Mike felt a presence to his left and realized Govanek was standing at his side. He wondered how much she'd told Captain Syradok about their brief jaunt to this doomed world. Probably not a lot, he mused. About as much as I told Rosa.

Govanek kept one eye on the display while aiming the other toward Mike. She gave him the slightest nod, then turned the other eyeball toward the display as well.

I don't think nods are a Sobrenian expression, Mike thought. I imagine that ranks up there with the handshakes all around when we arrived. That was her way of thanking me for letting Govanek explore alongside us.

Which makes me all the more grateful that we took the chance.

As Neska drew Risula closer, Mike and the others sat and watched as the star stripped the planet of the rest of its ice cover and as the planet's surface soil and rock tore away, revealing its center. Risula's interior contained only a small iron core, much less than a planet such as Earth—it had never grown hot enough during its formation to separate the iron from the rock.

Then some balance of Neska's heat and gravitational forces versus the integrity of Risula's rocky structure tilted in favor of the star, and Risula crumbled and broke apart. It's as if I had a dirt clod in my hand, Mike thought, and gave it a squeeze.

The fractured, continent-sized pieces of the planet also began to crumble, and in a very few minutes Risula was gone.

It had been a lifeless world, but Mike still felt a profound loss, as if something vital had just been snuffed out before him. Risula was named after the Cetronen mythological being who sacrificed herself to set the seasons in place. I'd like to know, he thought, what this Risula has sacrificed itself for.

Mike stared at the display showing the continued advance of Neska across the Moruteb system, its composition unchanged, its path undisturbed even after overwhelming a planet.

Mike turned to his left, meaning to speak some words of comfort to Govanek, but she was gone. He wondered what the Giver might be telling Govanek about this event.

A glance to his right and Linna looked to be holding up well.

Syradok spoke in much quieter tones than Mike had heard from him before. “Now, my friends,” the Sobrenian captain said, “after witnessing such an event together, after sharing this marvelous yet troubling experience, we must speak. Let us go to my quarters."

Syradok led the way into the corridor as Mike and Linna followed.

Mike thought, What the hell are we getting ourselves into? All told, I wonder if I wouldn't rather be somewhere having a beer.

* * * *

To Mike, Syradok's quarters stood in sharp contrast to the bridge of the *Meradeus*—shadowed rather than brightly illuminated, simply furnished rather than filled with viewscreens, compact rather than spacious. Mike was also more aware of the higher humidity and musty organic smell of his surroundings.

Syradok said, “I must apologize that there are no seats suitable for humans to use. I will keep my remarks short, Mike Christopher and Linna Maurishka."

Linna smiled. “You know, Captain Syradok, with humans you're familiar with—and I believe we qualify—you can just call us by our first names."

Syradok tilted his head. “Ah! That is good to know. And a marvelous timesaver. Why, out of all the galactic species, is it only humans who seem to require two names to identify themselves?"

Mike shared a glance with Linna, who said, “Not really sure."

"Another time, perhaps,” Syradok said. “What I am about to tell you, I was originally going to pass on through Govanek, unofficially. But I realized it would be best for me to explain matters myself, especially in the presence of Linna Maur ... of Linna, the empath."

Linna said, “We're honored, Captain Syradok."

Syradok continued: “I would still like you to consider this an unofficial meeting. We Sobrenians were interested in the Neska system because we believed our galactic precursors first sent the system on its journey as a rogue star."

Mike said, “Your ... precursors?"

"Many of our scientists believed we were the progeny of a more advanced species, which seeded our homeworld with life. We hoped to find evidence of that species here. We'd even dared to think such beings were the inspiration for the Giver and the Shaper. But even using nanoprobes throughout the system, we couldn't find them. We'd also hoped to find some sort of overwhelming weapon here. Again, we did not."

The usual Sobrenian emphasis on weaponry and conquest, Mike thought. Never mind that when the shit strikes the recycler, they're as likely to bluster as shoot. He asked, “Why are you telling us this?"

Syradok spread his arms wide. “My friends—I pride myself on seeing farther than most of my species. Knowing that these so-called precursors do not exist is a blow."

Mike said, “Something tells me you're looking at what happens after more Sobrenians find out."

"I believe it's time for Sobrenians to accept the Cetronen offer of an alliance."

"The one you didn't want any part of before."

Syradok didn't compliment Mike on his insight. “That's a harsh truth. But a truth all the same. Many of us believe we rose up from a primitive state, aided by our precursors, only to fall and rise again, many times over. We believed it was fated. Finding no evidence of those precursors makes that uncertain."

Linna said, *"Everything's* uncertain,” which made Mike turn and look at his shipmate as if seeing her in a new way. I've never heard her say something that cynical before, he thought. Has coping with her increased empathy had something to do with that?

"In this case,” Syradok said, “I cannot disagree with you. What I would ask of you, Linna, is that you confirm my sincerity in everything I've told you."

Linna said, “I do so gladly."

"Mike, Linna—please pass on what I have said, unofficially, to Captain Sandage and Captain Codari."

Mike told Syradok, “We'll talk to Rosa at once. And Codari very soon.” After a few more pleasantries, Mike led the way to the hangar deck and lifted the *Cosmic Egg* toward the *Asaph Hall*.

* * * *

Immediately upon their arrival back at the *Hall,* Mike asked Rosa to meet him and Linna in the ship's commons. When they arrived, Rosa was already there. She looked at Linna and said, “Do you really trust Syradok?"

Linna took a deep breath. “He's sincere in what he says. I have no way of knowing if his superiors have deceived him."

Mike said, “He strikes me as being particularly bright—and perceptive. I think anyone who tried to get him to pass on lies or even half-truths would discover that he'd figured it out."

Rosa said, “I agree. But it's thin stuff to take back to the Unity.” She wrung her hands, seemed to notice she was doing it, and stopped. “We'll get this information to Codari as soon as we can. But it has to be in person. Mike, don't wait for Heuri. Go now—the Itherin encounter's coming up, you can watch that one with him, too. Linna, you feel like going along?"

"That's day by day,” Linna said. “For now, I think I can make it."

Rosa told Mike, “Set up another trip over to the *Cerenam."*

"Sounds great—I shared the destruction of Risula with Syradok. Codari and I can take in whatever happens at Itherin together."

* * * *

As Mike guided the *Cosmic Egg* toward the mushroom-shaped Cetronen starcraft *Cerenam,* he asked

Linna, “You're sure about this?"

Linna glared at him. “For the thousandth time, I'm *fine*. Stop asking."

That reply doesn't make you sound fine, Mike thought. Through years of experience in being intimate with an empath, though, he didn't say anything.

The unusual thing, Mike realized, was that Linna didn't reply to his unexpressed emotion, didn't remind him that he couldn't hide his real feelings from her, or make a joke about how he should stop radiating his emotions at her. That's what's frightening, Mike thought. She's shutting down, trying not to let anything bother her. Which may be the worst thing she could do.

Or is her alternative to let the emotionalism all around her overwhelm her?

Then it was time to bring the *Egg* in for a landing at *Cerenam*.

Natai escorted Mike and Linna onto the Cetronen ship's bridge. It featured a cleaner look than the bridge of the Sobrenian ship—even, practical lighting, few viewscreens, and only a handful of crewmembers.

And one more thing. “Uh, Natai, a question."

Natai's minor said, “Yes, what can I answer for you?"

"Where do we sit?"

Natai's minor's ears waggled and he stared blankly for a moment. Then his body shook with laughter. “Well, I suppose that's something that never occurred to us. Because, you see, we minors sit almost constantly and majors seldom need to."

Mike said, “Well, then, we'll stand. When in Rome..."

"Sorry,” Natai's minor said. “Failure to translate."

Linna said, “Never mind. Earth idiom."

"We'll go to our main viewscreen. Neska should be coming up on its closest approach to Itherin soon."

That main viewscreen turned out to be a wall-sized display that made Mike feel as if he were standing on the edge of space, ready to fall off.

Itherin dominated that view. It was a small gas giant, its surface a dark blue-green with only faint banding visible across its atmosphere. Less than an AU distant, Neska was only .86 Solar masses, yet seemed nearly half again the size of Sol, a bright, deadly presence in the firmament.

Captain Codari entered the bridge. His major carried the minor toward the viewscreen to stand next to Mike, Linna, and Natai. “It is so good to see you again, my human friends. I understand you have much to relate to me."

Mike glanced around the bridge. “Should we discuss this here?"

"I trust Natai and all my bridge crew. And if what is rumored is true, then this is news my entire species will need to know."

"Very well, then.” Mike summarized Syradok's offer of an alliance between his people and the Cetronen.

When he finished, the minor repositioned himself in the major's arms before saying anything: “This is marvelous to hear. A galactic species known for its aggressive actions toward so many others—including your own, Mike Christopher—and we may be able to forge an alliance with them."

"We can only hope,” Mike said.

Linna spoke up. “Look at Itherin."

The blue-green world was losing its atmosphere. Hydrogen, helium, methane, it was all streaming off into space, mostly from the side of Itherin closer to Neska, forming a “tail” similar to a comet's.

"Soon,” Natai's minor said, “Neska will begin to pull Itherin from its orbit. Moruteb will barely notice, but the cost to Itherin will be high—it'll probably lose most of its outer layers of gas and be reduced down to its core."

Mike said, “I understand the Drodusarel haven't left yet?"

"They have not. Display: show the path of the *Dirat."* An image of the Drodusarel starcraft appeared in a corner of the display. It was in a high orbit, well away from any danger, but Mike still couldn't believe what he was seeing. “So they *are* still here? What about their shuttle I encountered at Heuri?"

"It remains there. And I share your surprise. It's an impressive technology that they're able to leave such a relatively small craft alone on a long-term basis."

Linna spoke up, her voice strained. “Or maybe ... maybe they *can't*. Maybe they're all going to *die* over at Heuri."

Mike saw that tears were flowing down Linna's face. He took her arm, but she pulled away from him. “Leave me *alone."*

Codari's minor asked, “Linna Maurishka, are you ill? How may I help you?"

"I'm not ill ... I'm..."

Mike took a step toward Linna and she took two steps away from him. He told Codari, “It's her empathy. It's become too strong. I have to get her back to the *Asaph Hall*."

Linna held up her hands as if to ward Mike away. “No,” she said. “Not *you."*

Mike understood immediately and asked Codari, “Could Natai take Linna back to the *Hall?"*

"Of course, but—"

"Why? Because being near me makes her empathic overload that much worse."

As Linna buried her head in her hands and sobbed uncontrollably, Natai spoke up. “Perhaps it's best if Linna Maurishka and I are on our way."

"Thank you,” Mike said. “Linna—"

She wiped away tears with one hand, caught her breath. “Yes. Let's go.” She led the way through the wide doorway off the bridge, Natai's major carrying the minor close behind.

Mike stared at that doorway for some time. Then he touched behind his ear. “Mike to *Asaph Hall."*

Rosa answered over the datalink. “Go ahead, Mike."

"Linna's on her way back. Prepare to receive a Cetronen shuttle. Be ready to show Natai every courtesy."

"I understand."

"I'll be along in a few minutes. Mike out."

"Asaph Hall out."

Codari's minor said, “She will recover, will she not?"

Mike returned his attention to the Cetronen captain. “I don't know. I hope you understand I need to leave as soon as your shuttle clears the hangar."

"We can speak more of this alliance between Cetronen and Sobrenians at another time. They often begin well, yet end—” The minor indicated the viewscreen, where Itherin displayed a perceptibly smaller globe. “—as ephemeral as that."

Just as Linna said, Mike thought. Everything changes.

Codari's minor rubbed his tiny hands together, as if in worry. “Go, my friend. Your first loyalty should be to your mate."

Just before Mike turned to go, he saw more of the spectacle of Neska's effects on Itherin. The rogue star was still ripping the planet's atmosphere to shreds—soon, some of its rocky, metallic core might even be visible, a repeat of what happened to Risula, on a larger scale. And despite himself, he delayed his departure for *Asaph Hall* and watched, fascinated and appalled, as Neska's gravitational pull tossed Itherin's two icy moons out of orbit like rocks thrown from a sling, never to return.

* * * *

As he piloted the *Cosmic Egg* alone, back toward the *Asaph Hall,* Mike contacted Rosa. “Is Linna all right?"

The answer came back: “I don't really know. I'm not with her—it's best to have as few people around her as possible. I'm told she's started disassociating. She's not sure what's real and what's her own perception."

"I want to see you the moment I get back."

"In my quarters. Natai's already here."

A quick landing in the *Hall*'s hangar bay next to Natai's shuttle—even it looked like a mushroom turned on its side—and Mike made it to Rosa's quarters within moments. She and Natai were both there.

Rosa embraced him and gave him a peck on the cheek. “I'm frightened for her, too,” she whispered into his ear.

"Have you heard anything else?"

Rosa's eyes were hooded, her features firm. “I just talked to Lauren again.” Lauren Takahashi was the *Asaph Hall*'s chief medical officer. “She's sedated Linna. It's the only thing that can give her some relief."

"From me and you and everyone else on the ship."

"Lauren says Linna should be all right in the morning—but this is only going to get worse. She thinks Linna needs at least a week alone. She'll die otherwise—or be driven mad."

Natai asked, “Do you have stasis technology that can preserve her until she can be treated?"

"No,” Mike said. “It's never been standard equipment on human ships, except for short-term use. Natai, I can't thank you enough for bringing Linna back here."

"I believe I may have had a calming influence upon her. Perhaps she wished to appear more in control around someone of a different species."

Rosa said, “We have to figure out what the hell's going to happen once Linna wakes up."

"She has to leave,” Mike said.

Rosa said, “It won't do her any good to go to the *Cerenam* or *Meradeus*. She reads other galactic species nearly as well as humans. Even the Drodusarel."

"I know. We have to separate her from everyone on this ship and any of the other ships."

"How? I've thought about it. The radius she receives from is expanding all the time, and this ship isn't that big. There's nowhere on board she can crawl into and be totally alone."

"We have to set her up to live for a week or so aboard one of the shuttles, far enough away that she can't pick up any emotional radiation."

Rosa folded her arms and looked away from Mike. “The risk wouldn't be minimal—letting someone stay out there in a shuttle all alone for a week."

"Compared to her dying?"

Rosa's features grew tight with determination. “I'll talk to Lauren about getting Linna in good enough shape to transfer her over to a shuttle. We'll use *Phobos 2*. You and Alice get it ready to go."

"Right away."

Rosa turned to Natai. “We're in your debt. If there's ever anything this crew can do for you, let us know."

Natai's major bowed for them both. “Merely that offer is honor enough. I'm returning to *Cerenam* now, and I'll tell Captain Codari of your appreciation."

Mike said, “I hope one day to show him just how far that appreciation extends.” He headed for *Phobos 2*.

* * * *

Mike and Alice got to work. *Phobos 2* was a tough little ship, more functional and utilitarian than the silvery *Cosmic Egg*. That Linna could survive aboard it went without saying; its life-support systems and food replicators were more than up to the task. And the shuttle would seldom be more than a few minutes away from docking with the *Asaph Hall* in an emergency.

But I don't want Linna just to survive here, Mike thought. I want her to be able to *live,* to become aware of herself once again.

I want her back with me someday.

That mostly meant upgrading the *Phobos 2*'s replicators to deliver a wider food variety than just snacks and drinks, and transferring over plenty of music and both fiction and nonfiction cube files. And installing an actual bed taken from ship's stores. This has to resemble a home, Mike thought. Or at a minimum, a hotel room—something that's a lot less makeshift than this really is.

Several times while they were working, Mike called up a holo to check on Itherin's progress. The resemblance to a comet was even more marked now, only no human eyes had ever seen a comet the size of a small Jovian. The world was noticeably smaller now, its atmosphere burning off quickly.

Another quick check, and Mike saw that the Drodusarel were still hanging around. Did they intend to follow Itherin's continued demise until the bitter end? What the hell were they waiting for?

Mike and Alice worked well into the early morning. Their refit of the shuttle completed, Mike thanked Alice for her help, grabbed a sandwich in the commons, and took it to his quarters. He dropped onto his couch, called up a holo of Itherin, and began to munch his sandwich.

And stopped in midchew. The planet was noticeably smaller than it had been a couple of hours earlier. As far as any human knows, he thought, nothing lived there. Certainly nothing does now. But to watch even a dead world essentially being dismantled before your eyes—there's something sad about it, almost undignified.

Even as he began chewing his sandwich again, a voice over his datalink made him stop: Rosa.

"Mike?"

"Here, Captain."

"Relax. Just wanted to thank you for the great job on the *Phobos*. And let you know I spoke awhile to Linna over the comm. She wants to talk."

"Oh. Then, should I—"

"You *should*. Quit talking to me. Talk to her." Rosa broke the connection.

Mike touched behind his ear and said quietly, "Linna?"

A sleepy voice in response: "Mike?"

"Yeah."

"Great to hear from you."

"You too. More than you can know."

"Hope I didn't embarrass you in front of Codari."

"He understands. He agreed right away to send Natai to bring you back."

"I'm grateful to them both." He heard her sob. "And I'm sorry I've been such a bitch."

"Linna ... you're my darling. Always have been. Wish you always could be. Once you get better, when I see you again ... it may just be a few hours at a time. A walk together or a drink or a meal or we make love...."

Silence. No, more than that, Mike realized. *Hesitation*. Somehow, even over the datalink, he could feel

it. Then Linna said, “Something occurred to me—I want to have a child someday, but if my empathy is such that I can't be around other people regularly, how can I? Its consciousness would grow inside me, it would feel things even before birth, and how could I even stand to be around my own child?"

"You wouldn't have to carry it."

"But how could I care for it? What kind of life is that—an artificial womb, then nannies or a foster home until he or she's grown?"

"The same kind of life I had."

"I'm sorry, I—"

"No, no, I'm agreeing with you. It's not the best kind of life."

"Mike?"

"Yeah."

"Thank Alice ... and thank *you* ... for getting *Phobos* ready."

"Everything should work out fine."

"For a while. Until I have to come back to *Asaph Hall."*

"We'll get you back. For good."

"I don't know how, Mike."

"My faith's in Rosa. In Lauren. In you and me."

"Mine too."

"Well ... let's hope we haven't misplaced it."

* * * *

Mike wasn't about to go down to the hangar deck the next morning as Linna arrived there to prep the *Phobos 2*. Making his presence known would've been the worst thing he could have done, given her condition. But nothing could keep him from calling up the cube feed from his quarters.

He watched as Linna entered *Phobos 2* and as it lifted off the deck and glided through the energy screen at *Asaph Hall*'s stern. Linna would maintain the shuttle on a parallel track to *Asaph Hall*, its nav comp locked to that of the larger ship. Its station-keeping position would be about a half K to port and slightly behind.

Not that far away, Mike thought. I can call up a holo or go to a viewscreen or even a port and look out at her anytime. I can't give myself over to worry. She'll be back. She'll be fine.

So why, when I think back on last night's conversation, does it seem so final?

* * * *

When the distress call from the Drodusarel ship came, not three hours after Linna's departure, Mike was manning a sensor console on the *Asaph Hall*'s bridge. He was trying his luck at interpreting the data pouring in from Itherin. So far, the only insight he'd gained was that the planet's atmosphere was ripping away faster than computer models had predicted—its remnants were just over Earthsize now, its liquid

hydrogen and helium only the barest layer of material covering its rocky, metallic core.

There's enough here for “real” scientists to study for years, he thought. Planetary composition, gravitation, orbital mechanics. For now, I'm satisfied that it takes my mind off Linna, at least for a few moments.

Then Alice spoke up from the comm position: “Rosa, we're getting an emergency signal from the *Dirat*."

Rosa said, “Let me hear it."

The call was audio only: “Greeting the human ones! Captain Dresk speaks! Hive mind is in unanimity—Starcraft *Dirat* is damaged and needs assistance."

As Rosa responded, trying to get more information despite the usual roundabout translation of Drodusarel speech, Mike turned his sensor sweep into a search for the *Dirat*. Within moments, he sighted the smooth, silvery oblong. “I found it. Close in to Itherin, or what's left of it."

Rosa ordered that sensor output onto the main screen. She said, “Too damn close! What the hell are they doing down there?"

"I don't know, but they took a pretty good hit. I think they strayed too close to that stream of atmosphere coming off the planet. A lot of their nav capability is down, and it looks like several thrusters were disabled."

"Life support?"

"Hard to tell—their needs are so much different from ours.” Another sensor sweep—*Dirat* was making a pass at the doomed world that took it dangerously close to a jet of hydrogen and helium being expelled from the planet. “Uh oh."

"I need better than that, Mike."

He checked distances. “That jet's ten thousand K wide—and the Drodusarel are just over a thousand K away from it."

"They're going to hit it?"

"The atmosphere's streaming off the planet like a hurricane the size of the Earth. Even if the *Dirat* doesn't get any closer, that jet could reach out and destroy it any moment now. That's not even taking into account any number of smaller jets that keep forming."

Alice spoke up. “We're the closest to the *Dirat.Cerenam*'s at the edge of the system. *Meradeus* is still at Risula."

Rosa studied the display. “How close can we go?"

Mike double-checked the distances. “Not at all, if we want to live. But a shuttle could go."

Rosa touched behind her ear. “Captain Dresk—we're sending our shuttles to try to rescue as many of your crew as we can. Linna, have you been listening?"

"I have,” Linna responded. “I'm already on an intercept course."

"Very good. You'll take aboard *Dirat* crewmembers who are in lifesuits. I'll have Luther work on reproducing a proper environment here on the ship for when they get here.” Rosa turned to Mike. “Prep *Cosmic Egg* quick as you can. Take Alice—she'll have to prepare the cargo hold for any *Dirat* crew

without lifesuits."

"I'm on it," Mike said, and within ten minutes he was piloting the *Egg* off the *Asaph Hall*'s hangar deck as Alice worked to reprogram the cargo hold's environmental controls to provide the proper methane atmosphere and bring the cargo hold down to a temperature the Drodusarel would find comfortable—something like—150 C.

Mike contacted Captain Dresk and asked, "How many of your crewmembers are still aboard?"

The audio feed came back: "Nineteen. And ... other beings accompany us."

Mike asked, "What other beings?" Then it came to him: "Are these the beings your shuttles removed from Heuri?"

"They are. We have approximately two hundred on board. You encountered them during your own trip into Heuri."

"The ribbons?"

"Yes."

Mike magnified the view of the *Dirat* on the *Egg*'s main screen. The silvery craft was edging ever closer to the gigantic jet of hydrogen and helium. "Captain Dresk, we're going to be lucky to save most of your crew, given the differences in environment between our species. To try to save so many others—"

* * * *

"You must try, human. They are sacred to us."

What *is* it about this system? Mike thought. The Sobrenians think their precursors sent Neska on its wild journey across the galaxy, and now the Drodusarel believe they've discovered something sacred. "We'll do what we can," Mike said. He signed off, knowing what he or Alice or Linna could do for those beings was limited at best. Dresk will realize that by the time we arrive, he thought. He'd better.

From behind him, Alice asked, "How long until we get there?"

Mike checked. "About fifteen minutes."

"I'll be ready."

Mike opened a private channel to Linna aboard *Phobos 2*. "How're you doing?"

Her voice came back over his datalink: "Right on track. I should beat you and Alice there by a few minutes."

"That's not what I mean."

"Oh ... well, better. I can already tell a difference."

"I'm sorry this happened. Having to call on you yet again."

"See you there, Mike."

"I'll be looking for you." Mike turned to Alice. "How's the cargo hold coming?"

"I've got it pretty cold, and close to the right atmosphere. We can land in *Dirat*'s docking bay, open up

the cargo hold, equalize pressure. Let as many of its crew in as we can."

Mike said, “I hope this business with the ribbons isn't going to be a problem. I suppose we'll find out one way or the other pretty quick.” If we make it past these smaller jets of atmosphere coming off the planet, Mike thought. What the *hell* were they doing here?

* * * *

A glance at Itherin, and Mike saw that the planet's core was becoming visible in places—soon the heat from Neska would begin burning off the carbon dioxide and water locked up in that core.

None of that helps us, he thought as he guided the shuttle around a new plume of hydrogen and helium even as it formed. There's still plenty of atmosphere rushing off the planet to destroy a hundred *Dirats*. And probably about a thousand *Cosmic Eggs*. Comforting thought.

Soon the silvery Drodusarel craft loomed large in the *Egg*'s viewscreen. A broad gash appeared in its side, and Mike realized the opening was *flowing* open, rather than having a door that slid across or opened outward. Nice tech, he thought, jealous to learn its secret sometime.

But not now. He guided the *Egg* through that mysterious opening and through the energy field that retained atmosphere within the bay. He set the shuttle onto the dark, shadowed floor of the *Dirat*'s hangar deck. As he peered out the forward viewscreen, his initial impression was of a series of arches forming a low dome. Seeing more was difficult through the ship's sluggish methane atmosphere, but he could tell that the area was cramped by human standards.

A closer look just ahead, and Mike realized Linna had been right about beating him. *Phobos 2* was already there, and a line of Drodusarel with their energy shields activated was entering it. Mike touched behind his ear and asked Linna, “How's everything proceeding?"

"Fine for now, Mike. Talk to you later."

She sounds frazzled, Mike thought. But damn if I'm not more than a little nervous myself.

From all around now, the tentacled forms of Drodusarel crewmembers without energy shields were converging on the *Cosmic Egg*. Their bodies were oval-shaped, their skin a robin's-egg blue. A dozen tentacles kept each individual suspended in the sluggish minus-150 methane atmosphere aboard *Dirat*. Alice said, “I'm still equalizing pressure—letting *Dirat*'s atmosphere in."

Mike contacted Captain Dresk. “It's going to be just a few more moments for your crew without energy shields."

Dresk responded, “Thanking the human one! Hive mind is approving!"

The *Dirat* shook violently as unseen forces pounded its exterior. It was a frightening idea, given that the Drodusarel ship had inertials the same as any human starcraft. Forces that could overcome them enough to make the ship shake like that must be on a scale that could easily destroy it.

Linna's voice came over Mike's datalink: “I've got seven on board, and I'm ready to haul mass!"

"Good luck, Linna. See you back at the *Hall."* Mike watched as *Phobos 2* lifted, glided carefully past the *Egg*, and headed out of the hangar bay. That magical door flowed open again.

Behind Mike, Alice said, “Ready to accept passengers."

On a small holo to one side, Mike saw the rest of the *Dirat*'s crew making their way into the cargo hold.

There was just room enough, Mike hoped, for the twelve remaining crewmembers to squeeze inside. “Captain Dresk, are you among those in the hold?"

"Entering as we speak, human friend! Looking for room for a container of ribbons."

"With all respect, Captain, we don't have time for this.” As if to punctuate Mike's thought, the *Dirat* shuddered again.

"Looking! Not finding! Centerpiece of mission! Hive mind displeased."

Mike thought, I'd like to tell the hive mind they're suffering from a cranial-rectal inversion if they think I'm waiting a moment more than I have to. “Captain Dresk, we have to *go."*

"No!” Dresk exclaimed and left the cargo hold.

Alice peered through a porthole looking into the hold. “Where's he going? No, wait—now more of them are headed after him."

"To pull him back, I hope."

"Not that I've seen."

Mike fidgeted in his seat. Here's a great dilemma, he thought. Do I leave a ship commander here to die, or risk over half his crew—not to mention myself and Alice—while waiting for him to come back?

Is he coming back?

Mike's hands gripped the *Egg*'s controls so fiercely they ached. He told Alice, “Get ready to lift."

"You don't mean—"

"I *do* mean! I don't intend to die here and neither do you."

"Wait! It's Dresk—he's coming back."

"And the others?"

"They're with him. And they're carrying something—some kind of container. It's long—about three meters."

"Dammit. It's a ribbon, maybe several of them, it has to be."

Alice said, “They're fitting it in. Length isn't a problem, but several of them are having to hold it above their heads."

The *Dirat* took yet another hit, a more prolonged one this time, as if a gigantic bell was ringing beneath Mike's feet. “Can we close the hold?"

"Closing!"

"Lifting!"

Once away from *Dirat,* Mike had to resort to fancy flying to dodge jets of methane, ammonia, and hydrogen shooting out from Itherin. And they hadn't left *Dirat* a moment too soon—Mike checked a holo-image looking back toward the Drodusarel craft just in time to see several atmospheric jets engulf and destroy it.

Mike's next thought: *What about Linna*?

He spoke to her over his datalink: “Linna—how are you doing? Are you going to make it?"

Her response was curt: “Flying, not talking."

The corner of Mike's mouth turned up in a reflexive smile. Very Drodusarel-sounding, he thought. Hope their speech patterns aren't rubbing off on her.

But he certainly understood her abruptness—for the next several minutes, avoiding those jets, not conversation, had to be the priority. They were about ten minutes from the *Asaph Hall* at maximum boost. I can only hope, Mike thought, that we'll be out of danger within the next two or three minutes.

Then proximity warnings chimed, and Mike desperately dodged new jets as they formed to either side of *Cosmic Egg*. The small craft shuddered as something struck its rear. He yelled back at Alice, “What's going on back there?"

"We're fine. Minimal damage, and it doesn't look as if any of the Drodusarel are hurt."

Thank goodness for that, Mike thought. The last thing I want Alice to have to do is treat an injured methane-breather. I wouldn't know where to start.

Linna's voice came over Mike's datalink. “We're nearly out of the worst of it."

"I know,” Mike replied, catching a glimpse of *Phobos 2* as it dodged one of the smaller jets. For an instant, Mike was more transfixed watching Linna's piloting than paying attention to his own. Can't do that, he thought an instant later, and aimed his attention back to his own craft.

And the instant after *that*, a jet of atmosphere struck *Phobos 2*.

"No!” Mike exclaimed as he saw Linna's shuttle falter, then veer off on a new trajectory taking it off on a tangent from its intended course toward *Asaph Hall*. Debris and gases trailed the shuttle's path. “Linna, come in! Are you all right?"

Rosa usually listened in when she had shuttles out, but seldom spoke up. Now was one of those times: “Mike, this is an order. Do *not* go after *Phobos*. You've got more survivors aboard than it does, not to mention that one of them's *Dirat*'s captain."

"But Linna—"

To Mike's relief, it was Linna's voice that broke in next: “She's right, Mike. *Keep going."*

"How are—"

"I'm hurt, but I can still fly. I'm trying to return to the right heading."

Rosa said, “Just a few more minutes, and we can get an enticement beam on you."

Linna didn't respond, and Mike said, “Linna—are you still with us?"

Phobos 2 was still headed on its wayward path.

I'm about to do something I've never done before, Mike thought. Violate a direct order from Rosa.

But then the *Asaph Hall* captain came back on the line: “Okay, Mike, try to catch up to *Phobos*. But I'm

bringing the *Hall* down, too."

Mike wanted to protest that it was too big a risk. But, he thought, it's the very same risk I'm taking. He altered course to intercept the *Phobos 2*. To Alice, he said, “Everything holding up back there?"

"So far,” the answer came.

"Then hold on. We're taking one helluva ride."

Rosa broke in over Mike's datalink: “Have you taken a sensor reading on *Phobos?"*

"No time."

"Linna ... she..."

"What?"

"It's bad."

"I'm getting there fast as I can."

"Make it faster."

Alice came up to sit in the copilot's seat. “The problem is, what the hell are we going to do once we get close to *Phobos?* I mean, *look* at it."

Mike understood Alice's concern. “I see what you mean. It's off on a tangent and starting to spin. By the time we matched speeds and spin, *Asaph Hall* would be here."

Then came a weak voice over Mike's datalink. “Mike..."

"Linna?"

"Yes..."

Mike told Alice, “I'll be in the back. Take the controls."

"Got ‘em,” Alice said, as she gave Mike a sideways look that said she understood Mike's interest wasn't in the cargo hold.

Rosa cut in: “Mike, latest scan shows ... Linna doesn't have much time."

Dammit, Mike thought. If I could just get *over* there.

The channel to *Phobos* was still open. “Linna ... what's happening over there?"

"Never mind that. *Asaph Hall*—on the way? Did I hear that right?"

"You did. And I'm close—not fifty meters behind."

"Don't try anything stupid. *Phobos* is tumbling. You can't make it over here.” Linna groaned, a sound all the more heart-wrenching since she was obviously trying to suppress it.

"I'd take my chances."

"With the Drodusarel, too? You'd risk a dozen of them for one of me?"

Two deep breaths, then he told Linna, “You'd be just as tempted.” He stepped to a sensor station next to the hold and called up two readouts—a flatscreen image of *Phobos 2* and Linna's lifesigns. Rosa was right, he thought.

"Mike, just listen. I know what I have to do.” Another pause, another low groan. “I have to tell you something."

In the instant before she said the words, Mike realized what they would be, and what Linna saying them meant. *"No!"*

"I love you."

Mike pressed his lips together and closed his eyes against tears. He leaned with one hand on the side of the cargo hold. He could barely catch his breath. He started to tell Linna, “And I..."

But then *Asaph Hall* snatched *Phobos 2* away, even as Linna's lifesigns failed.

"...love you,” Mike said, and gave himself up to grief.

* * * *

Mike paused in the corridor to the *Asaph Hall*'s hangar bay, where Linna's casket was waiting. He was delaying until the last possible second to enter.

I don't want to be the center of attention on this day, he thought. I can't handle it emotionally, and any notice I draw will be that much less for Linna.

The hangar bay's doors eased open as he approached them. As he expected, nearly everyone looked toward him as he entered, the low murmur of conversation dying down for a moment, then rising again.

He stood at the rear of the group gathered before Linna's casket. Fourteen of *Asaph Hall*'s crew were gathered here, with only ship's pilot Darwin Haidar minding the store on the bridge. Beyond the edge of the hangar bay, beyond the force screen holding in atmosphere and heat, Neska was grasping the hard core of Itherin and dragging that world's remnants along as it completed its pass through the Moruteb system.

Captain Codari had come over from the Cetronen starcraft *Cerenam,* along with the explorer, Natai. The Sobrenian captain, Syradok, was also present, as was his geological specialist Govanek. Captain Dresk of the late Drodusarel craft *Dirat* was, at least temporarily, a guest aboard *Asaph Hall,* as were fourteen other *Dirat* crewmembers. Another four had died along with Linna aboard *Phobos 2*.

Rosa stood next to Linna's casket. “Good afternoon, everyone,” she said, and even though her voice was low, all attending quieted down again. “We're here to remember Linna Michelle Maurishka. If anyone would like to come up here and share their memories of her, please feel free."

Alice was the first to come forward and praised Linna as her friend and as family. Luther Kindred was next and marveled at her calm even in the most dangerous situations.

Then came more praise from the rest of the *Asaph Hall* crew. Her friends.

Then the Cetronen Codari came forward. The shared symbiont simply stood there for a moment, the major carrying the minor effortlessly as usual. Then both beings cleared their throats and began to sing.

The major's voice was deep and full-throated, bringing power and resonance to their harmonies. The minor's contribution was a soaring tone that rose above the major's voice and gave it life.

Mike's datalink apparently couldn't cope with translating song, but none of that mattered.

I can't imagine that words would add to the sheer beauty, he thought.

The end of Codari's song was followed by a thoughtful silence. Then, as Mike had feared, Rosa caught his eye, urging him to come forward. He took a long, deep breath, then moved toward Linna's casket.

In the instant before he turned to face everyone in the hangar bay, Mike looked upon Linna for the last time. Her round features were at peace. I wish I could see her eyes, he thought. I always loved those brown eyes, so pretty and bright.

He turned toward those gathered to remember her and realized that he didn't see pity anymore in anyone's expression, and wondered if it had really disappeared or if his own perceptions had laid those emotions over everyone's features to begin with.

He said, “I didn't really want to come here today. I didn't want to see Linna lying here. I've never gotten comfort from seeing someone in their casket or visiting their grave.

"But I'm glad I came after all. I can't help but think back to meeting Linna right here aboard *Asaph Hall*. We didn't hit it off that well at first. Our whole relationship might've soured from the very beginning. But as most of you know ... it got better."

The scattered laughter arose from both relief and nervousness, Mike knew. He continued: “I remember the dangers we faced together on Splendor, against the Jenregar at Korolev Station, and on countless other worlds, right down to this very mission here in Moruteb system."

The final danger we faced, he thought, and we couldn't even be together.

I can barely think about that now. It's all too much to pour out in front of these people, as well as I know most of them, as much as I love some of them. Maybe some quiet or drunken night on the way back, but not now.

"I'm sorry,” Mike said. “Those are the only words I have. They aren't enough."

Mike stepped away from Linna's casket, wishing he could fade into the crowd, become imperceptible for as long as he wished. As Rosa and Alice closed Linna's casket, Mike closed his eyes and stood without thought, keeping himself as unaware of his surroundings as he could. When he couldn't sustain that trick any longer, he opened his eyes and Linna's casket was at the edge of the hangar bay, placed now on top of a small booster.

Rosa said, “As stardust we begin and as stardust we return.” She gave a quiet voice command, and Linna's casket moved smoothly out of the hangar bay, through the energy shield. Once clear of *Asaph Hall,* it would boost toward Itherin and crash upon it, even as that planet's remnants continued its new journey with its new primary, Neska.

As the rest of the crew dispersed, Mike approached Rosa and said, “There's one thing I meant to ask. Why Itherin? Traditionally, spacers are shot into a star."

Rosa favored Mike with a gentle smile. “Don't worry about that just yet. But we'll be back here at Itherin sometime soon."

Well, Mike thought, *that* was cryptic enough.

* * * *

Three weeks later, Mike watched from *Asaph Hall*'s bridge as the effects of Neska's presence on the planet Jilan became apparent. Most of them weren't visible from orbit, but one was about to be quite apparent—the Mars-like world was about to lose a couple of its small moons.

Neska wasn't approaching Jilan as closely as it had Itherin, so its grav wasn't exerting nearly as much of a pull. Already, though, the rogue star was pulling Jilan into a more elliptical orbit. Calculations showed that Moruteb would be able to hold on to Jilan, but at great cost to the planet itself.

Alice, from a sensor station, reported to Rosa, “I'm detecting massive stresses deep within Jilan. Pretty soon its crust will start cracking. That means it'll remain pretty active geologically even after Neska leaves."

"Look,” Rosa said. “One of the moons is heading in."

"It's called Reulo,” Alice said.

Mike's eyes widened as he watched. The rate of speed at which Reulo was approaching its primary was astounding. The moon was only a few kilometers wide, but Mike knew the effects of its collision with its primary would be as catastrophic as that of the asteroid that ended Earth's Cretaceous Period (and the dinosaurs’ reign) and ushered in the Tertiary Period.

The two worlds drew together in a slow-motion dance that ended when Reulo took only five seconds to burst through Jilan's thin atmosphere and impact the larger world. Reulo disappeared within a bright yellow fireball that spread across dozens of kilometers within seconds.

Over the course of the next half-minute, the fireball faded and debris from the impact crater splashed into space.

It's like watching a stone strike the surface of a lake, Mike thought. Only that's an impact that will change this world forever. The cliff dwellers, the spherical fish, they'll all be gone soon.

Alice said, “That's absolutely amazing."

"And there's another impact coming,” Mike said. “Nilanu should crash into Jilan during its next orbit. It'll probably get to keep Tyaila, though."

"And Jilan itself should stay with Moruteb. Its orbit will be screwed up, though."

"Sometimes,” Mike said, “I guess you just have to be satisfied with what you have left."

Three weeks after that, Mike watched the most catastrophic event of Neska's encounter with Moruteb as he stood on *Asaph Hall*'s bridge.

It was Heuri's time to die. The home of the ribbons was soon to meet one of Neska's planets, Lasira. Neither gas giant would survive the encounter.

Besides Mike, Rosa and Alice were also there. Rosa asked Alice, “How are the Drodusarel?"

"As good as we could expect. All of them aboard their shuttle now."

Mike asked, “Did we ever figure out why they kept the Dirat so close to Itherin?"

"As close as I can figure out,” Rosa said, “they had some sort of vague history involving two worlds that contributed to seeding their homeworld."

"Thus explaining how life arose in their ring system."

"Exactly—that's where it was seeded, then traveled down to their planet's atmosphere. When they found the ribbons on Heuri, that seemed a good sign to them. They thought Itherin was their true homeworld, so to speak—the place that seeded the homeworld they know."

Alice said, “It all sounds so unlikely."

Rosa said, “This whole encounter between two stars is unlikely. Life itself seems unlikely. Except we find it everywhere. The Drodusarel were trying to find out every nugget of information they could, even as the planet was dying underneath them."

Mike said, “It's going to be pretty tight for them—all fifteen aboard that little ship all the way back, piggy-backing on our stardrive fields."

Alice said, “Codari's already asking for help on their behalf. We're going to take turns with *Cerenam* and *Meradeus."*

"Speaking of *Meradeus*—did the Sobrenians ever decide whether to pursue that alliance with the Cetronen?"

Rosa pursed her lips. “That's not going to happen."

"Why? I thought Linna—"

"I wish I didn't have to tell you this. It's *because* of Linna that they're not pursuing it."

"But she's the one who was vouching for Syradok's sincerity."

"And the one who lost control right in front of Codari. I'm sorry."

"Damn,” Mike muttered.

"Look at Heuri and Lasira,” Rosa said, indicating the main viewscreen. “It's happening."

The two worlds were drawing together slowly but inexorably. Though they were both gas giants, they contrasted greatly; Heuri had its tan, brown, and red cloud bands and it rings, while Lasira, a world about three-fifths Heuri's size, was a nearly featureless aquamarine ball without rings.

As Mike watched, the two gas giants’ atmospheres began to flow toward one another, briefly creating a barbell shape. That flow disrupted Heuri's rings, and they began to fly apart, most of the debris remaining in Heuri's equatorial plane.

The barbell shape soon dissipated as the planets continued to draw closer. Then the two worlds began to crash into one another.

It's a catastrophe taking place in even slower motion than Reulo's impact upon Jilan, Mike thought. As he watched, Heuri's tan sphere bowed inward as Lasira struck, as if it intended to take the blow for an instant, only to deflect the intruder.

Which was impossible. Instead, the inevitable happened—debris thrust outward from Heuri's surface, as Lasira, the less-massive world, began to split apart.

I'm grieving yet again, Mike thought, this time for the ribbons, even though I've no way of knowing if they were sentient.

Then came the paradox: slow as the gas giants' self-destruction played out, when it was nearly complete it seemed to have passed within moments. Mike checked the time; it had been barely an hour since the two worlds began to collide. Now they were mere debris, merged clouds of deep blue and purple with ever-extending fingers of tan, brown, red, and aquamarine.

Afterward, watching the long spectacle of the debris of two star systems going their separate ways, Mike Christopher didn't think of the stupendous forces he'd witnessed as much as he thought of the dead. Even planetary collisions, he thought, don't affect the soul as profoundly as watching a loved one die.

I wonder at our own preconceptions, our self-centered presumption. We see an event literally astronomical and believe our most private concerns are as large as those events we're chasing. That our actions and reactions have galactic import.

After nearly two hours, Mike decided he'd seen enough. As the years passed, Heuri and Lasira's remnants would form a ring around Moruteb. He wondered if humans would be around someday to witness that.

* * * *

Mike was asleep three days later when Rosa awoke him with a call over his datalink. "Come to the bridge," was all she said and wouldn't respond when he asked for more details.

He dressed quickly, worried that some emergency had broken out in the middle of ship's night and that Rosa was too busy dealing with it to talk. Down the corridor, up the grav tube to the command level, then onto the bridge.

Which was empty except for Rosa, who was facing the main viewscreen.

"I don't understand," Mike said. The *Asaph Hall* was orbiting a planetary remnant, but it wasn't Heuri and Lasira. Then he realized: "We're at Itherin. Why?"

Rosa indicated the main screen. "Look at what's left."

Neska had stripped Itherin to its rocky, metallic core, which was a bit smaller than the Earth. Rosa hadn't called up any readouts to give him any further clues. "What's going to happen?"

Rosa turned to a console and punched up a closer view. It showed wide rifts in Itherin's surface the width and length of the Grand Canyon and smaller cracks wide as the Mississippi River. Gases were venting from those rifts and cracks. Mike shook his head. "I'm sorry, Rosa, I still don't—"

"Itherin's giving off carbon dioxide and water from its core. What happens next?"

"Rosa, if this were anyone but you trying to give me a lesson in planetary science—"

"Think, Mike."

He forced himself to suppress his exasperation and consider why in space Rosa felt it important to call him up here in the middle of the night.

Then it dawned on him. "Carbon dioxide. Water. Sunlight."

"Yes," Rosa said. "Water vapor. Clouds. Rain. *Oceans."*

"And eventually—life?"

Rosa nodded slowly. "I think so."

"That's why you wanted to bury Linna *here*—not within Neska."

Tears flowed freely down Rosa's cheeks. “I couldn't help thinking of a very old quote ... from the poet John Dryden ... that to die is landing on some distant shore."

Mike went to Rosa and held her. “And you found Linna's for her.” After a time they stood and watched Itherin and Neska.

Eventually Mike asked, “How long?"

Rosa said, “Millions of years. Who knows if humanity will still be around? Other species may have replaced us and the Cetronen, the Sobrenians, the Drodusarel, all the others."

Mike didn't speak. After a moment, Rosa said, “I'm going to bed. You staying?"

"Yeah. I'm fine."

"Luther should be here in an hour or so to start his shift."

Mike managed a wan smile. “Thanks. I appreciate you bringing me up here for this."

Rosa took Mike's hand for a moment. Then she left.

Mike turned toward the viewscreen and Neska's light shone full on his face. Itherin's core was a dark crescent, giving few clues as to whether life would one day evolve there.

How odd, he thought. I've always believed I didn't hold anything to be sacred. But perhaps I do, after all. Perhaps life itself is sacred for me—certainly it's the most glorious and mysterious of Nature's manifestations.

Images shot through Mike's consciousness—the first time he and Linna made love, the first time he noticed the reddish highlights in her hair, the last time they'd spoken together before that fatal mission and he'd called her his darling and wished they could just take a walk or share a meal.

I couldn't comfort her in her final moments, he thought, not by taking her hand or even with a look or finally being able to tell her I loved her. As I still love her, will love her until my own final day.

Despite the void that will remain in my heart until that day.

But I also have to envy her. She's embarking on her greatest and longest jaunt. She'll be exploring the galaxy long after I'm gone, there on Itherin as that cold dark world comes alive.

He stood there watching that world, which he thought of as Linna's own, until Luther Kindred arrived to begin his bridge shift. Luther nodded toward Mike, then went without words to a console and made a point of appearing busy.

Mike stood another moment, then left the bridge and Itherin's glories, seen and unseen, behind.

(EDITOR'S NOTE: Mike and Linna appeared earlier in “A Glimpse of Splendor” [February 2000], “Pathways” [May 2000], and “Swarming Korolev” [November 2000].)

[Back to Table of Contents]

SCIENCE FACT: BEYOND THIS POINT BE RFIDS by EDWARD M. LERNER

Science-fictional as this may seem, it assumes nothing beyond what we can already easily foresee....

"This is a consumer alert," the caller begins. The synthesized voice represents your favorite grocery store. The nut-free cookies you recently bought have been found to contain traces of peanuts.

"This is a consumer alert," the letter opens. Two tires on your car have been recalled. You wonder how the manufacturer found you, because you purchased those tires with cash, three years and two addresses ago.

Ten computers vanish from your place of business. Suspicion falls on you when the automated security system falsely reports that you were in the building that Saturday.

You're traveling in a foreign country. Terrorists snatch a handful of people from a public square—and it is your misfortune to be one of the abductees.

* * * *

Enter the RFID

One technology—radio frequency identification—unites these scenarios. In a little while, we'll explore how radio-frequency identification, RFID for short, influenced these events. We'll also consider societal and science-fictional implications.

First, let's review the technology.

At its most basic, an RFID tag stores and reports data without a human in the loop. Affix the tag, and an otherwise computer-invisible item (a can of peas, say) enters the realm of information technology. Computerized checkout, inventory management, and asset tracking are among the common applications. At this high level, the RFID tag sounds like the familiar bar code[1]—which, today, is the machine-readable identification you *will* find on a can of peas.

An RFID digitally encodes its information as data within a semiconductor microchip. RFIDs can (though not all do) hold far more data than bar codes. The chip does more than store bits, however. Minimally, it also provides a radio transponder (transmitter/responder). The complete RFID tag pairs a microchip with an antenna. In physical size, the antenna dominates, varying with the intended application. The chip itself can be grain-of-rice sized.

RFIDs come in two basic types: active and passive. An active tag contains its own power source. A passive tag draws its power from the radio signal that polls and awakens it. Passive tags modulate the reflected portion (also called "backscatter") of the received radio signal.[2]

Active tags transmit at higher power levels than passive tags. All other things equal, active tags can be read reliably from greater distances than passive tags. (How far? That depends, as discussed below.)

Not surprisingly, passive tags cost less. Even in volume, active RFID tags typically cost dollars apiece. In sufficiently high volume, passive RFID tags cost only a few cents each. Still, even passive tags aren't yet so inexpensive that you'd be likely to find one on that can of peas. You are likely to find an RFID tag in, for example, many garments.

Not all RFID tags go by that name. Embedded RFID tags enable Mobil/Exxon SpeedPass® key fobs, some electronic subway fare cards and read-at-a-distance building-access cards, and E-ZPass

automated toll-paying transponders.

Power levels vary by application but are typically low (e.g., a few watts in the reader's interrogation signal; milli—or microwatts in a tag's reply). Governmental health and safety regulations for radio signals apply.

RFID tags and their associated readers use various frequencies and encoding schemes. Popular frequencies include 433 MHz, 915 MHz, 2.45 GHz, and 13.65 GHz. In the United States, most RFID systems use unlicensed spectrum at low power under Part 15 of FCC rules.

* * * *

A Bit of History

RFID has its roots in military technology. One ancestor is the “Identification, Friend or Foe” (IFF) system. An IFF transponder, first deployed on military aircraft in World War II, replies to a suitably coded incident radar signal by broadcasting an identification code.

In an early Cold War Russian bugging device called “The Thing,” sound waves modulated the reflection of an incident radio signal. The bug emitted a signal (and hence was vulnerable to detection) only while powered by the external source.

US Patent 3,713,148 (1973, Cardullo et. al.) is often considered the immediate ancestor of the modern RFID tag. That patent describes a memory-equipped radio transponder, preferably implemented such that “the transponder generates its own operating power from the transmitted interrogation signal."

Arguably, RFID entered the public consciousness in 2004, when Wal-Mart levied an RFID tagging requirement on its top hundred suppliers. Effective January 2005, all cases and pallets sent by those suppliers to the megaretailer were to have RFID tags.

* * * *

Why Not Use Bar Codes?

Microchip plus antenna cost more than lines of ink. Why not stay with bar codes? For many reasons, it turns out. Consider:

Identifying an object from its bar code involves line-of-sight readout by a laser-based optical scanner. A person individually scans every can, package, and bottle.[3] In a hospital setting, someone holds a scanner to the patient's bar-coded wrist bracelet or test order.

An RFID tag (absent electromagnetic shielding, intentional or otherwise) is polled by an omnidirectional radio interrogation signal. RFID readers that discriminate among concurrent reply messages can identify at once: groceries in a packed cart (checkout application), books in an armload (library application), or pallets in a warehouse (inventory application).

Bar codes are intrinsically surface-mounted labels. An RFID tag can be implanted (an ID tag your cat can't lose), tucked out of sight (bar codes aren't pretty), or otherwise hidden (for example, an unobtrusive theft-avoidance marker).

Lines added to a bar code (e.g., a production batch number appended to a product code) increase specificity; they do not make the bar code smarter. The microchip in an RFID tag *can,* however, support whole new functions—like a microprocessor. The tag's memory then stores a computer program in addition to the part number.

And memory content need not be frozen at the factory. Many tags use Electrically Erasable

Programmable Read-Only Memory, EEPROM. The name is awkward; EEPROM is normally read-only but reprogrammable with suitable equipment. On a production line, individual tags can be rewritten with unit-specific identifiers and manufacturing history. At retail or library checkout, a tag can be rewritten so that it won't trigger the store or library's theft alarm.[4] Updateable tags can capture product experience along the distribution channel; returned items may then give clues to the root causes of breakage problems.

On-chip sensors offer more flexibility. Add temperature sensors, and a carton of ice cream can report that it thawed and then refroze in transit. Let a bar code try that trick!

These examples barely scratch the surface of what an RFID tag might do. Memory, microprocessing, sensors, and wireless communication: The possibilities offered by their combinations are numerous, indeed.

* * * *

Readout Constraints

An RFID tag alone serves no purpose. It must partner with a reader.

The short answer to “From what distance can a tag be read” is: It depends. Many things impact the range and accuracy of readout. These factors include: the power transmitted by the tag (for passive tags, a small fraction of the incident power); the communications protocol between tag and reader; the relative orientation and sizes of tag and reader antennae, interference (perhaps from other RFID tags awakened by the same interrogation pulse); and the sensitivity of the reader itself.

An active tag can be designed to be read from hundreds of feet away.[5] Passive-tag readouts are more frequently quoted in the range of inches to a few feet. In either case, nothing precludes construction of a more sensitive reader. It takes only the motivation (and money).[6]

PCs get faster, digital cameras hold more images, and TV screens approach life sized. It's fair to imagine future RFID readers that are more sensitive and less expensive.

And highly portable. Gentag was recently awarded a US patent for an RFID-reading cell phone. [7]8 An RFID readout can be made and instantly sent—anywhere.

Detecting a tag's response and *reading* it are different. Security protocols (signaling methods that authenticate reader and tag to one another) and message encryption can render detectable tag responses unintelligible.

* * * *

Processing System

Things get interesting when we consider vast numbers of related RFID tags, whether elevator-control cards for the workers of a secure office building, E-ZPass transponders for East Coast commuters, or crates in a Wal-Mart warehouse. When related items bear RFID tags, there is, behind the scene, a data repository that enumerates those items. Another repository saves the tags’ readouts. A computer manages those repositories.[8]

Consider managing access to a building through machine-readable employee badges. The system tests whether a sensed ID belongs. (Data look-up: Is this a valid access card?) It determines whether the badge requires special handling. (Data look-ups: Has this badge been reported lost? Are access times restricted for this employee?) It annotates when the employee entered the building (data capture).[9]

Thousands of workers report daily to that secured office. Thousands of cars with E-ZPass transponders pass toll plazas daily. Thousands of Nike sneakers roll daily off the assembly line, each bearing a unique RFID. Badges, transponders, and sneakers: Somewhere, there is a data repository about each.

Tags, readers, and computer/repository are the components of any RFID system.

* * * *

Avid for RFID?

Does RFID sound great? Then it's time to revisit our opening scenarios.

Recall three basic RFID properties. Tags are read from a distance. Tags may be personalized. Tag transactions flow to a data repository, where they can be combined, contrasted, and correlated with other information. Together, these features explain our incidents.

First, the peanut alert. The bakery assigned a unique number to each batch of cookies. The grocery, on receiving the batch-specific recall notice, searched its sales history. You once joined the store's loyalty program to qualify for discounts; the store matched your shopper ID (remember the key fob they gave you?) with a cookie label (identified by its RFID tag). That's how they can contact you.[10]

Next, the tire recall. The manufacturer lost track of many customers over the years. Whether altruistically or for fear of a lawsuit should a tire blow out, the manufacturer contacts toll-road authorities across the country. Each tire has an embedded individualized RFID tag.[11] You commute on a toll road; your car's tires, like your toll-paying transponder, have been noted. The toll-road authority has a database of transponder account holders; it sends (sells?) your address to the manufacturer.[12]

Next, the computer heist. Your employer's access-management system relies on RFID-enabled badges. A crook loitering in the lobby with a wireless “sniffer” in his briefcase captured the signaling between your badge and the door-lock control. That's sufficient information to get into the building, looking to the security system like you.[13]

Finally, your abduction wasn't random. Your new passport, which contains an embedded RFID tag for faster authentication and to deter counterfeiting, enabled terrorists with portable RFID readers to identify you as one of the foreigners in the crowd.

* * * *

Could You Be Any More Paranoid (or Unrealistic)?

The peanut warning was to your benefit. You might have had a peanut allergy. It's hard to feel warm and cuddly about the other scenarios.

But wait, you say. These aren't *realistic* scenarios. Data are encrypted, to prevent eavesdropping. Databases are secured. Laws bar disclosure of personal data. The sheer quantity of responses from countless myriads of tagged garments, vehicles, pets, whatever, collected at thousands of readers, spread across the country and the world, accumulating day after day after day ... surely those oceans of data render *my* digital presence effectively invisible.

I hope you're right—but I see too many counterexamples for optimism.

* * * *

Encryption

If the faint signal from most RFID tags doesn't prevent eavesdropping (but can't miscreants build more sensitive readers?), encryption might protect us. The argument goes: If eavesdroppers don't understand

what a tag says, we're okay.

What's the track record of encryption-based security in high-volume consumer products? Do security-enabled products remain secure?

No.

Digital video disk (DVD), satellite TV, and cable TV use encryption-based protection schemes. All have been cracked. In the United States, the Digital Millennium Copyright Act, 1998, outlaws such activity and discourages many—but certainly not everyone—from viewing content without paying, or from copying content without authorization.

RFID tags have cost and power constraints (read: computational limits) far more stringent than DVD players, satellite receivers, and TV set-up boxes. How credible is it that the security mechanisms in RFID systems will resist cracking?

Encryption schemes transform unencoded data into a new representation. The value of encryption lies in the difficulty (in the absence of presumed secret knowledge—the decoding key) of reversing the transformation. Encryption schemes fail when the secret is disclosed, the algorithm proves less mathematically challenging than believed, or technological advances make once impractical transformations easily computable.[14]

Recall the Data Encryption Standard (DES), a US federal standard introduced in 1976. DES uses a 56-bit key. DES was, at the time of its introduction, trusted to secure banking transactions.

Now fast-forward to 1998, when the Electronic Freedom Foundation broke DES in less than 72 hours with a custom DES cracker built for under $250,000. In 1999, a band of computer enthusiasts cracked DES with an ad hoc collection of personal computers in under twenty-four hours.[15] Today, we use *128-bit* encryption to buy books from Amazon.[16]

What accounts for code breakers' progress? More than anything else, Moore's Law.

Dependably since Gordon Moore, co-founder of Intel Corporation, articulated this forecast in 1965, the number of transistors on an integrated circuit chip has roughly doubled every two years. Data densities more or less double in eighteen months. Simply put, Moore's Law suggests that in five years computers will be five or six times more powerful than today, with ten times the storage. Hackers *will* have more powerful PCs, but many five-year-old RFID tags will remain. (My shoes don't last five years; sometimes my tires do.) For how many RFID-tagged possessions will encryption be cracked while I own the item?

* * * *

Sometimes Encryption Isn't Enough

Several central banks are considering embedding RFIDs in new currency. Embedded RFIDs will make counterfeiting harder. With a simple *ping,* a sales terminal can tally the cash in a drawer, and a bank can confirm the money in its vault.

And with a simple *ping,* a mugger can find the people in a crowd carrying wads of cash. The mugger does not need to know the serial number on each bill.[17]

The RFID reader in a cash register must discriminate currency tags from other tags (say, the tags embedded in high-value coupons also in the cash drawer). The distinguishing data patterns that make cash recognizable as cash *will* become known. Assume no one who knows the secret algorithm talks, whether for personal gain or under duress. Assume the algorithm cannot be cracked. The secret to

recognizing currency by pinging wallets will become known soon after the first cash-counting register is stolen.

When RFID-tagged money enters circulation, expect foil-lined wallets to follow.

* * * *

Spoofing

The ID in RFID stands for identification. Mimicking or copying a tag means forging credentials, with all the opportunity for mischief a false identity implies.

For simple systems, simply recording and playing back the automatic response of an RFID tag will fool a reader. For applications using robust encryption, a spoofing device can be constructed after the security scheme is understood. And there's always cloning. A cloned RFID tag *will* fool an RFID reader.[18]

Does cloning of RFID tags work? Yes. It's been demonstrated at the Black Hat hackers conference (everyone has conferences!) with prototype RFID-enabled US passports.[19] (In a bit of good news, the U.S. State Department has responded to security concerns. As finalized, the new RFID-carrying U.S. passport includes metal sheets in its covers and extra security software to control access to the onboard personal data.[20] Of course it's only a matter of time until someone steals and clones the border officers' special passport reader.)

RFID spoofing offers new ways to gain unauthorized access to a building (or country), create an alibi, and plant evidence implicating another.

* * * *

Misused Data

Might heretofore invisible traces of your activities now be used to your detriment?[21] Our answers may differ.

Appropriate bounds on government data collection is a hot topic as this is being written: warrantless wiretaps. Monitoring of international money transfers. Sifting of domestic call records (who calls whom, not phone taps). Prescreening passengers against a No Fly list.

A strong anti-terrorism case is made for such searches. A strong civil-liberties case is made against them. It's worth noting that these controversial, data-intensive searches involve government accessing businesses' databases. If you have an opinion about government using data gathered by your phone company, bank, and airline, you probably also care about the repurposing of RFID-centric repositories.

It is certainly plausible that government will take interest in new ways to track the activities and movements of individuals.[22]

* * * *

Lost Data

All this data sniffing, code cracking, and spoofing sounds so ... James Bond. It can't possibly apply to John Q. Public. Surely those digital footprints will be secure within corporate and governmental databases.

History calls into question the ability of organizations to protect their data.

ChoicePoint is a low-profile corporation that aggregates and sells personal data about most of the U.S. population. Its 19 billion records (as of February 2005) include Social Security numbers, credit reports,

and bank account and credit card information. In late 2004, at least 100,000 people's records were exposed to hackers.[23]

Consider these 2006 news items. AOL accidentally released data about 19 million searches by 650,000 users. The searches reveal Social Security numbers, among other items most people tend not to share. The Department of Veterans Affairs lost a laptop whose hard drive stored personal and financial data for more than 25 million veterans, active-duty military personnel, and spouses. Ernst & Young, a “Big Four” accounting firm, lost data on more than 200,000 Hotels.Com customers through a laptop theft.

To me, trust in the infallibility of data-center security seems misplaced.

* * * *

Data Overload?

Perhaps the sheer amount of data will obscure our RFID tracks.

The numbers involved seem daunting. Stores, warehouses, and toll plazas will each have multiple RFID readers. In large cities, it's easy to imagine hundreds or thousands of readers per square mile. Readers can take two hundred readings per second. (A reader that polls that frequently may detect the same tags [or no tags] over and over. Filtering software will discard repetitive data that add no value.)

How much data are we talking about?

While the least expensive tags will report only a few bytes, a payload of two to three kilobytes is more typical.[24] To the tag's own data payload, the reader and/or the associated data system will then append metadata (such as a timestamp and the reader's own identifier or location).

It's easy to construct a comforting scenario. Big Brother databases require continuous coverage across large areas over long time periods. Is it practical to retain that much data?

As a thought experiment, consider a future retail district. Within one square mile we find fifty large RFID-enabled businesses, each with one hundred RFID readers. (If you prefer, make that five hundred small businesses, each with ten readers.) That's five thousand readers per square mile. Retain one record per reader every ten seconds throughout an eight-hour business day.

(Reminders: Many RFID applications are intentionally short range—at checkout we want data from the shirt the customer selected, not the thousand shirts he didn't. Tags ignore pulses of the wrong frequency, too low a power level, or using the wrong protocol. Upstream data systems discard tags deemed irrelevant, such as sequences of unchanged readings.)

That's 14,400,000 (= 5,000 x [0.1] x [8 x 60 x 60]) readings. At three kilobytes of data per reading we get ~43 X 109 (that is, 43 gigabytes) of data in eight hours, from that square mile.

A top-end iPod holds 60 gigabytes. Apple sells them by the millions.

What if 50 GB were collected daily in every populous square mile across the United States? Most of us live in cities, which also seem to be the favored terrorist targets.

The nation's area is about 3.5 million square miles. One tenth that area encompasses 140 disjoint regions each of fifty miles square (2,500 square miles). That's many cities, and most U.S. residents.[25] [26]

Our thought experiment has expanded to (50 gigabyte/mi2) (350,000 mi2).

This *is* a large number: 1.75 X 1016 bytes (about eighteen petabytes) daily.

Organizations do deal in petabytes. Equifax, the credit-reporting company, faced such numbers in 2002.[27] Then there's the Large Hadron Collider, nearing completion at the European nuclear research center (called CERN from its French acronym). The LHC computing grid, a globally dispersed multi-supercomputer, will store 15 petabytes per year.[28] As a third example, the San Diego Supercomputing Center recently acquired an 18-petabyte tape library to support its work in Earth sciences.

Data centers large enough to accept daily torrents of RFID data are not far fetched.

* * * *

Processing Overload?

Okay, it's possible to store all the data, if not today, then surely after a few more Moore's Law doublings. Who can possibly locate anything within it?

Consider an iPod. Finding a tune does not require listening at random to thousands of songs. You search an organized index, whether by title, album, group, or performer. The indices were created and are continually updated as music files are uploaded from your Mac or PC.

So, too, will RFID tag records be labeled and organized for expedited search as they are uploaded from RFID readers.

Our thought experiment assumed archiving of three kilobytes per RFID reading, but it's not all needed for searching. Many queries will involve only time-and-place values or an ID code (of specific tags or associated persons). Everything else will be retrieved after the record(s) of interest has been found.

Time and place sorting are effectively free. Businesses and local governments (like toll-road authorities) will own most RFID readers. They will preprocess their tag readouts for their own purposes. The data are intrinsically geographically presorted, simply by knowing which reader(s) read what tag. The records are also intrinsically time-sequenced.

RFID data can thus be searched efficiently within and among organizations. Knowing the locale or timeframe to search quickly pares the amount of data to be examined.

We're contemplating a great deal of data, but some organizations are in exactly that business. Take two examples. Equifax, in the 2002 article cited above, describes sorting six months of data, 67 billion database records, in three seconds. On August 29, 2006, the Federal Bureau of Investigation demonstrated its Investigative Data Warehouse.[29] IDW reportedly contained on that day 659 million records among fifty databases. The FBI spokesman said a search of a thousand names and birthdates that in 2002 would have required more than 32,000 hours can now be done within thirty minutes.

Moore's Law again.

* * * *

Parallel Processing

But not only Moore's Law.

Large-scale computing challenges often yield to a divide-and-conquer approach—what computer scientists call parallel processing. It's true of climate studies (many small atmospheric volumes modeled concurrently), H-bomb simulations (far tinier volumes, in much shorter time slices), and data mining (subsets of vast data aggregations). Specialized computers harness many processors in parallel to more speedily calculate, sort, and search. Such computers gain increased throughput with faster chips or

increased parallelism.

Searching RFID repositories is a naturally parallel application.

IBM just received a U.S. Department of Energy order, for 2008 delivery, of a highly parallel supercomputer.[30] The aptly named Roadrunner will contain more than 16,000 commercial processors: AMD's Opteron chips, common in servers, and IBM's Cell chips, found in Sony's PlayStation 3. Roadrunner will achieve a throughput of 1015 operations per second.

Roadrunner appears well suited to exploiting even the largest RFID repositories.

* * * *

The Miracle We Forget

Google's cofounders began research on a search engine in 1996. By 2005, the *New York Times* reports, Google had indexed eight billion web objects, with more being added continually; the aggregated data volume in those objects is vastly larger. Constantly maintained indices enable us to search across those billions of items, often within a fraction of a second.

Web objects exhibit far more variability (read: they're harder to parse and index) than RFID records. Web objects include text pages, images, Usenet messages, and linked files of various types. It all keeps growing, of course. Google aspires to scan and make searchable *every book ever published* (although copyright issues may constrain that ambition).[31]

And Google does most of its work with swarms of commodity PCs.

In summary, precedents exist for handling data collections arguably of the size of a useful national RFID data repository. Moore's Law assures us that the ability to collect, sort, associate, and search data will increase. The proof is as near as your favorite search engine.

* * * *

Did We Have Privacy Anyway?

Some would argue that RFIDs are but one threat to our privacy.

You can be located by the mobile phone in your pocket (which is a good thing in association with a 911 call). You can be tracked by a GPS transmitter hidden on your car or in your child's teddy bear (GPS-enabled stalking has been reported). You may work somewhere, like downtown London, strewn with closed-circuit TV cameras (which were invaluable in investigating the 2005 London subways bombings.). Millions of people carry camera phones.

Perhaps privacy *is* a thing of the past. Privacy was a recent phenomenon anyway. It doesn't exist in small communities—where most people lived, for most of human history. Privacy didn't exist on telephone party lines.

Some (the author among them) still regret the level of surveillance to be made possible by the confluence of RFID data collection and data mining.

* * * *

And Yet...

Public law may yet save us from Moore's Law.

There are a few encouraging signs that the privacy risks of RFID tags, especially coupled with data

mining, are entering civil discourse. Public interest groups, such as the Electronic Frontier Foundation and the American Civil Liberties Union, are engaged. Industry groups increasingly acknowledge public concerns. Some in government recognize the potential problem, as noted in recent GAO testimony to Congress.[32]

In June 2006, U. S. Senators Dorgan and Cornyn proposed to their colleagues the formation of an RFID Caucus; its scope would include (albeit as the final item in their list) “privacy and security."

The privacy-motivated redesign of the RFID-equipped U.S. passport was certainly a positive step.

States are filling the policy void left by federal inaction on RFIDs and privacy.[33] On August 31, 2006, the California legislature passed the Identity Information Protection Act, setting privacy standards for RFID tags in state identification cards. If the governor signs the legislation, this will be among the first RFID-centric legal protections.[34]

How might an informed citizenry choose to influence RFID legislation? To name a few aspects: Disabling or removal of RFID tags in consumer goods at the point of sale. Transparency as to the intended uses of collected data. Rules to limit tracking people through their RFID traces. Standards for the secure transmission and storage of data reported by tags.

Do you have opinions about RFIDs? If so, consider sharing them with public officials. www.firstgov.gov/ offers contact information for office holders at all levels of government.

* * * *

SF Implications

Dark futures and dystopias abound in science fiction, and RFIDs offer a new flavor of doom. I explore a few possibilities in my story “The Day of the RFIDs."[35] The hero foresees many of the dangers outlined above and strives to prevent a Big Brother outcome.

Please join me in wishing him luck.

How might RFID technology influence our fiction?

It's easy to foresee a time when little can be accomplished in secrecy, and less can escape after-the-fact discovery through data mining. Still ... human nature (and story plots) demand that some of us will rebel. How, in an RFID micro-monitored future, will people conspire, commit crimes, or, in a pinch, assume a new identity? Neither forged paper IDs nor counterfeit RFID tags will suffice; any credible alias must involve extensively altering the archives of past RFID readouts.

RFIDs implanted under the skin could mean never lost, never left at home pointers to our medical history. In an emergency, that information could literally be a lifesaver. Easy access to medical-record identifiers also risks a staggering loss of personal data, and with it, individualized discrimination. If any healthcare professional can access your files, how secure can that data be?

Many RFID tags are programmable. So are many RFID readers, facilitating product upgrades. Programmability opens the door to hacking, computer viruses, and other malware attacks at every point from tag to archive. What are the opportunities for vandalism, theft, forgery, impersonation, and cyberterrorism?

RFID readers will be spoofed, stolen, and cloned. How much RFID data will be misappropriated or manipulated, and to what ends?

Imagine a society microscopically observed via RFIDs. Now something, perhaps a time-delayed virus

insinuated into a region's tag readers, corrupts the data stream and eliminates accountability. How might a city with a big hole in its data history reintegrate into the larger economy?

RFIDs *are* coming. We can at least hope for interesting fictional escape.

* * * *

Some Web Sites of Interest

From industry sources:

www.rfidjournal.com/article/articleview/1336/1/129/

www.rfidjournal.com/faq www.technovelgy.com/ct/Technology-Article.asp?ArtNum=50

* * * *

About privacy issues:

www.cdt.org/privacy/20060501rfid-best-practices.php

www.rsasecurity.com/rsalabs/node.asp?id=2120

www.eff.org/Privacy/Surveillance/RFID/

* * * *

About the Author

Now writing SF full time (and making appearances frequently in *Analog),* Edward M. Lerner worked for thirty years in aerospace, telecom, building management systems, and software development. Ed's recent books include the novel *Moonstruck* (2005) and the collection *Creative Destruction* (2006).

* * * *

[1] A bar code represents information—say, a product identification or part number—as a visual pattern imprinted onto the surface of the tagged item. On consumer goods (such as that can of peas), the width and spacing of parallel lines encode the data.

[2] Some analysts identify a third type, called semipassive (or semiactive). This hybrid uses an onboard power source to run its integrated circuit (active), but signals by modulating the RF backscatter (passive).

[3] Some stores allow shoppers to scan their purchases. That may reflect a sophisticated checkout system, (e.g., with scale-based tests to sanity-check the claimed purchases) or trust in the clientele. Regardless, bar code checkout requires that a human handle each item.

[4] Hold that thought. In this section, we're looking only at positives.

[5] If the active tag uses unlicensed spectrum, its transmission level is constrained by reg

[6] The Jupiter-orbiting Galileo probe transmits about twenty watts. The signal intercepted by one of the seventy-meter dish antennae of NASA's Deep Space Network has attenuated to about ten zeptowatts. (One zeptowatt = one sextillionth [10 -21] of a watt.) That's not to say anyone is apt to use DSN for scanning RFID tags.

[7] www.gentag.com/IP%20Release%2020050088299%20A1.pdf

[8] RFID tags used for a common purpose employ a common format. For many purposes, the collected data from similar tags are most efficiently compiled and searched within a simple file system. More complex applications may ingest tag-related records (or a copy of them) into a general-purpose—but more compute-intensive—database management system. A DBMS adds value when the goal is to exploit relationships between RFID data and other relevant information (e.g., customer accounts and employee files).

[9] This description applies whether the badges use RFID or magnetic-stripe badges and readers.

[10] This scenario might occur with bar code—identified cookies, but that's less likely. RFIDs better accommodate customization, especially on small production runs, than do printed labels.

[11] Individually labeled tires make sense. A tire may fail for reasons related to the car model on which it was mounted, the factory in which the tire (or car) was built, or improper handling anywhere along the distribution channel. Tires from the Firestone Decatur plant figured most prominently in the Ford Explorer tire recalls of 2000. Compared to the cost of a recall, a few cents per tire for a reprogrammable tag with which to capture tire-specific detail could prove a sound investment.

[12] Does your toll-road authority capture and record the RFID tags of passing tires when it IDs cars for billing? I don't know. Regardless, data that's ignored today might be saved—and subpoenaed—tomorrow.

[13] For any reasonable access-management system, the spoofing trick demands greater sophistication than mere record and playback. The tag/reader wireless link will be protected by security protocols and encryption. Still, systems do get cracked. As I write (August 2006) several RFID-based e-passport systems have been reported hacked.

[14] Secure systems rely on encryption not only to obscure messages, but also to authenticate sender and receiver to each other. After all, a “secret ID” broadcast in the clear isn't much of a secret.

[15] www.eff.org/Privacy/Crypto/Cryptomisc/DESCracker/

[16] 128-bit encryption is the US domestic standard for web browsers. Export versions of browsers have weaker encryption, but are readily upgraded.

[17] A unique, machine-readable ID on a bill raises other issues. Imagine an ATM record of a specific $20 bill, tied (of course) to the account of the customer who withdrew it. Next, imagine that bill appearing in a cash drawer, concurrent with a specific purchase. At least in theory, RFID-enabled currency makes cash purchases traceable. On the bright side, if money becomes associated with its owner, cash reported as stolen will announce itself to the police (not in real time, but soon after it's spent, when the business makes a cash drop at its bank). Thieves will be wise to spend their loot quickly (before the theft is reported and the serial numbers of stolen bills reconstructed from widely distributed records) and/or at businesses without RFID-reading registers.

[18] Here's an exception: Cloning alone may not work if the RFID tag provides a second identification mechanism. We've seen that the microchip in an RFID tag can implement other functions, including sensors. A biometric sensor initialized to recognize my fingerprint should stymie someone (who isn't me) using a cloned tag. The RFID spares me from sharing a fingerprint scanner (oh, the horror) by making the access system *much* costlier.

[19] www.technewsworld.com/story/52270.html

[20] “Passport Chip Sets Security Concerns,” *The Wall Street Journal*, August 9, 2006.

[21] The opportunity for data misuse is hardly unique to RFID. To the extent that RFID tags record your life in greater detail than was once practical, data misuse becomes that much more problematic.

[22] Will companies and public-transit agencies agree—or be required—to share their RFID records? If asked, will institutions (say, gas stations) tweak their RFID reader software to accept responses (say, from tires) previously discarded as irrelevant? Will law enforcement and anti-terrorism agencies—or bad guys—deploy their own RFID readers across the land? If those questions concern you, the proliferation of RFID tags should also concern you.

[23] www.consumeraffairs.com/news04/2005/choicepoint.html

[25] Deploying five thousand readers per square mile across such a large area is futuristic. It entails 1.75 billion readers. Estimates vary, but today's worldwide RFID *tag* population is probably about one billion.

[26] www.census.gov/geo/www/mapGallery/images/density90.jpg illustrates (with 1990 census data) a very concentrated U.S. population. Ten percent of the area certainly covers most of the population.

[27] www.cio.com/archive/101502/bigger.html

[28] "Old World, New Grid," *IEEE Spectrum,* July 2006. Somewhere in all that data, it is hoped, evidence of the Higgs boson (a missing piece from the Standard Model of particle physics) will finally be found.

[29] "FBI Shows Off Counterterrorism Database," the *Washington Post*, August 30, 2006.

[30] "U.S. Taps IBM for Supercomputer," the *Wall Street Journal*, September 7, 2006.

[31] www.sfwa.org/News/suesgoogle.htm

[32] www.gcn.com/online/vol1no1/40817-1.html

[33] States took a similar leadership role a few years ago, in the absence of federal data privacy standards. Many states modeled their legislation on California's privacy law. Much that we've recently learned about lost and stolen personal data comes from State-mandated reporting.

[34] A prepublication note: The governor vetoed this bill, deferring to future federal standards.

[35] In *Creative Destruction,* Wildside Press, 2006.

* * * *

Most people would sooner die than think. In fact, they do.

—Bertrand Russell

[Back to Table of Contents]

STRANGER THINGS by E. MARK MITCHELL

* * * *

Illustration by John Allemand

* * * *

Two (or more) heads are not necessarily better than one....

* * * *

Bill suspected there was trouble when he was distracted by a pretty girl walking down the sunny Chicago street—three identical versions of her, differing only in choice of outfit. It wasn't that he was seeing her three separate times, it was that she was in three places simultaneously. He immediately dubbed it “The Mystery Of The Multiple Maidens” in his head. Greg, walking beside him, was completely oblivious, talking about the matinee they'd just seen, a revival of that atmospheric sci-fi flick from a decade or so ago.

"So, yeah, it was a good mood piece, but the aliens really threw me. I mean, if you're damaged by water, it makes perfect sense to invade a planet that's seventy percent covered in the stuff.” Greg, terminally behind the pop-culture times, had never seen the film before.

It was at this point that two of the blond beauties crossed the street at the corner in front of them. Like any heterosexual male (of those who paid attention to their surroundings, at least), Bill noticed them. He was immediately struck by how similar they looked—like identical twins. So Bill paid attention to them as they continued past the corner and passed another identical blond woman heading the other way. While clearly related, being identical and all, all they did was nod cordially at each other as they passed, and the one jogged across the street toward the El stop.

"Have you heard of identical triplets, Greg?"

Greg, heedless, continued, “'So we're targeting a place where corrosive acid falls from the sky, or even just condenses on the ground some nights? Sure, sign me up!’”

As Bill glanced down after the pair, he saw another two identical women get out of a taxi as the first pair went into a small sports bar. “Identical quintuplets. That's very unlikely."

"It was so distracting, I barely had the energy to get annoyed at the portrayal of an arbitrarily deterministic universe he threw in there...."

Bill snagged Greg's arm, swinging him around to go down toward the sports bar. “Come on, I want to check something out. And I don't think he was trying to make the universe ‘arbitrarily deterministic.’”

"Oh, yeah? What would you call it?"

"An exploration of fate and faith?"

"Six of one..."

"...half dozen the other, yeah, yeah. I'm not trying to explain it, just saying what I think he was after. But I think you're right about the aliens, though. Guess I was too caught up in the flow of things to really notice it."

"Now you know what it's like when I'm in the midst of an experiment.” Greg stopped, squinted up at the sign. “A bar? What do you want to check out here?"

"It's not the bar, it's what's inside that counts. More accurately, who's inside."

"Who's inside?"

"That's what I'm trying to find out."

* * * *

The bar was dim and nearly empty in the early afternoon. Nearly, that is, but for the bartender and the eight blond women. The eight identical blond women, chatting quietly, reading the paper, or just contemplating the tabletop. The creepy, unnatural similarity of the women was enough to penetrate even Greg's normal obliviousness. His double take turned into a full on gawp, and Bill had to subtly lift the man's chin before he drew too much ire from the women.

Bill stepped up to the bar. The bartender, looking rather rattled himself, stepped up to meet him.

"Two colas, please."

"Think I'm gonna need a beer, actually," Greg muttered, still dazed.

"A cola and a beer," Bill corrected himself. Then he glanced around the room again. "Come to think of it, make that two beers." Both men sat with their backs to the bar.

Greg leaned in. "The statistical probabilities of identical octuplets? So high as to be impossible."

"Nonuplets. There was at least one other lady who left earlier." The drinks arrived with quiet clunks.

Greg blinked and reached for his beer without looking. "That hardly changes the situation. Admittedly, I don't run in biology or genetics circles, but multiple births that large usually get a lot of press and attention. Identical multiple births like that? Even more so."

Bill, still looking out over the small gaggle of blondes, also blindly grasped his beer and took a sip. "To be fair, we would have been young. They seem about our age, you think?"

A new, feminine voice spoke up behind them. "Ah, but it's impolite to ask a lady's age, isn't it?"

Greg nearly choked on his beer as Bill spun and stared at the blonde standing behind the bar, grinning at him. She hadn't been among the patrons; she must have been in a back room or something when they walked in. She was yet another exact copy. Close up, Bill realized she was awfully pretty. He experimentally changed the title in his head to "The Case of the Copied Cuties," but rejected it almost immediately.

"Um, hello. I'm Bill. This is Greg." When in doubt, Bill thought, introduce yourself.

"Lynne," said the new bartender, nodding. "So, you talking about us, then?"

"Decaplets," coughed Greg loudly, causing most of the other women to look up. Lynne waved them away, and they returned to their activities.

"You'll have to excuse Greg. He's a physics genius, pretty good with many other sciences, and a very nice guy, but he's socially useless." Bill grinned, punching his friend gently in the shoulder. Greg was recovered enough to wave weakly in greeting, but then realized he was waving at a creepy identical woman and had to take another drink.

Lynne sized them up, still grinning. The smile didn't quite reach her eyes, though. "So, you two just stopped in here for a drink?"

"Well ... to be honest, I have to admit, I'm intrigued by the family reunion." Bill gestured vaguely toward the rest of the bar. Lynne narrowed her eyes a little bit more, making her grin suddenly feral, and Bill had a brief fight-or-flight moment.

Lynne opened her mouth to respond, but her voice came from off to Bill's right. "How dare you!"

Bill turned his head to look and had time to register yet another new identical woman standing beside him, glaring, before her slim palm impacted his cheek. The slap rang though the bar, silencing all the murmured conversations, making them the center of attention. Bill stood there, dumbstruck, as the woman hissed, "After all you put me through, after all the lies, you have the nerve to show up here?"

Bill's normal glibness failed him. Greg, however, stepped in.

"Miss, please—this isn't the Bill from your reality!"

* * * *

Lynne the bartender hustled the men into the cramped office, and the other Lynne (the Slaphappy Siren, Bill dubbed her in his mind) closed the door behind her. Bill was keeping such a wary eye on her that he completely missed Greg's sudden stop and ran into his friend. Turning forward to see what was wrong he, too, stared in horror at the awful pink brocade couch that dominated the back wall of the office. It was disturbingly, distressingly, all too familiar.

Lynne the bartender frowned at them. "What? It's a good couch; good for catnaps during slow periods. Though, granted, I was surprised by the ugly pattern."

"Well, that tears it," Greg breathed. "It's alternate timelines again."

The second Lynne stepped forward and Bill flinched. She gave him an odd look. "Look, one thing at a time. I just want to know how you knew we were from different realities."

Greg gingerly sat down on the couch, as if he was afraid it might explode into soft, salmon-colored shrapnel. "When I saw you both up close, I could see immediately that you weren't just twin sisters. In particular, that tiny scar on your chins. Childhood injury, I'm presuming? It's identical, and that can't be explained by genetics. Therefore, you must be different versions of the same person."

Bill also sat carefully on the large pink monstrosity. "We, ah, have some experience dealing with multiple realities, branching time streams, and the like. It's been a few years, but a couch just like this one featured prominently in the situation." In response to the twin (literally) raised eyebrows, Bill grimaced. "I know how it sounds. But it's the truth."

"What are you two, some kind of con artists?" asked Lynne the bartender.

"The Bill I know is a sleazy talent agent," scoffed Lynne the pugilist.

"Really? I almost went into entertainment law, actually. But I ended up doing more employment work. I'm a lawyer, he's the scientist."

Greg tapped his chin. "Interesting. Lynne, do you normally tend bar?"

"At this very establishment. But not 'here,' if you get my meaning; I had to blackmail the bartender on duty to keep him from asking too many questions. Apparently, his affair hasn't gone public in this reality."

"Hmmm. And you, Lynne? What do you do for a living?"

"I'm a florist. I own a flower shop a few blocks south of here, though not in this reality."

"You sure you're not a boxer or something? Maybe as a hobby?" Bill asked, rubbing his cheek. Lynne the florist had the decency to duck her eyes and murmur an apology. Bill smiled and waved a hand. "Ah, it's okay. I've had worse."

"Yeah, fine." Lynne the bartender wasn't in the mood for small talk. "So, you guys have dealt with this sort of thing before?"

Bill glanced over at Greg. "Um, not exactly. Our situation had to do with reality breaking down, more and more unlikely things happening, until we were able to use our position as quantum observers to fix things."

Greg nodded. "Yes, it was a side effect of a particular experiment I was conducting. We ended up having to circumvent time entirely. And there was a talking dead fish involved, although it's not dead anymore. But at least we got to use the effect to win the lottery."

Bill grimaced. "They don't need to know that!"

Greg looked confused. "Were we keeping it secret? It's relevant to the story."

"Number one, given your skills as a film critic as just one example, I don't think you're qualified to determine what's relevant. Number two, we're not keeping it secret, but saying it like that makes us look bad. Now they're going to think we used the destruction of reality for our own profit."

"Didn't we?"

"No, we didn't! It was just a side effect!" Bill buried his face in his hands while Greg continued, addressing the Lynnes.

"Look, we split the winnings, and I've been funding my own experiments, while Bill's been doing a lot of pro bono work and trying to write mystery stories. So it's not like we're hedonists or something, abusing our ill-gained wealth."

Greg fell silent. Bill, face still in his hands, just shook his head. The Lynnes stared at them.

"Whoo. Too much information," said Lynne the bartender. "Though it's good to know you guys aren't just weirdos out of the blue. You actually have some kind of connection to this situation."

Bill dropped his hands, looked at Greg. "Do you think it's really connected? The Voice said the side effects would only last a short period. And we haven't been able to play the determining observer for some years now."

Greg gestured to indicate the couch. "I think this is some kind of evidence that it's connected. Besides, we don't know what sort of scale of a 'short period' the Voice was talking about. It was, like, a computer from a million years in the future. Maybe the strong side effects have worn off, but who knows how long any low-level effects might linger?"

"Computer from a million years in the future?" Lynne the florist asked mildly.

"You really ought to write it up." Greg nudged Bill. "If nothing else, it would simplify explanations like these."

"Oh, like we talk about this all the time." Bill paused and imagined the headline. "The Case of the

Collapsing Continuums," he intoned dramatically. Then he sighed. "Nah. Science fiction isn't my game."

"Well, neither is mystery, judging by your rejection letters."

Bill glared at him, then turned back to the Lynnes. "Anyway, for whatever reason, we appear to be involved in this puzzle, and I think we can help. Would you mind filling us in on the situation? Maybe something will tweak my buddy's synapses."

"Well," said Lynne the bartender, "if you think it'll help. But I'm not the one you should talk to."

* * * *

Lynne the physicist was like a twitchier Lynne the bartender, or a less physical Lynne the florist. Once she got over the fact that Greg was not the same Greg the industrial chemist she'd once met, they got along swimmingly.

"I should have known you'd be the Greg from this timeline," she sighed. "It's just one of those reactions."

"Well, to be fair," Greg offered, "I could have been a Greg who didn't diverge as much as you did in this timeline. It was a fair assumption."

"Thank you for that," Lynne the physicist said, then focused on the couch. "Dear God, who picked that color?"

Bill raised a hand to interrupt. "The universe, apparently. Lynne, we might be able to help all of you Lynnes get back to your appropriate places. But first, we need to know what happened. Lynne the bartender, here, says you may have some thoughts about that."

"Well, I was out at Fermilab, doing some work with the accelerator. We were testing mwah mwah-mwah mwah mwah..." Bill's comprehension of what she was saying abruptly stopped. Oh, sure, he could understand things like "...and then we..." or "...tried to..." and other fragments, but the specifics of vectoring bosuns or measuring the wave dispersion or what have you was all as good as "garb-flargle neark-wok" as far as he was concerned. Greg appeared to be following it, though, even cutting in with a few questions here and there. Bill caught the eyes of the other Lynnes in the room (the bartender, florist, and physicist had been joined by another, this one apparently a high-school English teacher), and shrugged as if to say "these eggheads, huh?" All the Lynnes smiled slightly in sympathy, in unison. It was weirdly attractive.

Both Lynne the physicist and Greg got more animated as they spoke, and finally that Lynne dropped back into Bill's comprehension zone with: "and when I got back to the monitoring room, nobody recognized me. I actually had to get a taxi back to the city, and my apartment wasn't there anymore. Well, it was there, but it had new tenants, who claimed they'd been there for years. I didn't want to go to the police quite yet, but I needed some time to think, and I didn't know where else to go, so I came to the old bar I used to hang out in back in college. Um, it wasn't a sports bar at the time. I was hoping maybe I'd be able to find some of my old friends that still come here occasionally. Instead, I found some other versions of myself. That's when I started to figure it out. I've been explaining it to new Lynnes ever since."

"Mmm-hmmm. So, now, what, you've got Lynnes going out and looking for other Lynnes? Bringing them back here until you can figure out what to do?" Greg looked around at the various Lynnes for confirmation.

Lynne the bartender nodded. "Seemed like the thing to do."

"Well, it seems obvious what we need to do. We need to recreate your experiment."

Bill glanced at his friend. “Um, wait. Wouldn't that make things worse? Break things down even more?"

Lynne the physicist chimed in, “Not necessarily. Depending on what happened, it's possible that recreating the energies involved could set things right. Since we don't know exactly what did it, we won't know for sure..."

"I've got some theories on that,” Greg started, but Bill grabbed him by the shoulder to get his attention before he started off on any lengthy explanations.

"Don't you think we might be better advised to be sure before we leap in?” Bill squeezed his friend's shoulder. “Impetuousness really didn't help us the last time."

"Bill, I don't foresee any futuristic supercomputers warping time and space to help us out of this one. We've got to do something ourselves, be more proactive, and I even have a theory as to what needs to be done."

"Wow,” Lynne the English teacher said, “a reality-bending supercomputer? Talk about *deus ex machina!"*

Bill and Greg blinked at her for a moment, then at each other.

"You're the writer, Bill; why didn't you think of that?"

"I'm a lawyer by training; I'm still working up to being a writer."

"Then you should have gotten the Latin right off!"

Lynne the bartender interrupted. “What should we do about the Lynnes that keep showing up?"

Greg shrugged. “I'm not really sure. If we restore the barriers between the divergent timelines, it's most probable that the respective Lynnes will simply find themselves back home. It's not like we exactly have a model to work from here."

"Well, one of you better come out here and help me explain this to the rest of the Lynnes. I'm not sure I can follow it all."

Bill stood up off of the hideous pink couch. “I'll go. These two probably want to talk shop anyway."

As Bill and the other nonphysicist Lynnes headed toward the door, another Lynne appeared in the doorway. “I think we have another problem,” she said, gesturing toward the bar's front door.

Bill leaned his head out of the doorway, over the nearest Lynne, and glimpsed ... himself. In a tacky suit. In the doorway to the bar, staring in horror at all the Lynnes.

"Come into my bar, find it packed full of my ex-girlfriends,” the other Bill muttered, loud enough to hear, “but it's all the same girl!"

"Oh, man,” Bill sighed. He turned to Lynne the florist. “I think your proper target might be here."

* * * *

They quickly dropped the “the” when distinguishing each other. By the time Bill had briefed the resident Lynnes and as many of the exploring Lynnes as could be contacted, two more Bills showed up, and a single extra Greg also wandered in. When the two physicists finally emerged from the office, a rough plan

and some preliminary equations all hammered out, they were surprised at the increase in patronage.

"Hey," muttered one of the new Bills, glancing into the office area, "I've got that same couch in my apartment."

"So you're the one," said Bill as he stepped up to drag Greg away from the door. Lowering his voice, he asked, "So you two figure out what we're going to do?"

"I think so. We're going to have to stop by my lab before we drive out to Fermilab; there's some equipment I think we might need."

"Okay, we're identifying by career, now, since that seems to be one of the major differences. Like you use last names in a room full of Jennifers or Gregs, no offense. So it's Lynne Physicist, now, and you're Greg Physicist. I'm Bill Attorney. The you over there is Greg Geneticist, who happened to see what he thought was identical triplets, and followed them here. He's been filled in now. We've also got Lynne Florist's ex, Bill Talent Agent, we've got Bill Debate Coach, and William McSnootypants, although we probably better call him Bill Stockbroker."

"Why the rancor? Don't you like yourself?"

"Oh, but that would have been an easier question two hours ago. Let's just say I now know what unfortunate choices I could have made. And I now have proof that money does not automatically make good people." Bill sighed. "Quite the opposite, it seems."

"Well, we're rich."

"Yeah, well, we arranged our own luck, we didn't have to sell out our principles for a quick buck." Bill shook his head. "Look, forget it, let's just get done what we need to get done and get everybody back home safe. This is turning out to be far too much of a comic book plot for my tastes."

Lynne Bartender stepped up to them. "Lynne Physicist tells me you got things worked out. There's just one problem."

Bill sighed. "See what I'm saying? You start messing around with alternate realities, you start getting all comic book." He turned to Lynne Bartender. "Let me guess: one of your twins is evil? She am your biggest fan, so must kill you? Married a man who's your brother in this reality?"

"No," said Lynne Bartender.

"Finally," breathed Bill, "something relatively normal."

"Three of my twins are evil, actually. And they've flown the coop, and we really should figure out how to stop them before anybody gets hurt."

"How do you get so many evil twins?" Bill grumbled, slipping behind the wheel of the minivan. Luckily, the rent-a-car place had three in stock. Bill had rented two, pointedly passing over the one with the loud pink brocade upholstery, and he and some of the others were heading out to look for the rogue Lynnes. Greg and Lynne Physicist and some of their doubles were taking the other to go gather the necessary equipment from his lab.

"Technically, they're not 'evil,'" said Lynne Florist. "They're just criminal, which isn't always the same thing. Life offers us all certain breaks, and you have to make choices to exploit those breaks or not. Not everybody's choices turn out to be good ones, and the hard consequences of that can change a person severely. Or have you always been agreeing with your own doubles?"

Thinking of Bill Stockbroker and the recently encountered Bill Maitre D', Bill had to nod. “Point taken."

A Lynne that Bill hadn't met yet picked up the discussion. “The way I see it, sometimes you get to a place where you can't get yourself out again; the weight of your bad decisions or bad luck or what have you just keeps you down forevermore. That's when this accident comes in. The only problem with Lynne Hacker and Lynne Thief is that they're finally in a place where they no longer have a criminal record. Nobody's looking for them here, so they feel free to head out and do what they want, make a fresh start. But they've still got their old instincts, their old ways of making a living.” She shook her head wearily. “It wouldn't be right if we let them rip somebody off before things got set to rights. It'd be like we all did it."

"Hacker and Thief. Fine. What about the third?"

"Oh, she's just crazy,” said Lynne Florist mildly. “I have it on good authority from both Lynne Psychologist and Lynne Police Detective that Lynne Delusional is pathological. We just don't want her to hurt herself or anyone else."

Bill finished boggling at that and sighed. The Case of the Crossdimensional Criminal Cuties, he thought, but figured that would be the title for a whole different sort of story than he was planning. “Fine. But how are we going to find them?"

"That's where I come in,” said the new Lynne. “You can call me Lynne Psychic."

"Psychic, huh? Figures—everything else has been going like that today. If you're psychic, what am I thinking?"

Lynne Psychic leaned back in one of the minivan's middle seats. “Damned if I know. I've never had any real psychic abilities before; it was just an easy gimmick, and I was good enough to do it for a living. But now, with all these other copies of me, I can tell you that she,” pointing at Lynne Florist in the front passenger seat, “is wondering how her Bill Talent Agent got to be so sleazy when you seem relatively aboveboard."

Lynne Florist whirled around and started arguing with Lynne Psychic so vehemently Bill was pretty certain the psychic ability had been proven. Okay, fine. A psychic who was only attuned to other versions of herself. Well, this is the one time when such a specialized capability would actually work. Or be noticeable, for that matter. The Mystery of the Mind-reading Multiples? Or would that be too confusing? He put the idea aside for the moment and tried to focus on the task at hand.

"So what are we looking for?” Bill asked, cutting into the argument. The two Lynnes subsided for the moment, glaring at each other.

"The hacker and the thief are going to want a place to hole up and plan,” called a Bill from the back seat. “The crazy may be with them, still. After all, there's a tendency to stick together, right? We're doing it, and we don't even have the same motivation."

Bill furrowed his brow, gazing at a scruffy version of himself in the rear-view mirror. “I'm sorry, I don't think we've met."

The other Bill just sighed. “Call me Bill P.I."

Bill thought that was a nice title, but *Magnum* had gotten there first. “Cool. I may want to talk to you about a story."

"Sure,” Bill P.I. grumbled. “If you want to hear about divorces and insurance scams. Everybody thinks it's glamorous and exciting, but it's a grind like any other."

His buzz effectively killed, Bill turned his attention back to the road. “I hope we can wrap this up soon,” he said, mostly to himself. “I've got a cat and a big fish I have to feed."

"You know, if you wait long enough, the one will probably take care of the other, so no worries,” Bill P.I. said from the back. Bill favored him with a warning glare, but the guy just grinned.

* * * *

Bill drove his van all around the city, past any place any of the Lynnes thought might be familiar. Each time, Lynne Psychic would close her eyes and “reach out with her feelings,” or whatever she did, and each time she came up blank for the three they were looking for. Bill's doubts about her capability, however, were erased when she spontaneously led them to two newly arrived Lynnes they happened to be passing near. If she could sense Lynne Romance Novelist and Lynne Aerobics Instructor, she ought to be able to detect the others. They also picked up a couple of Gregs and another Bill that they recognized as they passed.

When the Lynnes in the car ran out of likely places to check, Lynne Florist got on her cell phone to consult with other Lynnes for ideas. It was around then that Bill began to notice other twins. There were a lot more pedestrians around in the residential neighborhoods than he was used to, even for Chicago, even around rush hour. To his eye, far too many of them seemed to be identical twins, with a scattering of identical triplets.

He called Greg. “I think it's spreading."

"Which Bill is this?"

"Your Bill! Bill Attorney! Are you Greg Dunderhead? Criminy. Anyway, I've been seeing lots of people with their multiples. It's spreading beyond the three of us. It's no longer localized."

"That fits. The last breakdown we dealt with got progressively worse and more widespread. This one appears to be doing the same thing."

"Well, you better hurry up. If this gets too far out of hand...” Bill didn't finish the thought because he couldn't think of any phrasing that was properly apocalyptic.

"True. I hate to think what all these spontaneous people are doing to gravity. I mean, each one individually, very small effect, but their mass, en masse..."

"Crap, I hadn't even thought about that.” Bill closed his eyes momentarily and sighed.

Greg must have picked up on the tone of that sigh. “You seem very tense."

"Yeah, sorry about that. I'm just driving around town with a psychic, searching for some criminal Lynnes, for God only knows why. It's a little fraying on the nerves."

"Hey, it's the responsible thing to do. Besides, it's not like we're lacking for extra hands to help carry the gear. We've picked up a few more of us."

"Us too. Getting a little crowded."

"Well, we're packed up. We're going to head out to Fermilab, use my contacts to get us past security. If this is happening out there, too, well, maybe they'll cut us a break. Good luck."

"Back at you.” Bill shut off his phone, and glanced in the rearview mirror. Lynne Psychic had her eyes closed and was frowning. “What's the frequency, Lynne P.?"

"I'm trying to focus on the targets, but all I get is some images."

"What images?" Lynne Florist asked.

Lynne Psychic furrowed her brow, as if trying to squint into her mind for a better look. "Some kind of ... big circle. And a big letter H, sort of. Not really the letter, but that's the closest I can describe it."

"Cattle brands." Bill P.I. piped up from the back. "The Circle H might be a brand. Maybe they're in the Stockyards neighborhood."

"Cattle brands?" Bill asked, raising an eyebrow into the rearview mirror.

Bill P.I. shrugged. "What can I say? Western novel fan."

"Corporate logo, perhaps?" suggested Greg Commercial Artist (who was, incidentally, the least left-brained of all the Gregs Bill had met, and he still seemed pretty damn methodical and obsessive).

"I wish I had my laptop, we could try looking it up," Greg I.T. sighed.

"Wait a minute. The H symbol..." the new Bill murmured, leaning forward from the back seat and motioning in the air. "Two vertical swoops like that, and kind of filler in between?"

Lynne Psychic considered a moment. "Yeah, I think that fits it. Like it's solid in the middle, but different from the sides."

The new Bill, who had only been identified as Bill Technician, shook his head. "Trouble. If it's what I'm thinking of, that might be a building. Wilson Hall, the big office building over at Fermilab. I've done some service calls out there; it's quite distinctive."

"Trouble," Bill P.I. said, sitting up straighter. "They might be trying to keep from getting sent back home. None of them would really understand what's happening, so if they heard Lynne Physicist's story, they know it all started there. It's not a big jump to figure out it's probably going to be fixed there, too."

"Trouble. Greg and the others are on their way out there ... and my network is currently overloaded," said Bill, glancing at his phone.

"Mine too," said Lynne Florist. Everybody else in the van pulled out their phones and found the same thing.

"The more you say it," said Lynne Psychic, "the clearer it becomes. I think the H shape is the building, and the circle must be the accelerator."

"Hell," said Bill. He took the next corner and headed toward the highway.

* * * *

The entire drive out, the cell networks remained jammed. There was also far more than the usual traffic on the surface roads, as well, although the highways were unusually clear. The toll roads were just about deserted. That didn't stop Bill from slowing, wasting precious moments to pay his tolls. Because, if by any chance the world didn't all fall apart around them, the Illinois Department of Transportation was quite vindictive to toll scoffers.

He tried to think of clever titles for his situation, but found that in the tension of the drive he couldn't come up with the alliteration. They all started having the same theme, something like "The Case of the Collapsing Universe," and that didn't sound at all cheery. Nobody spoke in the van; they all knew what

was at stake, and they all wanted to see it end properly so they could get back to their regular lives in their regular timelines.

The sun was setting by the time they pulled into Fermilab's Pine Street entrance. Nobody stopped them at either of the guardhouses as they drove madly up the winding road, tall prairie grasses giving way to forest on each side. All the guards—about four to six of the same person at each station—were too busy arguing with each other to worry about the van. There were distant headlights behind him, but Bill couldn't afford to slow down. The Wilson building appeared on his right, across a pond; it was mostly dark, only a few interior lights to show that it wasn't completely uninhabited.

"Come on, come on." Bill muttered as he blew through the last stop sign and careered around the right turn, almost rising off two wheels. Wilson Hall lay straight ahead, beyond a reflecting pool. Pulled into a parking space right next to the building, the only car in the visitor lot near the door, was a junky little Honda hatchback. Three Lynne-like figures were clustered up next to the locked front doors.

Bill hit the curb at the opening plaza, screeching to a stop on the square tiles. Everybody started to pile out of the van. Bill swung the door open and was confronted with an identical van parked right next to him. It hadn't driven up, it was just there. And it contained exact copies of him and his compatriots; not a slight variation, but exactly Lynne Florist, Lynne Psychic, and the others. And him. They were all piling out of their van, as well, and the other Bill, the other Bill Attorney, caught his eye, as he was getting out of his own van. He had a look on his face, which Bill figured was probably mirrored in his own. The look basically said, "This is really messed up, but we don't have time to deal with it right now, so let's just do what we have to do." So they did, and everybody moved up the stairs.

The three Lynnes on the steps near the door were suddenly nine; the extra women didn't materialize or wink into existence as much as they were just there, as if they'd always been there but just hadn't been paid any attention until that moment. Some of them scattered, some of them kept working on the door, and some of them drew weapons. So did four Bill P.I.s. The steps were swiftly getting crowded.

More tires screeched; Bill risked a brief glance back over the six minivans crowding the entrance plaza and saw even more minivans pulling up, these not quite so identical. One even had the awful pink brocade visible through the windshield. And the Bills and Lynnes and the few Gregs that ran up from these vans were widely different, as well. He registered versions of himself in the red and orange robes of a Buddhist monk, in biker leathers with a Village People handlebar mustache, in some kind of 1980s *Miami Vice* outfit, and, in a memory-searing vision, full cowboy regalia, complete with chaps, twin pistols, and a lasso.

Gunshots broke his frozen moment of horror. Some of the dozens of Lynnes up by the building were firing out into the crowd, and many in the crowd were firing back. One military Greg even had an M-16 with him and wasn't afraid to use it. People scattered, took cover, and seemed to visibly multiply in midmotion. One Lynne would dive to her left, and three would land, one rolling behind a step, another ducking behind a van's fender, the third ending up flat on the concrete. Then the front row of criminal multiples finally met the oncoming rush of noncriminal multiples, and the quantum foam really hit the fan.

The noise was indescribable. A cacophony of violent sounds, as weapons fired and blows landed, and people screamed in pain or anger or merely effort. Glass shattered, bullets ricocheted off stone. There was shouting, of directions, of encouragement, of threats or pleas or who knows what, it was all such a muddled din. Bill's thigh suddenly stung, and he grabbed it, feeling hot blood under his palm. His knee buckled, he fell to the ground, and suddenly realized he was in the path of the mob, seemingly hundreds of feet stamping up the steps toward him, hordes of Lynnes and Gregs and himself.

Someone reached down and dragged him sideways, shouldering people out of the way to pull him up

near several other wounded people. His rescuer took a moment to check his wound and smiled. He had time to register his general face on a female form, as the woman said, “You'll be fine. Just a graze.” Then she stood and disappeared back into the fray.

Bill closed his eyes and rubbed them, not sure whether he'd actually seen a version of himself from a timeline where he didn't have a Y chromosome. And by the time he opened his eyes, a mere instant later, it was over.

He was lying alone on the steps, some ten yards from the minivan. The front of Wilson Hall was wrecked, the glass revolving doors and the sliding panels all broken out, the concrete and brick all chipped and crumbling from gunfire. The bronze dedication plaque was somehow entirely untouched, and Richard M. Nixon's name seemed to glare angrily down at him, as if to say, “Stop bleeding on my steps, you filthy hippie!” Or maybe Bill had read a bit too much about Kent State, and possibly his wound and the adrenaline were doing strange things to his perceptions. Whatever the case, it seemed to be finished.

He'd tightened his belt around his upper thigh with one hand, keeping pressure on his wound with the tail of his shirt, and was trying to remember what you did with a tourniquet when his cell phone began to ring. It was Greg.

"We did it!” was the first thing the scientist said.

"I know that. I'm shot! You're here at Fermi, right? I'm in front of Wilson Hall. Come and get me!” was the first thing Bill said in return. Then he hung up and went back to his hazy memories of first aid classes.

Shortly, Greg came trotting up from around the side of the building, a first aid kit in his hands. Among his many disciplines, he'd taken a few medical courses in his day. “I thought you'd be in there,” Bill called as he approached, gesturing to Wilson Hall.

Greg glanced at the building and almost stumbled, shocked at the state of it. He jogged up and knelt at Bill's side, popping open the plastic case and rummaging through the little boxes and bottles within. “Wilson Hall's mostly administrative offices and public areas. They shut it down when everybody started doubling, which seems a lucky thing, in retrospect. The accelerator controls are in the buildings around back.” Greg blinked at Bill's first aid efforts. “You know, you really don't need a tourniquet. Look, it's already clotted."

"Oh,” Bill felt lame, and not just because of the injury to his leg. “We thought the big building would be where the science was."

"Ah, don't worry about it. Everybody thinks that."

"There were many multiples. Not just new multiples with different jobs and such, but multiple *me's*, multiple Bill Attorneys."

"I know, we dealt with that, too. As the breakdown progressed, more recently diverged universes started bleeding in, meaning we were getting copies of ourselves based on divergent decisions made only a few minutes ago."

More like decisions made in an instant, from what Bill had seen. He grabbed Greg's arm. “I saw a female version of myself. She was a doctor or a nurse or something. And I saw a Bill Cowboy."

"Oof. That must have been interesting. Well, you did say it was getting pretty comic book."

"What does that have to do with anything?"

"Well, there's always a cowboy double in those multiple universe stories. Either that or an evil version of yourself with a beard." To Greg, it was a simple matter of fact. "The most unusual I had to deal with was a Greg Rodeo Clown. Seriously. How different would my life have to be for 'rodeo clown' to become a good idea, as opposed to 'physicist.' Makes you think, doesn't it?"

"A couple of Lynnes were saying you never know what breaks life is going to hand you. Any of us, with a different set of circumstances, could end up anywhere. That's why the criminal Lynnes were trying to stop you. They suspected what Lynne Physicist was going to try to do and came here to keep it from happening. So they could have a fresh start."

"Yeah, we ran into some versions who figured out where the action was really happening. We took care of it." Greg tried to sound casual, but it was obvious he was pleased at the story. "Maybe Lynne is pretty smart in every dimension, but we had some of her on our side, too. And we would have been able to handle it ourselves anyway."

"We?" Bill winced as some of the first aid tape Greg was applying pulled at his leg hair.

"Oh yeah. There were, like, thirty of me, all operating together. It was great, not having to explain to another technician what I was trying to do, everybody all working in concert. Barely had to talk there near the end; we all just knew what we were doing. Can you imagine what I could accomplish with thirty of me working 'round the clock? The possibilities boggle the mind!"

"Oh, yeah? Ask Deanna what she'd do with thirty of you sometime."

* * * *

There was a different bartender at the sports bar when they went back a week later, but he still seemed to recognize both of them; maybe he'd met one of their versions. It seemed most of Chicago was having déjà vu, as almost all the city was within the effect radius. The national networks had been running "Versions Of You" specials all week, and many physicists, including Greg, had become momentary celebrities by trying to explain the phenomenon to the populace. It wasn't in the nature of this sort of fame to last, Bill knew, but it was cool to see his buddy in the spotlight for a change.

"What strikes me, now that I've had a chance to think about it," said Greg as their beers were delivered to their table, "is that it didn't really seem like we were all that close in other universes. The ones that diverged far enough in the past, that is."

"Well, even if we'd met in college, I don't know that we'd be as close as this, if we hadn't had certain bonding experiences," Bill said. "I mean, without the first accident and its ancillary benefits, we wouldn't have all this extra time to hang out, for one."

"Yeah, I suppose. If it weren't for the first accident, I'd be spending a lot more time at work, and I'd be spending my free time with Deanna. Now, tonight she makes me go and hang out with you, just to get me out of her hair."

"To be fair, she did have a rough time of it with some of your versions. She had to wrangle, what, five? Five Gregs before any extra Deannas showed up to assist."

"True. I hear she ruled them with an iron fist." He smiled; Bill had always known Greg's wife was the perfect strong personality to counterbalance the scientist's own tendencies. Bill sometimes envied him his romantic match. But, he was hoping, not for too much longer.

"Did you ever figure out why it was our universe? I mean, this could have happened to any universe, and maybe it had effects in others, but it seemed for a while that we were the home team and everybody else

was visiting. Did you discover why?"

"There are always mysteries, Bill. There always will be. I don't know that we'll ever figure out exactly why, but you want my guess? It's you and me." At Bill's quizzical look, Greg motioned to the bar's back office. "Pink couch, remember? We've dealt with this kind of thing before, and it left its mark. I'm thinking that makes our branch of the cosmic timeline tree a magnet for this kind of thing. Or at least it increased the probabilities for us. Maybe. To be honest, I don't really know. But that's the best explanation I can think of."

"Well, it sounds good to me." Bill caught sight of someone entering the bar and stilled the part of his imagination that kept trying to come up with titles. Time to stop planning stories and start playing a role in one. "Hold on a second."

Greg glanced over as Bill got up. "I knew you had ulterior motives for coming back here!"

Bill ignored him and moved over to the blond woman who had just walked in. "Lynne, right?"

She looked at him and immediately recognized him. "Which Bill were you?"

"Bill Attorney. Mostly pro bono work these days."

"I don't think we met. Lynne Biologist. Medical research, right now. New applications of magnets, that kind of stuff."

"Really? That's fascinating. Very pleased to meet you. So, coming back to take a look at the place?"

"I got nostalgic, after all that. I realized some of the, what do you call them, branch moments happened in this very place. It was weird; to see what you could have been, if things had just broken a little differently."

"That's what they're playing on the TV, at least. Lots of stories where people met a version that was so much better, or so much worse, than they are. Hard to tell if it's inspirational or depressing."

"Depends on who you talk to, I suppose." Lynne glanced past him and noticed Greg. She gave him a slight wave, and he raised his beer to her, smiling. "So, I didn't know you boys hung out here in this reality."

"We don't. To be honest, I was curious to see what the Lynne of this reality was like. So, I was just hoping to meet you."

She regarded him with an appraising eye. "You know, I met a version of you that was married to a version of me."

"Really? I met a version of you that had been dumped by a sleazy version of me."

"I met a version of me that had just dumped a version of you, too. Well, there's no accounting for taste, I suppose." Her smile was enigmatic.

"I guess not. So can I buy you a drink?"

"Sure. And you and Greg can catch me up on what the versions of you in this reality are actually like. Who knows, maybe history will repeat itself." He couldn't help but notice that she hadn't specified which history she was thinking of. She was far too clever for that.

He smiled and escorted her back to their table. "Stranger things have happened."

(EDITOR'S NOTE: Bill, Greg, and the couch appeared earlier in "Improbable Times" [June 2005].)

[Back to Table of Contents]

BIOLOG: E. MARK MITCHELL by RICHARD A. LOVETT

* * * *

* * * *

If heritage had anything to do with it, E. Mark Mitchell might be reading science fiction, but he wouldn't be writing it. That's because his father is a computer science professor and his grandfather was one of the people who *really* invented the Internet. “I come from two generations of computer scientists,” he jokes, “so of course I went into the humanities."

But he also grew up immersed in the great writers of science fiction's Golden Age and he loved to tell adventure stories. “When I was eleven, I wrote about a space traveler and an intelligent parrot. That's the earliest story I can definitively say was science fiction."

After graduating from college, he tried a novel, religiously writing three pages a day. It didn't sell and then life intervened: marriage, graduate school (more creative writing), and the need for a day job. Meanwhile he took up role-playing games, discovering that they whetted his interest in character building and storytelling. Then in 2004 he worked up the nerve to submit a short story. “I'd been subscribing to *Analog* for more than ten years,” he says, “so I figured, ‘I'll just send it to them.’”

In one of those events that most first-timers only dream of, he got back a letter telling him the story was nearly publishable, but he might look a little more deeply into the underlying physics. He did, and found he'd gotten a key bit wrong. He fixed it and the result was “Improbable Times” (June 2005). “If I ever teach writing,” he says, “I'll tell people that it's important to know how to take advice. An actor needs to know how to take direction; a writer needs to take editorial advice."

Recently, he watched an interview with Joss Whedon (creator of *Buffy the Vampire Slayer, Angel,* and *Firefly*). Whedon said that initially, he just wanted to tell entertaining stories. But later, he found that he also wanted the stories to be about something.

"I'm getting to that point,” Mitchell says. Not that he plans to clobber people with blatant parables. “Some of my favorite episodes of *Battlestar Galactica,* for example, involve people with diametrically opposed viewpoints,” he says. “They're both right, but they can't both win.

"The world is a messy place and you've just got to try to do more good than harm.” That may not be profound, he adds, but it's a stronger message than much of today's mainstream entertainment delivers.

[Back to Table of Contents]

THE ALTERNATE VIEW: THE SUPPLEMENTAL VIEW by JEFFERY D. KOOISTRA

In the July/August 2007 issue of *Analog* appears a wonderful essay by Michael F. Flynn called "De Revolutione Scientiarum in 'Media Tempestus.'" I don't think I'm able to supply sufficient superlatives to describe how valuable I think his essay is, so I won't try. Therein Flynn covers a great deal of ground concerning the state of science in the fourteenth century, and explains why it is that science was born in the hey day of Christendom even though it was stillborn everywhere (and when) else. He also goes a long way toward dispelling the all too common notion that faith and reason (or in this case, science) can't go hand in hand.

This column is not going to be an "alternate" view—rather, it is a supplemental one. In Flynn's essay, his Reply to Objection 1 under the heading of Question IV, says: "That faith is opposed to reason is a modern dogma accepted on faith." I couldn't agree more, and to supplement Flynn's point, I'll treat you to a bit of my own history with respect to faith and science.

When I was a kid, my family attended Grandville Avenue Christian Reformed Church, which was right next to my elementary school, Southwest Christian. So almost everyone I knew was Christian Reformed. Indeed, Grand Rapids, Michigan is something of a Mecca for the Christian Reformed Church. The bulk of the congregation of my church came, at one time or another, from the Netherlands. My mother's side of the family had been in the US since at least the 1800s, because her father was born here on Christmas day, 1893. My father was born in the Netherlands, coming over on "the Boat" when he was four.

The Christian Reformed Church (hence, CRC) is Calvinist, so much so that both my high school and college *alma maters* are named after Calvin. But outside of Grand Rapids, it suffices to just tell people I'm Presbyterian if they happen to ask. The CRC is considered a conservative evangelical denomination by most who've heard of it. (It is thought to be *too* conservative by those "progressive" members who have been, in my opinion, systematically destroying it through misplaced good intentions since the 1970s.) Certainly, many of my childhood friends grew up in homes where on Sundays they were not allowed to ride their bikes, or watch TV, or even go swimming. Fortunately at my house, we watched *Lassie* every Sunday night, rode our bikes regardless of day, and dropped the no-swimming nonsense once our neighbors, who were Catholics, got a swimming pool. I didn't realize until I was older that the peculiar strain of legalism that ran in my church had nothing to do with Calvin, or even with my denomination's formal teachings. It was mostly a Dutch thing.

Even before I reached kindergarten, I was into science. I loved robots and stars and rocket ships, but, as for many kids still today, dinosaurs were the *coolest!* But wasn't this a problem, growing up a Christian kid in a conservative religious family? Isn't Christianity, or religion in general, or simply faith, antithetical to science? What did I do when I discovered dinosaurs? How did I reconcile the young Earth of the Bible with all those dinosaur books that not only said dinosaurs lived millions of years ago, but that no people, not even Adam and Eve, were around then?

All I can tell you is that none of those issues were ever much of a concern. Though I am still a conservative evangelical, I am not a Fundamentalist. And the CRC, though conservative, is not a Fundamentalist denomination. Oh, it certainly has its share of capital "C" Creationists in it, the same way it has its share of capital "S" Socialists, or any other capital letter "—ists" you can think of. But these beliefs are no more indicative of the actual teachings of the church than was the no-Sunday-TV rule.

I can recall exactly one time in grade school when a "Creationist" episode occurred. I was in either first or second grade, and students were asked to bring in a favorite book for the teacher to read to the class. I brought in *A Book to Begin on Dinosaurs.* At the point in the book where it mentions dinosaurs living millions and millions of years ago, the teacher skipped over that part. I don't think she personally had a

problem with the idea, but she didn't want to open a can of words if even one parent did. Even at that young age, I understood why she did it, and I also remember thinking it was silly, but it didn't bother me. After all, some kids were raised to believe in a literal six days of creation like others were raised to believe in Santa Claus. (And besides, what *really* bugged me was that my teacher mispronounced Brontosaurus as Bron-*tos*-er-us!)

I was as attracted to books as a child as I am now, so after the service while the adults were enjoying coffee and windmill cookies, I routinely visited the church library, even though it was mostly filled with old books even I found boring. However, I did take out a few volumes that dealt with science and religion and how there wasn't any conflict between them. Granted, some of the books argued points from both scientifically and theologically bogus angles (like treating the creation days in Genesis as referring to umpty-million-year-long sequential epochs), but they still embraced scientific findings with the same reverence scientists do.

Calvin Christian High School had biology as the science requirement for the sophomore class. As in any public school across the land, we were taught about the evolution of living organisms. Creation science existed then (the current Intelligent Design manifestation was still embryonic) but it wasn't part of our curriculum. Indeed, the only thing my biology teacher said that you wouldn't have heard in a public school were a few words meant to placate those few parents who were excessively influenced by Fundamentalism.

By the time I got to Calvin College, I was exceptionally well educated in science, both from my schooling and from what I had learned on my own, largely from books I found in my school libraries (and from reading *Analog*). At Calvin, I studied both psychology and physics, under professors who published in all the same journals that professors from non-church-affiliated colleges and universities do. None of my teachers had to run their class notes past the seminary faculty. And in the laboratory where I spent two summers measuring the thermopower of liquid rare earth elements, the only CRC handbook we consulted was the one published by the Chemical Rubber Company.

One of the last classes I took at Calvin was a Philosophy of Science post-graduate course taught by visiting professor David N. Livingstone. Among the books he's written is *Darwin's Forgotten Defenders: The Encounter Between Evangelical Theology and Evolutionary Thought* (Eerdmans, 1987. ISBN 0-8028-0260-5). Though currently out of print, it is a book well worth tracking down and reading. Livingstone presents the history of how evangelical theologians responded to evolutionary theory at the time Darwin first presented it. Far from rejecting it out of hand, "(The) greatest Victorian advocates had promoted a Christian evolutionism that was uncompromisingly scholarly, theologically sensitive, and scientifically informed." (Pg. 168) Essentially, they had no more difficulty with evolution than they did with heliocentrism.

One of the reasons why my church embraced science the way it did goes all the way back to John Calvin himself. Consider this bit of history.

Back before Galileo and the controversy about whether or not the Earth went around the Sun, some readers of the Bible had a different problem with certain passages in Genesis and what the science of the day was telling them about the sizes of the heavenly bodies. Specifically, Genesis chapter 1, vs. 16 refers to the Sun and the Moon as the "greater lights" as compared to the stars (and it was understood that this included the planets). Yet in the middle of the sixteenth century, astronomers already knew that Jupiter and Saturn were much larger than the Moon.

It was during the sixteenth century that Calvin wrote his commentaries on the Bible. Calvin was perhaps the most brilliant theologian of the Protestant Reformation, extremely influential on those responsible for Western civil society. I was delighted when I discovered what the founder of my branch of Christianity

had to say on this early religion-versus-science controversy.

In his commentaries on Genesis, with respect to Genesis 1:16, Calvin says: “I have said, that Moses does not here subtilely descant, as a philosopher, on the secrets of nature, as may be seen in these words ... Moses makes two great luminaries; but astronomers prove, by conclusive reasons, that the star of Saturn, which, on account of its great distance, appears the least of all, is greater than the moon. Here lies the difference; Moses wrote in the popular style things which, without instruction, all ordinary persons, endued with common sense, are able to understand; but astronomers investigate with great labor whatever the sagacity of the human mind can comprehend. Nevertheless, this study is not to be reprobated, nor this science to be condemned, because some frantic persons are wont boldly to reject whatever is unknown to them. For astronomy is not only pleasant, but also very useful to be known: it cannot be denied that this art unfolds the admirable wisdom of God."

As we learned from Flynn's essay, in Calvin's day theologians were expected to know natural philosophy. (As one who has heard a few too many ministers confuse “galaxy” with “solar system,” I wish seminarians were still required to take additional science classes.) What I find most telling in the above quote is the modern view Calvin took toward Biblical interpretation on scientific matters, best summed up in the phrase: “The Bible isn't a science textbook, and shouldn't be read as one.” I find Calvin's expressed attitude toward astronomy gratifying, and I especially appreciate his disdain for those “frantic persons” who “reject whatever is unknown to them."

* * * *

I've used instances from my own life as a kind of case history for how a man can grow up able to easily reconcile modern science with his religion. But I'm certainly not unique in this respect. Several of *Analog's* current crop of most frequently appearing authors of both fiction and fact are just like me in this respect.

Having grown up in a milieu that so openly embraced both science and religion, I was taken aback the first time I met someone who honestly thought you couldn't be a good Christian and a good scientist at the same time. I can see how he'd get that idea if his only exposure to “Christians doing science” was on the local religious channel where he'd been treated to a lecture on how there were no rainbows until after Noah's flood, or something like that.

But to echo with an addition Stan Schmidt's words from his May, 2007 editorial (page 4): “The vast majority of portrayals of scientists and engineers *who are also religious* in movies, television, and other popular media are grossly unrealistic stereotypes and caricatures.” (However, Creationist scientists appearing on local religious stations are exactly as depicted.)

[Back to Table of Contents]

A PLUTOID BY ANY OTHER NAME... by RICHARD A. LOVETT

* * * *

What's in a name?

* * * *

DATE: SEPTEMBER 1, 2007

TO: ALL PUGET COAST UNIVERSITY

EDUCATORS AND STAFF

FROM: PC UNIVERSITY BOARD

OF COMMUNICATIONS INFORMATION

RE: IAU DECISION

On August 24, 2006, the International Astronomical Union officially decided that the term “planet” shall apply only to celestial bodies that (a) orbit the Sun; (b) have sufficient mass for their gravity to make them nearly round; and (c) have cleared their orbital neighborhoods of other bodies.

The Solar System contains only eight bodies meeting all of these criteria: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Henceforth, any faculty or staff member who in lectures or informal conversations uses the words “Pluto” and “planet” in conjunction shall be subject to censure.

We are in the process of educating young minds. It is vital not to confuse them with conflicting information. In references to Pluto, it is permissible to use the terms “dwarf planet,” “Kuiper Belt object,” “plutoid,” or “The Object Formerly Known as the Ninth Planet.” “Pluton” is not a permissible term because a pluton is also a type of granite and Pluto is not made of granite. Above all, our definitions must be consistent.

NOTE: PC-U strongly supports the concept of academic freedom. Faculty are, as always, free to their own opinions, so long as they do not voice them.

It should be emphasized that the change in nomenclature is in no way intended to be derogatory toward Pluto or other plutoids. Pluto remains an important member of the Solar System and deserves the same respect it has always been accorded.

* * * *

DATE: MARCH 12, 2187

TO: ALL IPS CUSTOMERS

FROM: YOUR INTERPLANETARY SHUTTLE

RE: EXPRESS SERVICE

In order to increase efficiency and better serve customers, the Interplanetary Shuttle shall henceforth only serve planets. Nonplanetary routes will be served by our partner carriers, Asteroid Adventures, Saturn System Support, Kuiper Rambler, Cometary Connection, and The Jovial Taxi. We regret any inconvenience to our Pluto, Charon, and Xena Dome customers, but are certain that you appreciate the systemwide improvements engendered by these changes.

* * * *

DATE: DECEMBER 26, 2227

TO: ALL INTERESTED PARTIES

FROM: UNITED PLANETS COMMISSION

ON ASTRONOMICAL NOMENCLATURE

(UPCAN)

RE: NEPTUNE

Earlier this year, Pluto crossed inside the orbit of Neptune for the first time since 1999. An anonymous party has pointed out that this means that Neptune has not cleared its orbital neighborhood of other bodies, most notably Pluto.

For this reason, UPCAN has decided that Neptune does not meet the long-standing definition of "planet." Henceforth, the Solar System will be defined as having only seven planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, and Uranus.

Because Neptune is obviously not a "dwarf planet," it will be defined as an unclassifiable planetoid body of Uranoid characteristics. This appears to be a class of one. For simplicity, it may be referred to as an exotic nonplanet.

* * * *

DATE: DECEMBER 27, 2227

TO: ALL IPS CUSTOMERS

FROM: YOUR INTERPLANETARY SHUTTLE

RE: RECENT DECISIONS BEYOND OUR CONTROL

Effective immediately, due to the demotion of Neptune to the status of an "exotic nonplanet," IPS will no longer serve the Neptune System.

Neptune service will be conducted by our newly reconfigured affiliate, Kuiper/Neptune Rambler, which provides guaranteed service to many planetoidal bodies at least once per decade (please check schedule for the routing that best suits your needs).

We regret any inconvenience this may have caused for Neptune System residents visiting the Inner System for the holidays, but we know that our customers will appreciate the savings from our new, improved service.

Please be aware that Kuiper/Neptune Rambler passengers must provide their own foods, beverages, and air, and that local flights take considerably more time than the interplanetary expresses to which you may be accustomed. Consult your ticket agent for information on how to avoid asphyxiation, dehydration, starvation, rickets, scurvy, beriberi, and other nutritional mishaps.

* * * *

DATE: JUNE 4, 2333

TO: ALL INTERESTED PARTIES

FROM: UNITED PLANETS COMMISSION

ON ASTRONOMICAL NOMENCLATURE

(UPCAN)

RE: EXTRA-SOLAR SYSTEMS

For centuries, a “solar system” has been vaguely defined as a collection of planets or planetoid objects orbiting a star.

Unfortunately there are now 1,847,974 known such systems, a number that is unwieldy in the extreme. UPCAN has therefore concluded that the definition should be restricted.

Specifically, a solar system must have at last five bodies that (a) do not generate significant internal energies; (b) are more than 0.2 astronomical units away from their suns (Mercury is 0.39 AU distant from our own Sun); (c) qualify as “planets"; and (d) are not so massive that the centroid of their orbits falls beyond the confines of their star's generally recognized “surface."

* * * *

DATE: MARCH 29, 2395

TO: ALL ISS CUSTOMERS

FROM: YOUR INTERSTELLAR SHUTTLE

RE: SOLAR SYSTEMS

In order to increase efficiency and better serve customers, the Interstellar Shuttle shall henceforth serve only true solar systems. Non-solar-system routes will be served by our regional affiliates. We regret any inconvenience this might cause.

* * * *

DATE: SEPTEMBER 30, 2405

TO: ALL INTERESTED PARTIES

FROM: THE NOMENCLATURAL COMMISSION OF THE HUMAN DIASPORA OF COMMUNICATING PLANETS (HDOCP)

RE: SOL SYSTEM

An anonymous party has pointed out to HDoCP that Earth generates 38 trillion watts of heat due to radioactive decay. Jupiter and Saturn generate far more. These are not, the commenter correctly says, “insignificant” internal energies. The Earth/Sol system therefore does not qualify as a “solar system” as defined by the directive of June 4, 2333.

* * * *

DATE: OCTOBER 1, 2405

TO: ALL ISS CUSTOMERS

FROM: YOUR INTERSTELLAR SHUTTLE

RE: SOL SYSTEM

Service to Planet Earth and the rest of Sol System has been discontinued. We regret any inconvenience,

but note that our local affiliates provide service from several true solar systems in Sol's vicinity. Cold sleep is available on request, for an additional fee.

* * * *

DATE: MAY 9, 2927

TO: ALL INTERESTED PARTIES

FROM: THE UNIVERSAL CONSORTIUM ON ASTRONOMICAL NOMENCLATURAL SIMPLICITY (UCANS)

RE: GALAXIES

There are at present too many objects referred to as galaxies. Henceforth, the term “galaxy” will be reserved for self-organizing agglomerations of at least 1011 stars with clearly defined structure and central black holes massing at least 375 million Hawking Units. All other large star clusters will be reclassified as protogalaxies, failed galaxies, or galactoids.

* * * *

DATE: MAY 15, 2927

TO: ALL IGS CUSTOMERS

FROM: YOUR INTERGALACTIC SHUTTLE (BLACK HOLE SERVICE)

RE: GALAXIES

Service to the Greater and Lesser Magellanic Clouds has been discontinued.

Direct black hole to black hole service to the Object Formerly Known as the Milky Way Galaxy is being reconsidered pending reevaluation of the core mass of its central black hole, for which the most recent data indicates a mass of only 374 million Hawking Units. Black Hole Service is technologically feasible for masses down to ten million Hawking Units, but restricting service to larger holes allows IGS to please more customers by keeping costs low.

Please remember that IGS service extends only to registered planets of properly configured solar systems in designated galaxies. Shuttle service is available for local transport, although transit time generally exceeds the average human lifespan. Please plan accordingly.

* * * *

DATE: JANUARY 10, 4101

TO: ALL INTERESTED PARTIES

FROM: THE INTERGALACTIC COMMISSION ON SUPRA-UNIVERSAL NOMENCLATURE

(IC-SUN)

RE: PARALLEL UNIVERSES

In recent centuries, the willy-nilly classification of alternative realities as “universes” has become unmanageable....

[Back to Table of Contents]

PALIMPSEST by HOWARD V. HENDRIX

How far can this arms race go?

"You think it's possible?" MéMé Gelernter asked, flicking back the blue and green tips of her blond hair as she stared out of our window.

I followed her gaze to where it lingered. Below us, in front of InterPortation's corporate headquarters, street-preachers and protesters filled the boulevard.

"Do I think *what's* possible?"

"You know. What they're saying."

"Which is...?" I said, turning away and thus causing InterPortation code to start scrolling through the information space before my eyes again.

"That God is always sending us a message we can't refuse. One we can't live without. One we shouldn't try to block."

I sat back in my chair, pulling my head out of i-space.

"MéMé my dear, I have no doubt the divine ground of all being works in mysterious ways. If that being *were* trying to send us all a message, however, even *I* doubt the message would come in the form of unwanted and apocalyptic chain e-mail."

"You don't think virtual manna is hidden somewhere in the godspam, then?"

"No," I said, sighing heavily. "And not electronic grace or web blessings, either. Our concern here is the tools, not the rules. Our job descriptions do not include pondering moral, legal, or religious questions. Back to work, please."

MéMé nodded. She turned from the window and sat down at her workstation. I stuck my head back into i-space and returned to work myself.

MéMé was too idiot-compassionate for her own good. Her heart was on her sleeve for every stray cat or stray protest ideology she met on the street. At least in i-space, her head was in the right place. She was an undeniably sharp information engineer. With her once again on task, it wouldn't be long before we finished the final filters.

* * * *

Calling it unwanted "e-mail" wasn't quite true, since it was in fact virtual mail, far more fully immersive than the old flatlander stuff. Not entirely true either, to say it *wasn't* manna, given that "manna" was the transliteration of two Hebrew words meaning "What is it?"

What the original "it" might actually have been was variously defined in the Bible as the "grain of heaven," the "bread of angels," the "meat" which God "rained down on the Israelites like dust ... until they had more than enough."

God's ... spam. Not the pink whatzit in the Hormel can—Shoulder Pork and hAM? SPiced hAM? Not the old Monty Python sketch song refrain, either. Spam, dragon eggs, and spam. The Wild Old Days. The days of high filtration percentages and low false positives. When there were no federal laws prohibiting unsolicited solicitations, no marshal to enforce the law on the electronic frontier. When such solicitations were mostly simplistic e-mails and pop-ups pushing commercial stuff—penis and breast

enlargement, generic Viagra, banned CDs. Sex, drugs, and rock ‘n’ roll.

When it first began to show up, there was no consensus on who was sending the godspam. Some claimed atheistic hackers were the culprits, while others believed it was the work of Islamo—or Judeo—or Christo-fascist terrorists. Whoever was behind it, it was much easier to block than the sly beast the commercial stuff had by then already become.

A “Jesus” here, or a “Buddha” there, or an “Allah” or “Lord Krishna” anywhere—accompanied by strange symbols, unlikely return addresses, threats of global apocalypse, personal damnation, or slime-mold status in one's next life—taken together, such were almost always a tip-off to some sort of virtual proselytizing, blockable by the most rudimentary rule-based content filters.

Then the churches objected, in the courts, that such blockers were stifling communication among the faithful. Their lawyers argued that such defenses were in fact heuristic hammers, treating even legitimate religious discussions as nails to be pounded down wherever they popped up. The tangle of issues—freedom of speech and expression, separation of Church and State, common law prohibitions against unauthorized use of another's property (computer networks, in this case)—all would take decades to unsnarl. Long before which time, of course, e-mail went truly virtual, and unsolicited infosphere communications made a huge comeback.

Attempts by legislators to attach monetary or computational costs to each piece of virtual mail—tiny sums, which nonetheless piled up into considerable amounts given the huge volumes of messages sent by the virtual proselytizers—were all eventually struck down as burdensome intrusions of State power into religious affairs.

Blacklisting, whitelisting, signature-based filtering—all failed. Too low a percentage of godspam filtered out. Or too high a false positive rate, killing too many legitimate messages. Or too hard to maintain and keep current, especially in the face of zealots willing to continually falsify their network locations.

Collaborative filtering schemes collapsed too, when user-voters failed to reach consensus on which missives were legitimate religious messages and which were godspam. Probability-based Bayesian filters, like their heuristic predecessors, fell prey to the “what is it?” factor, writ large: “Manna” and “Babel” counterattacks. In the former, godspam tended to look more and more like godless nonspam, the “sacred” hidden in the profane, the “celestial” encrypted in the mundane. In the latter, the meaningful lay buried in line after line of gibberish.

Things didn't really get worrisome, however, until wireless nanotech sensors began exchanging properties with the physical environment—and godspam began weaving numbers into stone and tree and leaf, names into steel and flesh and bone. InterPortation, which had built itself from a tiny field-sensor company to the planet's largest provider of quantum-based virtual services, saw the writing on the world first. That's when IP called in my startup company, Spamazonian Extinctions.

* * * *

Being chosen by InterPortation to create the ultimate blocker was quite a coup for us. We hyped every media contact we had—to get the word out about the project, to give it as high a cultural profile as possible. I didn't realize just how high we'd managed to build that profile until MéMé and I came in to officially oversee the custom installation of Spamazonian software on InterPortation's own systems.

I should have known something was up when they asked us to park our cars off site, a dozen blocks from InterPortation, for security reasons. As it turned out, all the streets in a five block radius around InterPortation's Sacramento headquarters had been shut down by police and protesters. Trying to make our way through and around the demonstration, we were trapped time and again in the crowds. What

really stunned us, though, was when we learned that the protest furor was about *our* project.

'"—sustaining *all things,* by his powerful word,' as the Apostle puts it in the Letter to the Hebrews," said a preacher with alpha-male, executive-gray hair.

We were trapped amid the preacher's very responsive audience, many of whom carried placards depicting InterPortation's founder and CEO, Darin Mallecott, as the Devil. This was not too difficult to do, alas. Mallecott's sharp facial features, pointed goatee, and prominent earring in his left ear only added to his reputation as a buccaneer of the business world. Perhaps it was this reputation that made his eyes and teeth seem to sparkle—with piracy at least, if not perdition.

"The *Word* is the most powerful food!" thundered the preacher. "In their exodus from Egypt, the Israelites were sustained by the instructive and testing food called manna, which God gave them to teach them that 'man does not live on bread alone, but on every *word* that comes from the mouth of God.'"

Choruses of "Amen! Amen!" sounded. I wished we could work our way through this crowd clot faster.

"It is the message itself that sustains us. Remember what it says in *Psalms:* 'O Lord, our Lord ... when I consider your heavens, the work of your fingers, the moon and the stars, which you have set in place, what is man, that thou art mindful of him?' But what is God, if we should prove unmindful of Him? Remember the words of the great seventeenth-century preacher Jeremy Taylor, who tells us in his *Holy Dying* that man 'is born in vanity and sin; he comes into the world like morning mushrooms, and as soon turns into dust and forgetfulness. To preserve him from rushing into nothing, and at first to draw him up from nothing, were equally the issues of an almighty power'!

"Those who would block God's word, who would destroy His manna, would withdraw from all of us the power that prevents us from rushing into nothing, the power that sustains *everything*—from our individual souls, to the creation in its entirety!"

More fervent amens sounded as we managed to untangle ourselves from the crowd around the preacher. As we escaped, MéMé gave me a look. I shrugged. What else could one expect from such bibliolatrous throwbacks?

The next speaker we could not escape in this mad marketplace of beliefs and ideas, and he annoyed me even more.

"No, I am not a 'philosophical idealist,'" said the young man, his face framed with wild dark beard and hair, answering over a bullhorn a question shouted at him by someone in the mob around him. "I'm a computer programmer. I don't think the universe is just a thought or dream in the mind of God. I don't think that if God woke up or stopped thinking, this would all disappear.

"I *do* believe, though, that our entire universe is a computational process, a universal quantum Turing machine running a foundational self-evolving algorithm. The quantum gravity theorists say the entire initial state of our universe could be burned into a single good data needle—that the foundational rule set in fact encompasses a fairly small amount of information."

"Then why should we worry about it?" I shouted at him, confident of my anonymity in the crowd, despite all the publicity my company had received.

"What's important," he bullhorned back, "is not the initial state, but the ongoing evolution, the iterations and elaborations. If the Spamazonian programmers block all so-called godspam—in not only the virtual world, but also the physical one—they could generate the ultimate false positive, extinguishing the iteration command, the one that drives the universal system to keep elaborating, to keep evolving, *to*

keep existing.

"Universal oblivion is too big a risk to take just so we won't have to remember to update our blocker watchlists! In computer systems, there is no memory without electrical resistance. In human social systems, there is no political resistance without memory. We must remember how dangerous this 'universal godspam blocker' may be! We must keep fighting it. We must stop it!"

MéMé actually looked concerned by the possibilities the man was suggesting. Seeing a break in the crowd, I grabbed MéMé lightly by the arm and headed through it.

"'All the world's a simulation'," I sneered to her, "'and we are only programs.' That nutball has spent too much time in virtuality. Mostly pornos, I'd bet."

Next we got jammed up in clusters of various faithful whom I recognized as chanting Buddhists and Hare Krishnas, dancing Sufis, praying Hindus and Muslims, and a particularly large group in which the men wore yarmulkes.

"Oh, I get it," MéMé Gelernter said, listening to the rabbis and their students. "They're Neo-Kabbalists."

"What?"

"In Hebrew, every letter is also a number. In Kabbalah, the ten permutations of the four-letter Hebrew name of God form the ten mythic letter-numbers of creation. Those constitute the larger set of ineradicable Names, the attributes that allow us to contemplate the divine essence."

I began shouldering a way for us through the crowd.

"Very interesting, I'm sure, but what's it got to do with our godspam blocker?"

MéMé stopped and listened a moment longer, then turned to me—that annoying look of concern on her face once again.

"They say that if what we're working on succeeds, we'll eradicate the ineradicable names. That'll block the flow of the divine power through the Tree of the Sefirot, from Keter to Hokhmah to Binah to Hesed to Gevurah to Tif'eret to Netsah to Hod to Yesod to Shekhinah, and back again, and—"

"Let me guess. The world as we know it will cease to exist."

MéMé nodded. Listening to the babble of languages around me, I shook my head.

"I'm glad I don't understand what most of these protesters are saying," I said as we passed through the last of the crowds. We waited in line to present our credentials at the police and security checkpoints. "I'm *thankful* for what happened at Babel, for once!"

For all the mad diversity of tongues and beliefs represented in the throngs surrounding InterPortation's headquarters, I could not help but realize that all those multitudes spoke with one voice when it came to their opposition to our project. As we entered the building, I was stunned anew at the superstition and irrationality to which so many of my fellow human beings could so easily fall prey.

* * * *

"I've been very pleased with your progress on the godspam blocker," Darin Mallecott told us the following afternoon. We met with him around an oversized teleconference table, in the dark wood environs of his penthouse office suite. "Your idea of treating all of information space as a 'gateway' at which you could vaccinate users' addresses and completely hide them from godspammers—it's a stroke

of genius."

"I—we—thank you very much for that," I replied awkwardly. "Not only for myself and MéMé, but for the combined staff of Spamazonian and InterPortation technicians in the basement."

"I would request only one change," Mallecott continued. "I would like you to weaken the copy-protection encryption on your work."

MéMé and I looked at each other.

"I don't understand," I said after a moment.

"I want you to make it easier to pirate the material."

"You're paying us," I said with a shrug, "and you'll own the completed work. But, if you don't mind my asking, why?"

"An altruistic act. A *mitzvot,* as Ms. Gelernter would have it. I want to help protect as much of information space from godspam as I can."

"But you already control over eighty percent of the access corridors into i-space," MéMé said. "If the software is readily piratable, then there goes InterPortation's exclusivity. It'll saturate the remainder of i-space completely—in a matter of days."

"Hours, actually," Mallecott said, nodding. "Which is precisely what I'm after."

"Why?" I asked again. Such behavior didn't jibe at all with Mallecott's reputation for sharklike business practice. The CEO glanced away at the view of the Sierra Nevada foothills, visible at a distance through the many windows. Then he looked back to us, his bright eyes glittering with the cutting hardness of diamond.

"Let's just say I'm trying to do something that will be best for everyone. It's not all about money—not all the time. If you must have a deeper reason, then you might want to consider that a particular danger has presented itself, which makes the issue of money seem insignificant."

MéMé stared at me, then at Mallecott.

"Might that danger have something to do with the godspam encoding information into the physical environment itself?" she asked.

"Indeed," Mallecott said.

"How does that encoding happen?" I asked.

"There are only theories. Some of my experts tell me this is the latest variant of a problem we've already encountered with our more advanced biological nanotech, our biotech field sensors. It's worst with the latest and smallest modular motes."

"'Motes'?"

"A network of field data sensors tinier than dust motes," Mallecott said, nodding. "Wirelessly connected. Wind and solar powered. Remotely accessible from i-space. As a demonstration project, we saturated an island in the Outer Hebrides with them. Along with researchers from Cambridge and St. Andrews, we were trying to create the fullest virtual representation, ever, of an actual physical environment. We succeeded, beyond our expectations. It appears there's something in the godspam now that blurs the

boundaries between the virtual and the physical. It has insinuated itself into everything on that island."

"It's reprogramming living things?" MéMé asked. "A biohack?"

"That's the theory most of the biotechnologists favor," Mallecott said. "But nonliving things are 'reprogrammed' as well. That's why the quantum physicists favor a different explanation."

"Which is?" I asked.

"Most of InterPortation's work involves quantum computing. Quantum entanglement and teleportation effects are a part of the way we do business. Some of the physicists who work for us think that what's happening on that island doesn't originate in our universe. That the island is being overwritten by aspects of a parallel universe."

"But how might that affect us?"

"If the process continues, our physicists think the entire universe as we know it might be entirely overwritten, displaced, but not until all the existing 'writing' on the big board—including us—is completely erased.

"Whichever theory is true, it's clear we can't allow either the physicists' or the biologists' scenario to come to completion. The infiltration has spread far beyond the island. That's why it's imperative we stop this godspam, which lies at the root of these boundary-blurring problems, in every case. And that we do it *before* the stuff infiltrates everything and kicks over into 'delete' mode."

Out of the corner of my eye, I saw MéMé nodding enthusiastically. She had bought it, which was a good thing if it kept her on task and motivated about the project. I was not as convinced. Mallecott noticed.

"You still look skeptical, Paul."

"I'm just here to do my job," I said with a shrug. "Like I was telling MéMé this morning, I'm interested in the tools, not the rules. Let the wise consider the whys of it. I'm interested only in the how."

"And from everything we've seen of the universal godspam blocker," Mallecott said, "you and your people at Extinctions certainly seem to know how. Indulge me on the copy protection issue, if you will. I look forward to the release of the final product. Oh—and tell your people we're going to throw them a hell of a party, once this is all done."

Mallecott stood then, and we shook hands with him before taking our leave. Once we were back in i-space, MéMé worked as diligently on the project as I could ever have hoped.

The product release party was a real heller, just as Mallecott had promised. InterPortation's largest employee lounge was decked out more gloriously than the best ballroom in the best hotel downtown. The reception was catered by five-star restaurateurs. The wine and champagne flowed freely throughout the evening—so freely that it was nearly midnight before MéMé and I left the building, to stagger away the many blocks to where we had parked our cars.

The street blocks, sidewalks, and plazas around InterPortation, so crowded for the last week, were now empty, completely abandoned. MéMé noticed it too.

"What do you think happened to everybody? Where'd they go?"

"Maybe they're in their churches, waiting for the end to come," I said, trying but failing to keep the smugness from my voice. "Maybe they're out getting drunk. Maybe they're all praying at home. Or

maybe, since everybody knows what time our software was released to i-space—"

"—and everybody saw that the world didn't end," MéMé said, a sly look on her face.

"—maybe they're all trying to pretend their predicted apocalypse isn't the biggest bust since Y2K."

We laughed. I checked my watch.

"Hey, according to the figures Mallecott gave us, our software should be achieving a one hundred percent block of all godspam on Earth right about now. Virtual and physical both."

She checked her watch as well and nodded.

"Just in the nick of time, before the stuff it's blocking would have infiltrated everything—if Darin was right about that too."

We stopped and stood, waiting for something to happen. Nothing did. I walked further down the street with MéMé, secretly relieved.

Until the streetlights went out. Then, clear to the horizon in every direction, all the lights of the city went dark too.

Above us, in a cloudless night sky with only the thinnest sliver of moon, the stars came out, shockingly bright and abrupt, then just as suddenly began to go out too, as if being eclipsed by the passage of an enormous dark wing.

Who was responsible for this vast erasure? Was this happening because we'd failed—or because we'd succeeded? Who had been running the great program of us? For whom? And for what purpose?

Why?

Feeling myself and all the world around me becoming insubstantial, I remembered everything—and realized, as all of it passed before my mind's eye, that if my memories were virtual mails in the big system, then the religious terms in them would be causing them to be blocked and deleted now....

Were causing them to be blocked and deleted, the instant they were scanned?

In the last of the dying starlight, I turned toward MéMé. Beyond shock or despair, beyond anger or remorse, beyond the power of words to describe, the look on her face is the last memory I carry with me into oblivion.

(Nine billion thanks to ACC.)

[Back to Table of Contents]

IN TIMES TO COME

Last year Barry B. Longyear introduced the improbable detective team of Jaggers and Shad in “The Good Kill,” which won the “Best Novella” award in The Analytical Laboratory, our annual poll in which you, the readers, choose your favorite stories for the year. It was an especially impressive and refreshing achievement, because funny work too seldom wins awards. “The Good Kill” was *funny,* with its very British future where bodies are a matter of choice (not necessarily binding) and some of the choices are—well, a bit odd. (Where else would you find a mallard and a gorilla as colleagues on the same police force?) Next month, Jaggers and Shad are back, with a new mystery in the same vein, “The Hangingstone Rat,” and I think you'll find it just as much fun.

We'll also have a wide-ranging variety of other stories by such writers as Daniel Hatch and Tom Ligon, and a fact article by Stephen L. Gillett, Ph.D. on “Nanotech Rocket fuel.” He cheerfully admits the title sounds like a science-fiction cliché carried a bit too far, but the subject is very real and timely: nanotechnology really can help us

[Back to Table of Contents]

GINGER EAR AND ELEPHANT HAIR by UNCLE RIVER

One culture's "obvious and fundamental" may be another's "strange and baffling."

Oh, children, when I imagine! It is a funny story to hear. But I do not think it was a funny story to live.

So let us laugh. And thank the Creator that we can! Indulge me a little. You are big, and strong enough now to carry full bundles. My knees have reached an age to tire. This will be the first trek so extensive for most of you, most likely my last.

It was the Late Abysmal Time. You know what that means. Whirlpools of madness, stirred by a soup too thick, of people, people, and ever more people, everywhere.

Some say it was the weight of so many people that sank the world of the Abysmal Epoch into the abyss where so many of its teeming cities now sleep. This is true, in a way. You are old enough now to understand. It is allegory. It is an image for the feeling of an event. But it is not the event itself. A cartoon, really.

You all know the cartoon of the rabbit who munches on the lettuce where Grandmother Pigeon Toe so blithely sprinkled so much cayenne. Oh, it is to laugh, the expression on that appalled rabbit's face!

The Late Abysmal Time was filled to exploding with people, and that same appalled expression was the one they knew best, in every mirror and mirrored on so many, many of each other's faces.

I was your age once, an age when I first noticed Love, half attracted, but still half silly.

So imagine two lovers, under a sickly bush, sharing a ripe pomegranate. And every time one starts to share with the other, by word or by touch, how they feel, two hundred machine wagons roar up, flashing lights and screaming motors and sticking other people's noses under that sad bush, where the pomegranate falls, startled too many times, to the dust. And the lovers, too confused by all the noise and light to remember what they feel, collapse, one in arbitrary sex, the other in exhaustion, both appalled as that rabbit with a mouthful of cayenne.

How can we not laugh at such lives? It is funny, from the right distance. Ridiculous, what they did, those Late Abysmals. A cartoon. But a cartoon of Hell. I do not think it was funny to live.

So, elephants. Elephants living in Late Abysmal Times...

In Late Abysmal Times, elephants had, for many centuries, called home lands warm as the outlaw Arizona Coast, and filled by then with people, most of them not outlaws at all, but all of them as much on edge by there being so many. And living so long in warm lands, it had come to pass that none of the elephants that then did live had a pelt of hair.

Elephants are very big. They have four legs and a trunk: a limb both nose and hand, each as large as you or even me, and a body and head to match the scale, to ride on top of all that. They have large families too.

Well, not as large as a Zionite family. But what with assorted cousins and aunts ... Think again of Grandmother Pigeon Toe's garden, or your own. A family of ground squirrels can wreak havoc, nipping off every pea vine, gobbling down every lettuce, not caring a whit for the cayenne that stopped the rabbit. A herd of javelina in the garden can make your family beggars to the neighbors a whole season. A herd of elephants could eat your garden and all the neighbors' gardens and a couple of other villages, too, in a single day and night.

This isn't a problem to us. We and the elephants live far apart. There are lots of places to live to go around. Well, we and the elephants could run into each other, or someone might, and might even fight about it if we did. But we haven't. And we don't have to.

Not so those Late Abysmals. They bumped into elephants just about everyplace where there were any. There just wasn't anyplace left in the lands the elephants then knew as home, for elephants to get out of the way of people. There just wasn't anyplace left in those warm lands fertile enough to feed an elephant and thus fertile enough to sustain people, for people to get out of the way of people, people, and yet more people, everywhere that the elephants lived.

So the elephants had to get into somebody's garden—a lot of somebodies, every day. Even if they could have lived by eating trees, the elephants, in what centuries-long had been their home country, no longer could get from one grove to the next, for enough trees to eat to sustain a family of elephants, without passing through somebody's garden. And an elephant family's snack for the road could be your whole village's crop of corn and wheat and just about everything you would have eaten that year.

Think of two householders talking.

One says: “Oh, the gophers have been dreadful. My carrot patch looks like a Public Room the day the Innkeep refuses to sell alcohol anymore."

The other might answer: “Look at it this way. The Innkeep can say, ‘At least it wasn't a quake to take down the walls as well as the tables.’”

"And maybe get Cost Compensation for the tables at that!” says the first.

"Just so,” says the second householder. “And we can say, ‘At least it wasn't elephants.’ And since it wasn't, I can say that I'm looking to have more carrots than cellar to store them, and I've already got more cellar than mouths to feed."

So, elephants in the garden. Maybe even trampling houses! Imagine the expression on the householders’ faces. Now imagine it's your family's garden and home, and your mother's face.

That's the big difference between the cartoon and having to live it.

We live in a prosperous time. Yes, we have rich years and years when most meals are not very interesting, years when our village has crops to sell and to give away and to store, and years when we depend on those crops from someone else. But we have known no real famine, anywhere that I know of, in your lifetimes or even in mine. Those Late Abysmals, for all their machine wagons to transport things far and fast, were not so lucky.

So, what to do about the elephants? Kill them all or capture them if you could? Elephants could be captured and even domesticated, especially if captured young. But they still had to eat, and they still were very big. So maybe just best to run them off, to someone else's garden ... who might not like that at all, nor you for doing it. Or run away and maybe starve.

What to do about the elephants, in all the lands that elephants knew as home, was a subject of considerable disagreement. It was the Late Abysmal, after all. Everything was a subject of considerable disagreement! Imagine the faces! Frantic faces everywhere. A cartoon indeed, but a cartoon of Hell.

* * * *

Yet there were places, even in very Late Abysmal Times, where people were few, with space between them and between their homes. Enough space, it seemed to some people of that time, for elephants.

Some of those places of few people were fertile enough. But none of them were warm year around. That was a complication. It also seems that those who did live in those places were not the same people as the ones who saw those places as suitable new home places for elephants.

Well now, we must remember, it was a different world. Were Abysmal ways always madness? Or did they only become so at the end, in the frenzy of a way that could not go on, as futile attempts to maintain life grew ever more desperate and farfetched? That the Change happened does not really answer that question. We cannot really know what life of some other time and world was like, beyond living memory. But mad or not, it was a different world. People and peoples made decisions very differently.

Consider crops. Households share knowledge and plans with the village Council. Synod members bring word to Council of what crops are planted where, and how well they do, to know who has enough or more, and if anyone is in need. And each household decides for themselves what to plant and when, whatever seems to them best for that field or crop. The best way to see that our Nation entire has enough to eat and some treats when we can? Who knows? It is how we do it.

Now suppose that, instead of carrying knowledge of who has what or needs what in Kessa, the Synod was required by law of the Nation to declare a day for each of a hundred, hundred villages to plant, what crops they should plant, and how much. While in Solvene, a dozen or so Corporate Persons vied for the influence to determine the day for everyone to plant, what, and how much. Of course, the result would be good crops some places, but widespread crop failures in others.

Crazy by the end, and perhaps from the outset, it seems to us. Yet it was the way to do things that they had. And they had to manage it somehow because doing things that way, with so much centralized decision making, was how they ever got so big, how they got to be so many. Whether they had to do things that way or not, once it became customary, their very numbers made them more and more dependent on continuing ... just as those numbers themselves became ever more a strain.

But how to manage their big, centralized way of life? Crops and quantities and who should grow what and how to transport it, from huge farms, tended by few people with huge machines, to huge cities where vast numbers more of people lived. A cartoon to us. Too foreign to see anything so huge, with such huge numbers, as anything but a frenzied cartoon. But to them it was daily life, and they had to manage it somehow.

Money was how. Money became the organizing structure. And that doesn't have to be crazy. That is why I do not know how to tell if the world of the Abysmal Epoch was crazy from the outset or only became so in the extremity of its overwhelming numbers. After all, traders and shopkeeps exchange wares and transport those wares for money, all the time. Many in Kessa and more in Solvene live by exchange for money, even if most farmers and herders use money only a little, mostly to make life richer and more varied in our prosperous time, and could live without money at all if they had to.

We do not live in a Heaven, by any means. But we do not live in a Hell either, of a world full of people, who each of us love some of, in utterly unsupportable numbers. Was the Late Abysmal's organization of everything big, and money to organize it by, crazy from the outset? Perhaps. Or maybe that was the inevitable way that they could grow so big, those people of the Abysmal Epoch, and was as sensible a way to do things as any, until they did grow too big, too many to continue.

Whatever they really did and why, the result was big crops some places and big famine other places, and a big system of management by big governments and Corporate Persons, with enormous caravans of machine wagons and huge ships and railroads made of vast quantities of steel that they had to work huge mines to have, to transport vast quantities of things from wherever they were to someplace else.

Money. It is a handy way to manage all sorts of exchange, to make life prosperous and pleasant.

But if you have to ship everything everywhere, all the time, it gets confusing. By the Late Abysmal, money had forgotten to be *how* to do things that there was some reason to do, for sustenance or for pleasure. Instead, money had become *why* to do anything and everything.

I do not understand this. I don't think we can understand it. It happened and could happen in a world so very foreign to all we know, as it had to be with so many people to sustain, and all the many things so many people both could do and had to do just because there were so many. But to see at all how elephants of our day came to have hair, we have to try, at least, to see something of how people of the Late Abysmal made decisions.

They did things big. They made decisions at big distances from where people would live with the results. And they organized both who made decisions and how to bring about whatever they did decide by means of money.

Should we see more allegory in elephants being so big? I don't know. It was a world of elephants in a way: coordinating the big.

* * * *

All the places that the actual elephants called home were warm and full of people and their gardens. But some elephants had been captured, and some of them had been taken to other places. Elephants could live in at least a somewhat colder climate.

The Barrenlands ... It is so very barren a country today because it gets no rain at all. But even with rain, it was a big, open country. A great, grassy plain in Abysmal Times, it must still have been a harsh country, with wild winds to blow across so wide an open expanse, frigid in winter, and a blazing sun in summer any time the winds stilled. We can only guess what it really was like to live there, when there was water and life that water sustained, to make it a place to live. Yet it might have been at least something like the strips of plain even now, at both edges of the Barrenlands. Why not? It was the plants and animals already there at the Change, to live on where they could, that must have given us what we will see when we reach that strip of plain, where the elephants live now, between the forested Mudo Mountains and the dust and bare rock of the Barrenlands.

Or that other strip, far to the north, between Barrenlands and wet forest of the Mississippi Coast, where the buffalo live. A goodly expanse both of them, a good day's trek to cross. Good country, it has turned out, for the elephants that live now on our side, and the buffalo at the other. How appealing it must have seemed ... to some of that day, to bring elephants to that country when that country extended, horizon to broad horizon, full of waving grasses and fragrant wildflowers, and thickets where birds sang and there was water, across the whole wide Plain of what now is lifeless Barrens, where only windblown dust traces curves of what once were the courses of streams.

There were a few large cities on those plains in Late Abysmal Times, and a sprinkling of small ones. Shards and foundation lines are all the easier to see, for lack of any covering life now, if anyone wants to go out onto the Barrens to see them. Well, it was the Late Abysmal. A small city then still was as large as Solvene, the biggest city we know, with its water works and university and manufactories and fifteen thousand people or more, all living one household and garden next to another.

But by Late Abysmal standards, those plains were mostly empty of people. And parts of them were getting emptier. Not because the land could not sustain more people was it getting emptier of people. That is not how they did things. They transported everything everywhere all the time. So what land could sustain how many people and where people lived might or might not have anything to do with each other.

It was all big decisions, which those in a position to make big decisions might make one place for some other place entirely.

But people who lived anyplace had to do it somehow. That has not changed. Just how we do it has changed. Just, then, the *somehow* was not crops or firewood or even water, but always money. So the reason why the plains were getting emptier of people was not that the land could not sustain more people, but that they had organized how the land sustained people by money, in some way that it came to require more and more land to sustain less and less people. I do not understand this, in a time when the greatest problem was too many people. But it had something to do with transporting so much of everything, and where any of it came from had little to do with how anyone lived by it.

So there came to be less and less people scattered across the plains, even as the cities grew ever more populous. But those few people who did still live there still lived by what that land produced. They just had to do it on a huge scale, a scale of elephants, to do it all for money.

So imagine what they would have said. They certainly imagined it and maybe lived it. That part of the story is not entirely clear, as all stories from the time closest to the Change become not entirely clear. But imagine what one householder of that time might have said, roaring over to some neighbor, in a machine wagon, to travel in a morning a distance we might trek in half a Moon:

"Elephants just snarfed up a hundred miles of my wheat!"

"They ate the pasture my sheep could have grazed for fifty years!" the neighbor might reply.

It was that sort of world. Such enormous quantities and neighbors such distances apart, living by all the land between, even if no people lived on it. But that herder didn't really have fifty times enough pasture to graze her sheep for the year. That is what the quantity would look like to us. What she had was so much pasture and so many sheep that she had to tend fifty years worth of grazing all the time. It had become entirely incidental to raising sheep that they produced mutton and wool. The only thing that mattered, in sheep as in anything, was producing money. By then, the only way to make money from raising sheep on those plains was in huge quantity, and only someone who could make money at it could live by herding sheep at all.

A problem indeed elephants would be to those who lived both where and by the places the elephants would go. But those people were few. And whether or not it mattered to anyone's sustenance in the cities of that time, scattered but big and ever bigger, if those few people on the plains did raise wheat or sheep or not, their concerns in living where and how they did live on the plains did not matter to how and where decisions were made.

This does not mean that they could have no ... influence. Perhaps the Solvene concept is as close as we can come to understanding how they did things, though I think even that must have been very different in a world where the people vying for influence mostly did not know each other, to see for themselves who they affected and how. But for just that reason, of big and distance, any influence that anyone had, they had in their Temples of Council, in a world where Council was required to decide everything, by decree, for everyone. Madness? We hear tales of how grumpy most Synod members become whenever the Synod must shift from the congenial job of exchanging information of conditions of life, in this part of Kessa or that, to decide anything. Could those who came to Council in that Abysmal World be anything but mad, perpetually grumpy and harassed, required to decide and decree how everyone should live everywhere all the time? Or was it in some way a satisfaction to them to do the job, to coordinate their big world at all?

I do not know how to tell what it was to them to do things as they did. But we do know that they made

decisions at a distance, on a big scale. And the Montana legend, that we of Aztlan already knew, affirms the Cherokee tale we have learned only more recently, that someone, somewhere, came to a decision that elephants on the plains would be a good idea. But there was a problem. Winters on those Late Abysmal Plains were too cold.

You all know the saying: “Elephants are born old because their hair is gray.” But that saying, traditional now, was new when I was your age. It is still within living memory, from the youth only of the generation old when I was young, to tell my generation first hand, that people in Aztlan had anything to say about elephant hair.

There were pictures, it is said, in some of the books in Solvene's lost Degna Library and in the Library at the Monastery of Saint Jude The Miraculous that the Cherokee knew. But even when first we knew of elephants still living, when they fled the fall of Ozark up the Arkansas River, to the wide strip of plain that they now call home, we did not know to think one way or another of their having hair. It is only in the years since, as we and the Cherokee have gotten to know each other, that we have learned what those who once saw the pictures in the pre-Change books of the Degna Library assumed, to describe what we thought was an extinct creature, to say that Abysmal elephants did not have hair. We now know that it is true. They didn't.

It is Cherokee scholars, as well, who have pointed out what an irony it is that elephants, able to live at all in cold country only because they do now have hair, lived so long in Ozark's wet forest. Ozark does have cold winters, but it is not the country the elephants were bred to have hair to live in. Elephants, too, know Millennium's cleansing the more achieved in Ozark's end!

Here is what we know now of what happened, some from the Montana legend, but most of the real knowledge from the Cherokee scholar, Ismail Red Fox.

* * * *

There was, in those days of the Late Abysmal, a great University of the Arkansas. It was only one of many universities then. But it was one that had enough influence in that world where influence did things so big, to achieve a contract known to Ismail Red Fox's study as the Kamchak Forest Contract. Even in Solvene, with its governance by influence and its Corporate Persons, I never heard of the University operating in its own right as a Corporate Person, to contract for things. But I think that must be how the Kamchak Forest Contract, which the University of the Arkansas obtained, must have been possible.

Actually, the Cherokee call Kamchak by another name. So to them, it was the Sibir Forest Contract. But we may as well use the Aztlanian name, since it is the one we are familiar with. The name is not so important. The one thing about the place itself that it is important to remember is that, unlike Aztlan, and far more than Cherokee or Ozark, far more like Greenland, that country we know as Kamchak, and which the Cherokee know as Sibir, changed climates a lot at the Change.

But a contract. In some ways, this contract between the University of the Arkansas and ... some enormous, and perhaps temporary, combination of several governments and Persons, both individual and Corporate, was a contract we could recognize. Like a Kessian or Solvene contract, it said that some party would do something in exchange for something that another party did. Complicated indeed with so many parties, on so big a scale, involved. But the exchange was an exchange as we would know it. And it should surprise no one, with so big and complicated an exchange, that all concerned designated who received what for doing their part in money.

In that way, it was not all that different from a Kessian trader, bringing woolen goods to Solvene and coming back with steel pump gears, who needs the warehouse in Kessa City refurbished, to store those gears. The Kessian carpenter might not need pump gears this year or next, so the Kessian trader sells

gears to someone else for money, and contracts with the carpenter to pay for the work on the warehouse the same way.

That part of a contract, that says who will do what and that designates pay in money, we might do the same. But there are some differences between the world of the University of the Arkansas' Kamchak Forest Contract and any contract we would know, every bit as determining as the difference in number of people. With so many people, and with the centralization of decision making that their world had grown accustomed to, and therefore required, to keep anything so big going once it got so big, who decided what, and how, and therefore what got done, and who got paid how much for doing any part of it...

Why people of that world really did what is just utterly foreign to us. In a way, as crazy as Ozark, or so it seems to me, if more subtly so, to have lasted long enough to grow so big. Yet...

Some saw the coming demise long before it arrived, even if no one could have known beforehand that the Change would happen as it did, or even when. We have, even today, some record and much tradition, in Aztlan and Cherokee, Puget, Algan Green, Kamchak, too, for that matter, to know that some Abysmals did see the coming of an abyss into which their world must plunge. Some believe that it must not have been apparent until it was too late. And that is why it became so crazy, trying to keep a way of life going, that everyone needed, which those most capable to keep it going knew all too well that, ultimately, they could not ... And tension grew ever greater as "ultimately" loomed ever closer. But that is hindsight. Even for those who did know that their ways could not go on, none knew that the Earth would tip as it did at the Change, to end their world so abruptly and so thoroughly, for ours to descend from.

So was the Abysmal World crazy from the outset or did it only become crazy in face of doom? Or is it only we who call it crazy because it was so different and we know that it really was doomed? I don't know. But by the Late Abysmal Time of the elephants, I think it had gotten pretty crazy. And even if it was not, it certainly was very different.

Differences in climate, in any circumstance, are just facts to know, to make decisions about. Kamchak, then, was in the Northern Hemisphere. More important, it was cold and had been cold all the time since before the Change that ended the Abysmal Epoch and began our own. Fine. But decisions are a mix of facts and what facts matter to us, how and how much.

That Kamchak Forest Contract, which the University of the Arkansas on one side and some vast consortium on the other undertook, had to do with logging, mining, fishing, and various such practical endeavors. Yes, I know, we of Kessa don't know mining as a practical endeavor. But they did, and there are some who do even today. Besides, they needed it. It is just because there were so many of them that we have enough archae steel to rerefine.

What the University of the Arkansas contracted to do in Kamchak was to conduct a study of what was there and to draw up a plan for ... well, whatever it was to them, we know a name for what they intended, only in Aztlanian translation from the Cherokee, itself a translation from the original. And for that matter, I think that there were several Nations involved in that original, and that may well have meant several languages, and I don't know if they all understood the same thing by what they called their purpose! Whatever it was, what we understand as the purpose of the study the University of the Arkansas contracted to conduct, and the plan that study was to produce, was something we translate to mean, "sustainable yield."

So far as Ismail Red Fox was able to tell from the records he then had available in the lost library at the Monastery of Saint Jude the Miraculous, those Abysmals did make a serious attempt, by their own lights, to determine what "sustainable yield" for Kamchak might be. According to Ismail Red Fox, the original

document began with a preface that made quite a fuss about what an important new development all of this was.

In a way, it makes sense. Like the Kessa-Solvene border dispute and the brawling in Waystation Public Rooms on the Five Sun Mountain Trail, with rapid communication to complicate questions of who should pay for its maintenance to know what is happening more quickly ... or not, and even occasional intrusions on Zion. Lots of people and even several different Nations involved in any decision! The Synod had to call new members even to rouse itself to consider the questions, all tangled as they were. And grumpy as it made most Synod members, it was just because big, tangled questions were involved that the Synod had to consider it at all, for there to be someone to speak for the Nation entire. When *everything* was big, and there were so many people, zooming about in machine wagons and air cars and with several different kinds of rapid communication!

Perhaps we should admire the audacious skill of those Abysmals, even to try to sort out questions of how to do things as big and complicated as they did. Yet there is an underlying element in the very structure of how they decided anything that looks to me just plain crazy.

"Sustainable yield." That meant quantity, but how to measure quantity of logs and fish and machine wagons to haul them? When those Abysmals said, "sustainable yield," I think they meant two things. "Sustainable" meant that whatever they were measuring continued to exist. But "yield" really meant money because it was the only way they had to record quantity.

Each thing that they measured had value, regardless of quantity—regardless of money. Ismail Red Fox wasn't sure why the Abysmal text made such a point of this. He believed that it mattered to some of the parties to the contract a lot, perhaps not to others. Were the people at the University of the Arkansas taking sides in a dispute of their time? We have no way to know. But whatever they thought mattered most, they still had to measure quantity, of what was there and of whatever anyone did with it. And the way they had to measure quantities of all these different things and endeavors was to do it in units of money.

There was lots of fuss over whether it mattered that a "yield" of something—this much or that much, some or none, of timber or a kind of fish—was sustainable or would make that thing, or some other that needed it to live, cease to exist. It is a fuss rendered altogether irrelevant to us, by the Earth tipping over at the Change, to end their world and heal to ours.

Still, we can sympathize. What they did may have been crazy. But the problem they were up against, of their own numbers crowding each other and everything else besides, was all too real. Would it make us any less crazy? We can be thankful not to know. What we do know is that along with big fusses and big projects and big studies to fuss, decide, and do anything, the very size of the Kamchak Forest Contract, and of the parties to it, left lots of small projects that got sucked right into the big one.

They did things that way. Maybe they had to, being so many. As a village must allocate fields and irrigation water because there may be only so much within handy walking distance, and as two nearby villages may have to decide which one has claim to one fertile bit of bottom. It was to settle just such questions that a lot of villages petitioned the Synod of Kessa to join the Nation. We don't really know what it was like when there was no Nation, and disputes turned to blood feud, and many who called themselves Kessian as People lived by raiding. No more do we know what it was like to those Abysmals, so many that there was no place left to plant a bean field or pick up sticks of firewood that someone else did not have use for too.

Was their way of designating at the outset in a contract *who* was to decide everything, instead of whoever was around figuring things out as best they could when they came up, as sensible a solution as

they could manage to the problem of their numbers? Or is it only we who see their numbers as the subject because it so obviously is the subject of everything they did, from our view? All we really know is that that Kamchak Forest Contract designated who was in charge of what. Maybe that quelled some disputes before they got going.

Study and money. Who got what money to do what. For a lot, we don't know why. But we do know that the contract said that the University of the Arkansas got flesh from any frozen ancient creatures to study. And we even know a little of why. It was about elephants.

* * * *

A certain Dr. Siltzer—Ismail Red Fox even found a name—was a person of influence at the University of the Arkansas, and this enabled him to include things he personally wanted in that contract. Dr. Siltzer knew that there were frozen elephants, or rather their thick-haired ancient relatives from a cold land, from the world before the world the Change was to happen to, that ended Dr. Siltzer's world and left our own. He knew that there were frozen hairy elephant kin in Kamchak.

Dr. Siltzer was one of the persons who ... spoke for...? decided...? had something to do, at any rate, with determining what made the contract acceptable to the University of the Arkansas. Amid all the big studies with big hopes for "sustainable yield," it was he who made sure that a small section on frozen ancient creatures "authorized" the university to "conduct scientific study" on flesh of any well-preserved frozen elephants that turned up in Kamchak. Several other universities, including some in Kamchak itself, were to get pieces of frozen elephant flesh to study too. But the important thing that this Dr. Siltzer got into the contract was the definition of the word "authorized." It included a quantity of money to do these "scientific studies."

Dr. Siltzer was able to write this little provision into the huge contract because everyone in his world, including the University ... functioning as a sort of Corporate Person, measured everything in units of money. But the record he left, that Ismail Red Fox found at the Monastery of Saint Jude the Miraculous, also made it clear that Dr. Siltzer included a budget for elephant study because he personally wanted to recreate hairy elephants.

Did many people want hairy elephants? We know that some did not. Farmers and herders, on the plains that now are the Barrenlands, did not. They didn't want elephants living where they lived and made their living, at all. So was it like a decision that the Synod of Kessa might make, grumpily, to settle some dispute as best they could? Or a decision that some Solvene Administration might make, sadly or gleefully or whatever the mood of the moment was in Solvene, to do what someone of influence wanted, even though someone else did not want it?

I don't think so. I don't think it was quite like any decision, of what to do when people disagree, that we know. There were so many more people in the Late Abysmal. People made decisions so distant from others who those decisions would affect. Was it corruption to them as it would be to us? The Cherokee text that now preserves what we know of the lost Abysmal record makes it sound just matter of fact. Dr. Siltzer somehow was in a position in his own world to include an elephant budget in the contract just because he wanted to. He wanted to recreate hairy elephants.

Did Dr. Siltzer and others involved in the contract not know about the farmers and herders on the plains, where the hairy elephants were intended to live, who did not want them? Or is it just that Ismail Red Fox didn't know about them, as the Cherokee did not know then of the Montana tradition that we know, and we did not know elephants still lived at all, until we and the Cherokee got to know each other at the same time as the fall of Ozark and the loss of the Saint Jude library? All we know is that Dr. Siltzer was in a position to include an elephant budget for the University, and that it was customary in his time to make such decisions at a distance from where and who the results would affect.

So we don't know how this decision was reached. Was it the settlement of a dispute or was it a decision at such distance that the people who made the decision didn't even know that others objected? What we do know is that what Dr. Siltzer wanted to do was to recreate those ancient hairy elephants and how he had in mind to do it. What he was looking for was frozen hairy elephant flesh with cells—those little bits of life we can see under a strong lens that make up all living flesh—intact enough to be viable. Better yet, intact reproductive flesh. Then he wanted to put the pieces of this ancient hairy elephant flesh together to create an embryo that he could quicken and plant it in an elephant of his own time, to gestate.

This did not work. They did find plenty of frozen hairy elephant flesh in good enough condition to study, but nothing intact enough, after a whole Epoch in the ice, to quicken.

What to do?

It is not known in current Cherokee records from which we know most of this story, where the idea of relocating elephants to the plains, of what now mostly is the Barrenlands, came from. Only that the people at the University of the Arkansas picked up on the idea from someone else. It is another defining, if confusing, feature of the Late Abysmal, a brief historical moment different even from most of the Abysmal Epoch, that they not only had so enormously many people. But it was also only at that brief time of the Late Abysmal's suffocating numbers that those vast throngs of people all had a dozen kinds of rapid communication. What a frenzy it must have been!

So we don't know where the people at the University of the Arkansas got the idea to put any hairy elephants that they might recreate on the plains. But as decisions got made at big distances, so too did ideas travel from one spot to some other far away, perhaps without any communication with people between. What the record we have translated from the Cherokee does tell us is why the people at the University picked up on the idea. It justified continued “study,” which really meant that it justified a continued budget: money to do the “study."

This is where the story gets strange. It was because Dr. Siltzer wanted to recreate ancient hairy elephants and had sufficient influence to include his personal desire in the contract that the University of the Arkansas ever began such a “study.” But money itself apparently had more influence than anyone's personal desire, or any other consideration that we would call practical. To them, money was not a way to make it more convenient to transfer what people needed to live from one place to another and, in prosperity, what else they might want. To them, money itself was what people needed to live on! So by the time that Dr. Siltzer's original idea to recreate ancient hairy elephants had sufficiently failed that it no longer justified a continued budget, that budget itself had become the reason to continue the “study."

"Study.” It is what the people at the University always called it. But thanks to Dr. Siltzer, that “study” always did mean actually bringing hairy elephants to life. He wanted to recreate the ancient ones. That didn't work. He hated what his project turned into, which eventually did work. But by then the budget, “funding,” had become the central purpose of the “study,” because that “funding” supported so many people and whatever equipment it took for them to conduct their “study."

Dr. Siltzer wanted to bring back the ancient hairy elephants of the world before the world of the Abysmal Epoch. Visionary or fool? Or, as I incline to suspect, visionary half mad, living in the time he did. After all, as we know and he could not, some life, plants at least, such as Greenland frondy redwoods, do seem to have come back from that world of two Changes ago. The warm lands that elephants called home in the Late Abysmal were too full of people. Maybe there was room for elephants in colder places if there were hairy elephants who could live there. Was that a good idea? Did it matter if there were elephants or not? I don't know how to tell, and what records we've got give us no real answer.

But those records did make clear that if the rebreeding attempt ended, so did its budget. The people

working on that project needed money to keep coming to it because that money was the way that they had to live, as well as to do their work, regardless of what else that work might or might not be good for. Money as means, metamorphosed to money as purpose unto itself! As much as we can understand, that seems to be a big part of how the Late Abysmals understood their own motivations.

Dr. Siltzer hated the idea for hairy elephants that did turn out to work. Because it was ... not pure? Not natural? We turn him into a cartoon, calling how he felt by names we have for it. But it was a serious matter to him. A wound to his soul, in service to duty to those who depended on him.

Mad or not, and corrupt or not in writing a personal desire into that big contract, Dr. Siltzer also had a sense of integrity. Perhaps many did. Perhaps it was only the circumstances of the Late Abysmal that were so different. People may not have been all that different from us, for all that so much of what they did in that frenzied time seems so much a cartoon. So even when his desire to recreate ancient hairy elephants turned to the ... Ginger Ear instead, which he hated, he “authorized” (the word that the record Ismail Red Fox found used, as best we understand it through two translations) and supported his colleagues in their continuing hairy elephant project.

Crazy those Late Abysmals may have been. And doomed we know that they were, and at least some of them seem to have known it too. But they were not primitive. They could do many things that we cannot. They had to, to sustain so many. But they also could, just because they were so many, to do so many things, and the many parts of big, complicated things. We are surely better off than they, not desperately crowding up on each other. But there are many things that we might understand, but could not do, just because there are not enough of us to do the many steps it would take ever to get to doing those things. We see the Late Abysmal as a time of chaos and looming cataclysm. But for them, it was daily life, and there were many very complicated things that they could do, just because they were so many and lived in a late time of their own world, which had had time and people to build the many necessary background pieces to do complicated things.

Dr. Siltzer's original notion to recreate hairy elephants from the flesh of ancient frozen ones may have been crazy. But considering what those Late Abysmals at the University of the Arkansas were able to do, maybe not. It didn't work. But they were able to learn enough from the flesh of those frozen hairy elephants to do ... something, to elephants of their own time.

Ginger Ear. If that means something in Cherokee, it has gotten lost in the translation to Aztlanian. But Solvenes, who work with metals and chemicals so much more than we Kessians, to make sense of what Ismail Red Fox understood in Dr. Siltzer's record, believe that what it did mean to the Late Abysmals was that someone knew how to find the right chemicals in the cells of elephants’ skin for their bodies to tell themselves to grow hair.

They tried first to insert the chemical instruction from the flesh of a frozen hairy elephant. This did not work, but it did ... something, hopeful enough that Dr. Siltzer believed that further attempts might work. He was at least less unhappy at that prospect than the other one, the Ginger Ear, which was tried at the same time and which was the one that finally did work.

Elephants are big creatures. They eat a lot. A problem, if wild, if there is no place where someone's garden is not in their way. Elephants can be domesticated though, and some were, during many centuries of the Abysmal Epoch, and for that matter, in Ozark to follow, to set out with the Ozarkers up the Arkansas into the Barrenlands, where Ozark met its end, and the elephants found their way to the plain that now is their home between the Barrens and the Mudos. Mad as Ozark was, the Ozarkers were not devoid of all skill. But to keep domestic elephants takes a lot of effort ... or expense, to feed them. As well, elephants, like most big creatures, breed slowly.

Had Dr. Siltzer and his colleagues known that the Change was upon them, who knows what they would have done? What they did know was that their budget required them to "make efficient use of resources." The way that they did this was a sort of mathematical evaluation of how probable it was to accomplish what they were trying to do by doing it one way or another. What their mathematics told them was that, as many elephants as they had, and as slowly as elephants breed, the most efficient way for them to try hairy elephant ideas was now to try two at once.

One method was to insert chemical instruction from the frozen hairy elephants. The other was to mix up their own chemicals for a "Ginger Ear" instruction to elephant skin to grow hair. We sort of can understand what they did, for all that we have no way to make the equipment to do anything of the sort ourselves because we have nowhere near enough people for any likelihood that we would get to making the equipment to make the equipment to make the equipment. Like plumbing. Some of you have sunlight heat pools and pipes to bring both hot and cold water right into the house. Others still haul water in a bucket and heat it on the fire. It just takes a while to get enough else done to get to something complicated. A sunlight and pipes and maybe a pump, and time to dig and to build.

We don't have enough people for the industrial base ever to be likely to do something like that "Ginger Ear" that gave our world hairy elephants. But we can understand, more or less anyhow, what those Late Abysmals did. They had equipment that let them take out the bits from living creatures, including elephants, to make embryos that were viable, and to keep those embryos alive in their equipment long enough to insert their "Ginger Ear" chemical instructions into them. Then, they could put the embryos back into elephant mothers to gestate.

Equipment that could sustain a viable embryo sounds impossibly complicated and expensive to us. But what was expensive to them was keeping the live mother elephants. So they tested for safety first, even if that killed lots of embryos in their "Ginger Ear" equipment. Then when they were pretty sure they had something that wouldn't kill their expensive stock, they put the best embryos they had into their mother elephants and waited to see what would come to birth. And because that mother elephant stock was so expensive to keep and gestation took so long, they tried it both ways at once: chemicals from frozen, ancient hairy elephants and "Ginger Ear" chemicals they had mixed up themselves.

Two years later, most of the mama elephants with the hair instruction chemicals that the scientists at the University had mixed up themselves gave birth. And most of their babies had hair. A fair number of the elephant mamas with the embryos that had frozen hairy elephant hair instruction chemicals also gave birth, and most of those elephant babies lived too. But none of them grew hair.

* * * *

Dr. Siltzer was devastated. He wished his colleagues all the best in their continuing efforts. He gratefully accepted some sort of station called "early retirement." Whatever else that meant, it seems to have meant that he stepped aside from his position of influence at the University of the Arkansas, gave up his project entirely, and was paid some sort of money pension in exchange for going away. Not how we customarily do things, since so many more of us have families than depend on money. But a way not all that foreign to us, I think, if it came up.

Hard to tell, really. Not only were the Late Abysmals' sane ways, that any human being had to live by to live at all, all mixed together with the Late Abysmal madness. But some of their ways, sane or not, are foreign to us only in circumstances, while others are foreign to the point of incomprehensible, in attitude.

Well, Dr. Siltzer was devastated that the "artificial," as he called it, "Ginger Ear" method to produce hairy elephants was the only one that worked. Why mixing up the "Ginger Ear" chemicals was any more artificial than chemicals from flesh of an elephant frozen twelve thousand years, who knows? But why ever he felt as he did, Dr. Siltzer took his leave from the University of the Arkansas, took his "early

retirement" pension, and took his personal copy of the record he had kept of his work, with lots of explanation of why he did what he did. And then he did retire, to the Monastery of Saint Jude the Miraculous.

Then the Change happened.

Where or even what the University of The Arkansas was disappeared from memory, perhaps into the actual abyss of the Mississippi Sea, where once there was inhabited land, perhaps just into the abyss of the Terror, of the horrible quakes and unstable weather that made whole centuries following the Change so unhealthy. But the library at the Monastery of Saint Jude the Miraculous survived those centuries, for Cherokee scholars, Ismail Red Fox among them, to study, before the outbreak of madness among some Solvenes of our own world, in face of Ozark madness, destroyed it too. And while that library did survive, Dr. Siltzer's record was one that could be studied because it was one of the better preserved, quite likely because it already was there, packed in a box, when the Change happened.

By the time there were Cherokee scholars and wholesome times for such studies, Ozark already was Ozark. The Cherokee knew that there were elephants in Ozark, but knew what they looked like only from what little they heard of them from the Ozarkers, with whom the Cherokee did not get along ... as no one could. So Cherokee knowledge of elephants was second hand, and they might never have gotten around to checking Ozark descriptions of elephants that said their elephants had hair.

But those scholars who visited the Monastery of Saint Jude the Miraculous, while its library still existed, did see an occasional picture, as well as description, of an elephant, in a pre-Change book. You didn't need to be very fluent in pre-Change English to see that the elephants depicted did not have hair. And if you could read the text at all, you also knew that Abysmal elephants were native to a warmer climate than Ozark. There were Cherokee texts, just as we have Aztlanian texts, which mention elephants. They were remarkable creatures, to remember even when we thought them extinct, the more for the Cherokee who knew that they were not.

So when Ismail Red Fox happened on Dr. Siltzer's record, he not only read it with interest, but he made a translation of parts and used it to write a text of his own in Cherokee: "How Elephants Came To Have Hair." Several copies of that Cherokee book existed at the time of the loss of the library at Saint Jude. Now it is among our most complete records of any specific event of the Late Abysmal.

And for all the loss of both the Saint Jude library and the Degna Library at Solvene University, and the outbreak of madness that was Ozark and our encounter with Ozark ways, we have gained too. For what the Cherokee knew from Ismail Red Fox's record and what we knew from the Montana tradition, increase all our understanding of both.

It is from the Montana alligator swamp country that the tale has been passed down, of a rich, but harsh Plains country of Abysmal Times, what then was east, now north, of the coleus and philodendron alligator jungle. It is a tradition remembered in Montana because it is a tale of romantic heroism, of a fight against rulers both crazy and corrupt. Though the ending of the Montana tale is ... confused, I suspect, because the Change intervened. Did this affirm the righteous cause or just end the world in which the heroic Montanans fought their oppressors?

There are several versions of the Montana tradition, some saying that elephants actually were set loose to ravage their crops and pastures, others saying that their farmers and herders, few though they were, successfully fought off the wicked scheme right up to the Change. Whether any elephants were introduced there or not, no elephants survived the Change in Montana.

But elephants did survive the Change in Ozark, for that Cherokee scholar, Ismail Red Fox, to notice Dr.

Siltzer's record of how they came to be hairy. And now the elephants live on a stretch of plain a good deal more like the land they were intended for ... perhaps designed for ... than Ozark ever was, with Ozark's wet coastal forest on its peninsula in the Mississippi Sea. Perhaps that is what “Ginger Ear” means: creatures that people designed.

Oh, children, you are at the end of the time in your lives when anyone will call you “children.” You are at the age when you soon will be making up your own minds what is what and what to do about it for most of what sustains you. You are at the age when it soon will be you who there is to figure anything out.

You will not see anything as foreign as the Late Abysmal or, for that matter, as Ozark. And I, for one, am thankful not to see anything that foreign in that way. I believe you all are mature enough to understand that it is a privilege for you to make the trek to see the elephants. There are many your age as physically capable and as competent in skills, who might like to go, too, who cannot because they are needed for crops and herds or a family business.

But if nothing as foreign as the Late Abysmal, you will see foreign ways on this trek. At Arkansas Lake, you will meet a smaller People than we. They will offer us hospitality. They can continue to do this only that we remember that they are too few to feed so many as we very long or very often.

Solvene, too, will offer us hospitality. There our number will not matter. They are many, in the greatest city of our time. They could readily feed us all indefinitely, so long as we offer something back, of goods or effort or money or ideas, stories and art, too, if we have some that they want. Solvene is a prosperous Nation as we are, and if a smaller Nation than Kessa, a city next to which Kessa City is just a bustling village.

But in Solvene, you will encounter ways very different than ours indeed. Most of you have met Solvenes. We find them volatile, and they can be pushy and are far more so among themselves. Those who travel to Kessa respect our hospitality ... or don't stay long. And I want us all to be able to stay in Solvene and to return there if we wish or have occasion to do so.

We do not need to pretend to be Solvenes, as they do not pretend to be Kessians. But as you apply skills you have learned on the trail, and as you contemplate the strange history that gave our day elephants at all, hairy or any other sort, to live on the plain north of the Mudo Mountains above Arkansas Lake, let us also learn to meet the foreign.

Snows are nearly gone now on the Five Sun Mountain Trail. It will be time to set out, at daylight, three days from now. It is time for you to pack your bundles and say your good-byes. You likely next will see the apple trees now just budding too late to help with harvest. Few of you have been away from home, let alone away from Kessa, that long. And if deep snow comes early this fall, we may even have to winter over in Solvene on the way back.

And yes, your families have ... funded ... a party. Tomorrow at Sun slipping among the trees. That way, you will have a full day left to recover and to finish packing and for saying good-bye before we set out.

(EDITOR'S NOTE: This story takes place in the same universe as the novel Ever Broten, *forthcoming from Zumaya Publications.)*

[Back to Table of Contents]

VERTEX (A STORY OF THE BLACK HOLE PROJECT) by C. SANFORD LOWE & G. DAVID NORDLEY

* * * *

Ilustration by William Warren

* * * *

Anything unique and powerful can be very useful—but different people will see different uses for it.

About eight billion years ago, Shiva had been a Neptune-sized planet circling a newborn M3 Star. But stars lie close at the time of their birth, and within a couple of million years, a neighbor passed near the fledgling planetary system, perturbing it.

Nothing happened immediately, but as eccentricities waxed and waned in chaos, it moved closer to another world until, a hundred million years after their formation, they swung around each other in one final mad gravitational embrace and flew away from their former orbits. One planet dropped in toward the star, and the other fled outward with a few remaining moons to wander forever in the endless night.

In 2206, astronomer Chanda Rae found Shiva on a trip from UV Ceti to Ross 248 that passed near the center of the tetrahedron of stars chosen to power humanity's greatest experiment in physics. She took some deep infrared images and judged the lone planet's moon system contained enough lithium and hydrogen to supply the fusion reactors needed for starship operations. She named the lone planet "Shiva" and the outer moon "Vertex," in hopes that Dr. Zhau Tse Wen's project staff would find it a suitable place for their collision.

They did, and eighty-two years later, one by one, four billion-ton iron rods were being pushed by streams of relativistic pellets toward the most precise and energetic implosion ever arranged by human scientists. The result, they hoped, would be a micro black hole—the mass of an asteroid crammed into the volume of an atomic nucleus.

* * * *

Chapter 1

The Barrel, a space colony orbiting Luyten 789-6B, 18 September 2274 SST

Hi Mom, I got fired. Went walking on a virgin kuiperoid without asking and it turned out someone else was supposed to get the honor. What bullshit! But guess what? Hilda talked me into taking charge of the impactor launch at Lacaille 9352!

Katherine Avonford, sunning on the beach, grinned as she listened to the bioradio net message from Elizabeth. Her youngest daughter was far too much like her mother for the bureaucratic confines of the Solar System.

The full-spectrum artificial sun of *The Barrel* wasn't quite the same thing as a real sky, with nothing but air between her skin and a real star—but for a tan, it did much better than the mainly infrared light from the M-star, "Big Red," that fell on the outside of the space colony.

She'd gone into space when it was "Luyten 789-6B," the largest of a young triplet of nearby red dwarfs, but the old Earth-based catalog names were used less and less. Some of the new names were her doing. As the captain of various starships, she'd planted three colonies, including this one. Out here you could build a space colony and be *free!* Now Liz was out here, too.

She glanced sideways up the beach; from her sand-level viewpoint, it was hard to tell she was on the inside of a rotating barrel rather than on a planet. The far shore of the equatorial sea was at least a kilometer away—barely a light line in the mist. Hazy clouds, lit by the artificial sun, covered the opposite side of the colony. She might be on a Greek island.

This is pretty, she mused. The habitat was done; the colony was planted and ready to be lived in. She came here thinking it was time to give motherhood another try and maybe get it right this time. Why then were the vast empty reaches of space calling her? She wrestled with her thoughts.

The Black Hole Project was part of it. Someday, with tame black holes to power them, starships might range through space independent of the beams needed to push them in the present era. Both of her older daughters were now part of the project, and she was bit jealous.

...as you read this, I'll be on the C. E. Singer *on my way to launch a piece of history and maybe pick up a squeeze.*

Oops! Kate thought. The *Singer* was Pete DeRoot's ship. A brilliant star captain and leader of the first crewed expeditions to Barnard's Star and Ross 154, he had a dark side that was only whispered about when women who had starfared under him got together. A starship captain was a minor deity when light-years from any threat of correction. Power corrupts, Kate thought ruefully, and she'd had her own temptations. DeRoot liked power. On top of that, Liz was headed for a colony governed by the equally power-hungry Aussie, Roger Gunheim, and his mistress, Cyan Mutori—and Liz would be displacing Cyan on the Black Hole Project.

Kate sat up. The grass no longer felt like an enjoyable luxury. What was Liz getting into?

* * * *

Uneasy weeks followed, made no less uneasy by the knowledge that because of lightspeed delay, what had happened had already happened.

Hi Mom. DeRoot thinks he's a Casanova or something. I had to play up to him for a while, but my friend David helped me turn the tables, so that DeRoot shouldn't be any further problem. But what a disagreeable experience! Also, I understand that he and the System Council Chair at the Lacaille 9352 System—they're calling it Campbell now—are very thick and DeRoot's anger could be a problem for me there. I expect to be able to handle that. Meanwhile, David is a lot of fun, when he isn't being too *principled.*

Kate ran her fingers methodically through her long flowing hair as she scanned the other messages. One of the problems with living a very, very long time is that the stories live a very long time too. Cyan Mutori and Gunheim went way back and had as prickly a relationship as the one she'd had with Liz's father, Wotan Kremer. Cyan was every bit as ambitious as Gunheim, if a little more subtle, and loved to play with fire.

But Liz would have to handle them without any help from her. The impactor would be launched and on its way before anything she said would reach Campbell. Would her daughter stay there? No, she would probably head to Vertex to see what happened.

Maybe, Kate mused, she should go, too.

* * * *

Over the next two months, Kate's worries subsided. Liz wasn't any better than most children in keeping a parent informed, but usually, no news was good news. On the morning of the fourth celebration of *The Barrel's* "Suits-Off Day," Kate had a speech to give and woke early to get ready. As she stepped onto

the shower platform and selected the standard program, she scanned on through the messages and smiled when she got to a message from Ivan Marenkov. Ivan had been her engineer on the *R. L. Forward* a hundred and twenty years ago.

Yo, love. Hope you are enjoying yourself at Big Red. We've got word that your daughter Liz is due here in a few weeks to supervise the BHP launch. Roger Gunheim's been paying a lot of attention to the BHP lately, wandering around asking questions like he was getting set to buy one. Or knowing his character, maybe steal it, if he could get away with it. Ha ha. Slim chance. Anyway, the good news is that people are a little sick of his act and just waiting for the next election. By the way, I'm single again if you're thinking of coming this way. The times with you were the best. Love, Ivan.

Kate smiled and shook water out of her hair. The drying cycle took over, and warm air gushed up from the grill. Gunheim? Stealing a black hole? Knowing Peter DeRoot's ego, Kate found the idea nowhere near as humorous as Ivan. Zhau Tse Wen was a dear, sweet man and extraordinarily competent in everything. But he had too rosy a view of human nature.

Stealing a black hole was an outrageous, absurd idea, but with DeRoot and Gunheim reinforcing each other's megalomania, it wasn't completely impossible. Well, at least if they wanted the black hole, they wouldn't interfere with making it, so maybe Liz would be okay.

But what then? DeRoot had been out in the deep too long and become a law unto himself. The same, of course, could be said of her. She touched the net for the timeline. The Campbell projectile would be launching soon. Big Red was about the same distance away from Vertex as Campbell. Her lips curved into a what-if smile.

Decision made, she called down the hair robot and unconsciously selected braids, a style suitable for space. The bot floated down around her head like an oversize crown of thorns, and hundreds of tiny hands began braiding. It would probably not be a good idea for DeRoot to know she was coming, but she would need a stream of pellets to decelerate her starship. Someone on site there would have to arrange it quietly. Pat Barrett had said his daughter Kelly was on her way to be a space operations shift leader at Shiva. Kelly had been her navigator's mate on the Tau Ceti expedition—a thoroughly competent officer. Kate sent the necessary messages on faith—she would have to be well on her way before any confirmation would be possible. After the robot was done with her hair, she took a plain pin and wove it thoughtfully through her braided bun as she composed a few more lines. Her Suits-Off Day speech would also be her farewell.

* * * *

Chapter 2

Chandrasekhar Station, in orbit about Shiva, 22 December 2284

Torsten Ried touched the net one last time for the facts on his *Popular Issues* interview subject, Kelly Barrett. An operations control shift leader, she'd been among the first to reach the Shiva system, betting fifteen years of her life that operations on four other stars would take place on time.

She'd very nearly lost the bet, he reflected, when the Consolidationist coalition, headed by Torsten's half-brother, Lars, finally won the presidency of the Solar System's Interplanetary Association Senate. The coalition didn't have the votes to make the IPA kill the project, however, and Torsten and Ried operative Anna Messenger had left for Shiva on the *Giovanni Vulpetti* on the heels of the impactor from Sol, passing it and arriving a week ago.

The door announced Barrett's arrival. Torsten told it to open with a gesture.

It revealed a medium height brunette with long wavy hair that flowed dramatically over one shoulder. She wore a bright white jumpsuit with the tetrahedral BHP logo on the right shoulder, dramatically open in front. Amazing stuff, geckro, Torsten thought.

He beamed. “Nice of you to come, Kelly. I'm Torsten Ried, and this is my assistant, Anna.” Except for hairstyle and clothes, he thought, they might be sisters. Anna had chosen a long, flowing Hawaiian dress.

"Hi, Mr. Ried,” Kelly gushed, standing fixated like a deer caught in a spotlight. “Hi, Anna."

"You can call me Torsten.” Torsten laughed. “You've never done an interview before, right?"

Kelly nodded nervously.

He smiled disarmingly. “Don't worry, I'll let you know when we're on the record. Just come on in and make yourself comfortable."

After she'd done so, he gave her a well-practiced, disarming smile. “Okay, let's start!"

He held still for a second, then introduced her for the audience and asked, “How has it been, Kelly, waiting here ten years for an event that may or may not happen?"

She nodded seriously. “We formed a very close-knit community here at Chandrasekhar Station. In the early days, the complex was just a big empty ring."

"Kelly, our viewers will see us floating in front of a holographic cutaway view of the station with the giant planet Shiva behind us. But I'm mainly interested in all the uncertainty about the project. How did you folks handle it?"

She shrugged. “The physics isn't that uncertain. When the four impactors hit, the pressure exceeds what makes a neutron star collapse by an order of magnitude in an attosecond or so. So boom, you get an event horizon."

"Thank you, Kelly. I take it that you are confident the black hole will form."

"Huh? Oh, sure. The only thing to worry about was whether all the impactors got off, and we just got word they have. They even finished pushing Sol's impactor out here despite all the political stuff."

Torsten winced. *Johnson,crop everything after “out here."*

He continued the interview. “It's been lonely for you, hasn't it?"

She giggled. “There are, uh, about forty-eight men and thirty-two women here. That is, there were until all the tourists from Campbell arrived. That was quite a surprise! Then the *Oberth's* inbound from New Antarctica. And that's not all.... “She cut herself off abruptly. “I, uh, didn't say that last, okay?"

Torsten nodded. “I'll cut it.” He'd been surprised himself to find a shipload of Campbell residents here. They were there, they said, as a tribute to Elizabeth Avonford, who'd lost her life in an effort to save a researcher from an asteroid impact, rather than divert BHP resources to prevent it. The whole thing smelled of a scandal to him. As for “...and that's not all...” he'd wait until Barrett's guard was down and probe in that direction again.

Anna came in, set Torsten's lemonade down, and offered Kelly a glass, which Kelly drank eagerly.

"You must have protocols for every contingency, is that right?"

"Oh yes, we're trained to handle everything. Flight clearances, accidents, resource conflicts, that kind of thing." Kelly pulled at her neckline.

Oops, no geckro, Torsten noted. *Mark that, Johnson*.

"It's a bit warm in here, isn't it?"

Anna smiled. "I've lowered the room settings; you should be fine in a minute."

"Kelly, what exactly do you do?" Torsten asked.

"I'm in charge of the operations room for six hours a day. A lot of times, decisions have to be made that can't be made by the AI because they involve competing human interests. So I make those calls, or now that Dr. Zhau is here, bump them up to him." She sighed.

Apparently, Torsten thought, she'd had a normal human reaction to project management showing up and starting to run the show. He smiled.

"So if, for example, some disastrous thing happened with the new black hole, you would jump into action?" Torsten prompted.

Kelly seemed much more relaxed now, even stifling a yawn. "Yeah. Look, what we'll get is a big explosion. If the black hole forms, we get a tiny bright speck where Vertex used to be; if not, nothing. There's not much in between that can happen unless..." She shook her head and took a deep breath as if trying to fight sleepiness. "Sorry. I'm awfully tired all of a sudden."

Torsten shot Anna a look. Had she drugged Kelly, hoping to get more information out of her? Utterly unethical, and it looked like she'd given the woman too much.

"Anna," he said sharply, "would you get some coffee?"

Kelly smiled. Then she yawned again. "Don' unnerstand this." She shook herself. "Could we continue this another time...?" She fell back onto the couch with her eyes rolled upward.

"Kelly," Torsten said hurriedly, realizing that he was losing her. "Just one more thing for now. You mentioned that the Campbell ship wasn't all. Is there something else coming? Another ship? We know about the ship from New Antarctica, is that it?"

Kelly's eyelids flickered and then she was sound asleep.

"Don't call the medics," Anna said. "I doped her."

"I should have figured that. Anna, first you got the dose wrong, and second, we don't do that. Ever. If anyone finds out ... God! What are you doing?!"

Anna took off her wig and pulled the muumuu over her head, revealing an outfit identical to Kelly Barrett's. Then she sprayed herself with something.

"You can't..." he started.

"I can. I'm covered with her DNA," she flashed her fingers, "I've got her fingerprints, and I'm going to take her place."

"Anna, they'll lock me up!"

She shrugged. “Sometimes sacrifices are needed. But you can finish off her lemonade and call the medics when you wake up. Say we all had the lemonade, fell asleep, and you woke up alone. Maybe they'll buy it.” Anna took a white ring with a tiny tetrahedral logo from Kelly's finger. “This opens doors and keyboards—a fail-operational hedge against the system going down."

"Anna, those people know her. You can't pull this off."

"I can. Kelly Barrett basically does what the position description says. I've studied her job.” She beamed a Kelly Barrett grin at him. “And I'm a really good actress!"

"But security..."

"They don't have any real security systems here; they counted on the Solar System's outbound checks. I'll use the keyboard, which isn't so unusual in Ops because people don't multitask well when their heads are in the net. I've got my own access to any net info I need. Piece of cake.” She raised an eyebrow, daring him to say something. He knew better.

She laughed and pointed to Barrett's unconscious body. “Dump her."

"Me?"

"You're in this up to your neck now. Your brother expected you might grouse a bit, but he trusts you to follow orders first and recriminate later.” Anna stared him in the eye.

Torsten took hold of his cousin's arm and held it tight. “Anna, I want her alive. No funny business like last time."

"That was Vitali's idea.” Anna tantalized him with a finger under his chin and patted his cheek. “Anyway, your precious Hilda survived, blew our plans up in Vitali's face, and he got the blame. Then she went to New Antarctica and made a mess of the backup plan as well. So, no, dear, she didn't get killed and here we are with one last chance."

Hilda Kremer. A diffident, modest, intriguing scientist with a brilliant mind, utterly dedicated to the project. Twenty years ago, Anna's sabotage team had misjudged what “brilliant” meant. He sighed.

"She's coming here, too, you know,” he told her.

"Huh? Who?"

"Hilda Kremer. Her father kicked her out of New Antarctica for overstepping her authority—probably something to do with Vitali's fake schedule change message. Her ship won't get here before the impact, though."

Anna laughed and shook her head. “Thank God for small favors. I keep telling Lars that you're too sensitive. Anyway, you don't have to kill Kelly Barrett.” She gave him a wicked grin. “I just wanted to see if you would. We can put her in my Cold Sleep Unit; it's self-contained, I've got it off net, and a CSU controller isn't sentient—no Asimovian laws of robotics apply."

Anna, he remembered, had arranged to arrive in the coffin-shaped CSU from the *Vulpetti* and wake up in her room. No one on the starship had seen her and the CSU was still conveniently in her quarters. How was he going to get out of *this* when she got caught?

He sighed. “I see why Lars sent you out here, Anna. You're three steps ahead of everyone else. But look, the election is over, and the BHP is just a science story now. Why not leave it alone?"

She smiled. “Torsten, Dr. Zhau has become increasingly political. If he succeeds in this, he'll return a hero. It would be better if something went a little wrong."

Torsten shook his head. “Sabotage? Lars would never..."

Anna shook her head. “You poor, dear wimp. Lars has to play the statesman. That doesn't mean he's given up. And this is personal with me now. When I undertake something, I don't give up either. Anyway, we're all opportunists—you, me, Lars. There's an opportunity to sabotage the impact and make political hay with this, and I'm grabbing it."

Torsten nodded dumbly.

"Now let's get her in the CSU, okay?"

* * * *

Anna bounced into the operations area. It was the biggest room on Chandrasekhar station, large enough that the curve of the floor was visible. The entire north wall of the room was a video screen with three banks of virtual consoles that rose from floor level halfway up the south wall of the room. The saddle-shaped ceiling glowed white.

The duty controller's position was in the middle of the top rank of consoles. Only a couple of the other consoles were active; all spacecraft were docked until after the impact, and most of the other controllers were getting some sleep now. The impact was in twelve hours and nobody would want to sleep through that.

Security was almost nonexistent, as advertised. Nonetheless, Anna was nervous and excited. It was performance time—now or never. She took a breath, walked up behind the day-shift controller, and tapped him on the shoulder. The shift officer turned, his eyes passing only briefly at her face on their way down to more interesting scenery.

"Hi, Kelly.” He grinned.

So far so good. Anna grinned back at him and nodded to the 1.5-meter-long, half-meter-wide console display of graphics and touch zones.

He started his briefing. “The impactor from Campbell is a bit hot; it's on full braking mode and we added all the pellet mass we could to its approach lane. It's tight, but if nothing else goes wrong, we'll have a hole. It might have some residual momentum, though. The other three impactors are on phase within a couple of microradians. The hole retrieval vessels are ready. Nothing much else to do. The *C. E. Singer*, with half of the Campbell tourists, will be headed toward a position beyond the impact site opposite Campbell in a couple of hours. They want pictures of the impact with their star in the background.” He shook his head. “If that Campbell impactor stays hot, they may get more than they bargained for. Are you okay for taking the board through impact? The rest of us will be over in the Science Section."

Anna nodded and whispered, “Sounds like a party. I drank some really hot coffee. Scalded my tongue, so I need to keep quiet a while anyway."

"Sorry to hear that. Well, all's quiet here now, but we'll probably have more people soon. We have a ship coming in from New Antarctica at 2100. Reggie Terry has it covered over at services. I suspect some of them might want clearance to visit the hole, if we get one. If you need anything, check the on-call list.” He got up, glanced down at her chest one last time, and headed for the door with a grin. “Good night."

Anna smiled and waved him good-bye. Then she surveyed the console display. It was close to what she'd studied—only two different keys and a new gauge—she looked those up quickly enough. She found the beacon controls. The impactor from Campbell was already on the knife-edge of being too early and was dragging at maximum thrust. If she were to move the guidance null just a couple of picoradians, it should deflect just enough to cause the implosion to fail. But she had to do it quickly, and without attracting notice. For practice, she sent an attoradian change—pushing the center point a few micrometers west of dead on. The AI asked if she was sure, but accepted her affirmative response. She started typing in the modifications to the beacon calibration.

"G'd evening, Miss," said a male voice from somewhere in the remains of the British Empire.

Anna whirled around in her chair to see an amiable-looking heavy set man in trousers, turtleneck, and jacket, his hand in the jacket pocket.

"I'm Roger Gunheim from Campbell. Came by Ops to make sure everything is okay."

Anna flashed her come-hither smile. "Is that so? Are folks from Campbell supervising us now?"

He eased himself into the seat beside her and laughed. "The BHP project sent someone in to take over our operation, so we thought we'd return the favor."

Anna measured the man up and down. So this was Roger Gunheim, the former Campbell chief executive she'd heard about. It would be fun to discuss Nietzsche and the will to power with him someday, but that would be out of character for Kelly Barrett.

She arched an eyebrow. "Everything appears normal." She smiled seductively, "Is there anything you need?"

He smiled back. "Only to find out what your intentions are...."

Alarm bells started to ring in Anna's head. Hoping that was just a pickup line, she gently raised her chest to distract him. "I see a man of action. When and where?"

Gunheim laughed, pulled out a trank gun, and waved it in her face. "Not so fast there, sheila. Hands off the keyboard. You're not Kelly Barrett, you're Lars Ried's cousin, Anna Messenger."

Anna froze, then relaxed a little. He knew, but he hadn't shot her or called the authorities. What was his game? She lifted her chin. "How did you know?"

Gunheim gave a short laugh. "I've compromised the net. Item one, Anna Messenger is listed on the news staff and present in the Operations Center but seems invisible. Item two, Kelly Barrett is supposed to be on duty but is not physically present. Item three, Lars Ried never gives up—commendable. I always liked his style, never liked his politics, but he did a few favors for me once. Item four, Peter recognized you despite your disguise. He did you at Earthport, about thirty years ago? It must have been memorable."

Anna groaned. It had seemed like a good idea at the time. *"I* did *him,"* she said. "Okay, you haven't shot me or called security. Why? What do you want?"

He might have compromised the system, but maybe not the press encryption within it. She sent a note to the press file. *Torsten, I've been caught....*

Gunheim folded his arms. "My suggestion is that what we have planned might be as useful to Lars Ried as your sabotage. More useful, even."

Anna turned to look at him. The trank gun was a palm-sized Cavalli twin-barrel of the kind that had been standard issue for security forces for the last half century. It fired two-millimeter flechettes that dissolved in blood.

"More useful?" she asked coolly.

He nodded, looking her over. "If the experiment fails through sabotage, and that becomes known, there would be a political backlash of the sort he might not survive. Whereas, if some of the darker predictions come true, he'll look like a bloody prophet."

"Darker predictions?"

Gunheim just smiled.

Anna raised an eyebrow. "I have to take that on faith?"

"For now." His smile vanished. "You just keep your Kelly Barrett persona and do nothing she wouldn't do until the impact. And after the impact, you do nothing she would do. Is it a deal?"

"Hi, Kelly!" Torsten said, finally arriving.

Gunheim smoothly pocketed the Cavalli.

Just play it cool, Anna sent to Torsten. *Distract him. I only need a second or two.*

Anna, You're nuts!

Do it!

Her cousin's expression resolved itself into a media man's public mask. "Good evening, Mr. Gunheim," Torsten said, affecting his best Ried smile. "What brings you to operations?"

"I'm busy, Ried." Gunheim glanced toward him.

While he did, Anna silently finished her inputs.

A woman's voice boomed from across the room. "Messenger, move away from the console."

Anna froze. The computer was flashing at her, asking if she really wanted to do the guidance change. She had only to acknowledge the command. She moved her arm.

The dart felt like a wasp had stung her. With her hand inches from the console, she went numb. As she fell, she heard Roger Gunheim's answer to Torsten.

"What's going on, Mr. Ried, is perhaps the most significant event in human history. With a few changes. As you have probably gathered, we are taking over the station. This is Magda Lobacz, who will be in charge while my party heads out to collect the black hole."

So that was their game! Even lying paralyzed on the floor, Anna was thrilled by the audacity of it. Yes indeed, it would be one of Lars' worst propaganda nightmares confirmed. And if everything people said they could do with tame black holes was true, Roger Gunheim would become the most powerful man in the universe. Maybe, just maybe...

Lobacz was a grim-faced butch-cut blonde at least two meters tall and not in the least bit willowy. Her jumpsuit was solid black and she had a full security belt. She picked Anna up off the floor as if Anna

were a feather, placed her in the chair, and slapped pieces of yellow tape around her to pin her arms and keep her there.

"Next time I say something to you, you do it and ask questions later, understand?"

Anna found she couldn't move her mouth. The question, of course, was purely rhetorical. But if she read Lobacz's tone of voice correctly, a long line of power-seeking females lay between her and Roger Gunheim.

Torsten, answer yes to the system prompt. Now. Do it even if they shoot you!

"Mr. Gunheim, Ms. Lobacz," Torsten said. "Uh, I see the board's calling for an automated guidance adjustment to be okayed. I hate to bother you, but if you want a black hole, you probably shouldn't hold it up."

Lobacz turned and looked at the board, then at Gunheim.

Gunheim stared at the panel for a minute, looked at Anna, then looked back at the board.

"It's routine," he said finally. "I studied this setup on the way in; the adjustments are automatic, but the system gets a human okay to let them think they're doing something."

Trust Torsten to know people, Anna thought. Gunheim apparently liked to impress people and pretend he knew what was going on. Lobacz nodded obediently to him and hit the okay herself.

* * * *

Dr. Bradford Adams watched the data come in and tension mount. Ten hours and counting. Over a century of work behind them. His mouth was dry. They'd replicated his favorite Melbourne pub in the recreation area of Chandrasekhar Station, and he intended to spend some time with a Victoria Bitter there when this was done.

He tore his eyes from the displays. Gunheim's people were everywhere. Why weren't they all on the *Singer?* The starship turned excursion boat had just left for the impact point. Maybe these were just the cautious ones.

"Dr. Adams?"

"Yes?" He turned and saw an Asian woman of medium height.

"Kim Soh Young," she introduced herself with a big smile, "representing *InterplaNet News*. How do you feel about making the black hole tonight? You are working on this a very long time."

Brad smiled. "You might say we all have our fingers crossed."

Kim smiled. "Everything is coming out okay, then?"

"She'll be right. Some problems with the Campbell impactor, but..." He looked at the board just to be sure. Brad couldn't believe his eyes. "Pardon me, Miss."

Sarah, Tse Wen. Check Hilda's impactor.

Brad, this is Sarah. It's right down the pipe.

Brad, Sarah, Tse Wen here. Brad's concern, I believe, is that it should not *be right down the pipe. It was under full deceleration only two hours ago. It may be wise to question the instruments.*

"What's going on?" a new voice said.

Brad turned and saw another Campbell person, a tall, grim-faced man with short hair. Brad frowned. "Could you wait a moment, mate? I've got an interview in progress."

He looked at the data again—normal. Something was bloody rooted. *System, who's on Ops Control?*

It is Kelly Barrett's shift. However, Anna Messenger of Popular Issues *magazine is currently occupying the control seat.*

What did that mean? A news interview? *Who else is there?* he asked.

Magda Lobacz, of Campbell security.

Brad shot a look at the Campbell person near him. *Where is Barrett?*

She is not responding.

We have an emergency! Get someone on the staff there!

Magda Lobacz is authorized staff, the system replied.

Since when?

"Problem happening now?" Kim asked.

"Do you have a problem, Dr. Adams?" the Campbell man asked.

Brad was on the point of wheeling around and yelling that yes, he bloody well had a problem—but caught himself in time. If he did something like that, he'd likely end up wherever Kelly Barrett was.

"No," he said evenly. "Just some adjustments need to be made." He changed the view field from the Campbell impactor to the one from Earth, which had a dramatic effect on the screen and did nothing whatsoever to the impactors. "There, Ms. Kim. She'll be right."

He turned to see the Campbell man looking over his shoulder and gave him a big phony smile. Kim had vanished.

"Nothing special here, mate," he said, laying his Australian accent on a bit heavy, hoping they would underestimate him. "Lots to look at, but she's all nominal, right down the pipe. Here, why don't you sit down yourself for a bit? Something to tell your wallies about, right?"

The man smiled, nodded, and sat down eagerly. "Is that one of the impactors?" he asked, pointing to a long line in an upper left-hand screen.

"Sure is, mate. That's the one from Earth. Up the mag and look on the front end."

He did so. "It's dark out there. How can I see it?"

"We're illuminating it with lasers and we've got a synthetic aperture a million kilometers across staring at it. The big can on the front end is the brains. We send out a string of pulses, kind of like road signs on a rally. The impactor has to pass each road sign at just the right time."

"What if it doesn't?"

"The big magsail off the back—you can't see it at this magnification—is set to drag at thirty kilonewtons,

but it can increase or decrease that to make up a difference. That's not much thrust for a billion tons, but we'd only need to move it a few wavelengths back or forward. Let's go max on the magnification,"

Brad's mouth dropped open as the video magnified. The bloody idiots back home had done just what he'd done on the sim, painted his initials, B.A., right on the nose of the thing, like it was a bomb in some old war. He shook his head, laughing.

"What's so funny?"

"Just what the guys painted on the thing's nose." Brad laughed. Then the laugh died in his throat as he saw an "S2" below the initials, for "simulation two." That wasn't the real impactor.

"Something wrong?"

"No, no, mate. Just gotta run for the bloody loo, I've been sitting here five hours, worrying and drinking coffee."

The man laughed. "I know how that goes."

"See if anyone else has painted stuff on the noses of the other ones. I'll be right back."

Whoever hacked that image could probably listen in on anything he sent to Sarah or Tse Wen. He didn't dare let anyone know he'd caught on. Even so, he might have only a few minutes. He gave a quick look at Sarah, whose head was buried in her displays, and then Tse Wen, who looked up at the right time. Their eyes met. From the frown on his face, Brad thought Tse Wen knew things were amiss as well. Brad tossed his head ever so lightly at the exit and Tse Wen gave a barely perceptible nod. The exchange might have taken two seconds.

Brad then turned away and headed out of the operations room. He passed the rest room, headed for the elevator, opened the service panel, and pulled it off the net. He then told the lift to take him to the maintenance floor; elevators were designed to work autonomously in emergencies.

At maintenance, he picked up a spare central processor for the *Martinez,* an in-system shuttle equipped for monitoring the black hole. That would be duly reported, but as he was scheduled to be on the post-event inspection crew, it probably wouldn't ring any AI alarms. He could only hope the Campbell crowd hadn't anticipated everything. Worried that any exceptionally hurried activity might trigger concern, he pulled himself along with the handholds at normal speed through the access tube to the lock. Once aboard the *Martinez,* he headed right for the engineering bay and threw the manual comm disconnect. He had the processors swapped in seconds and touched the local net secure. Would this work? He bit his lip and touched the ship's net.

Martinez, Bradford Adams commanding, secure. We have a hijacking emergency involving the Chandrasekhar Station AI. It must not know I am aboard and am giving instructions.

Understood. Bioradios were self-authenticating; no two were alike any more than fingerprints. But Brad sighed with relief anyway. Halfway out. *Can you get us pumped down and out of here without the station knowing in time to stop us?*

You have authority for such an emergency bypass.

Right. I'm going to restore com. Give them a couple minutes to think that everything is okay and I'm heading back to shuttle ops. Then get us the hell out of here.

Prepare for acceleration in three minutes. Where are we headed?

Good question. He quickly abandoned any notion of trying to attack the *Singer*. Its AI was probably fully compliant to DeRoot and Gunheim at this point. Even without a beam to ride on, a starship still had three hundred megawatts of nuclear-powered lasers and fusion torch drives to play with. There was no point in trying to challenge that in a runabout. The *Oberth* from New Antarctica was less than a light-minute out and decelerating. He didn't know her captain, but Hilda was on board. It would be good to have her head on this.

Rendezvous with the Oberth, *minimum time trajectory. I'll take the acceleration.Get a direct link to the Vertex site. Transfer control here without notification to central.* Did he have sufficient authority? Had the site been hacked, too? Seconds of lightspeed lag passed.

Emergency transfer authenticated.

Various audible clanks and whirs confirmed the *Martinez's* departure.

He shut his eyes and scanned the data flowing into his head—the real data. The Campbell impactor was still hot, though decelerating on schedule. But it was also off line, almost a hundred nanometers—barely a quarter of the wavelength the guidance beacons used, but a huge error given the requirements.

The Campbell takeover, a Consolidationist in the ops chair—what the hell was going on?

He had to put that out of his mind and concentrate on the impactor. What was making it go off course? Something to do with the phase of the guidance beams? What was the command history? He read. He checked. He thought. He checked again.

"Prepare for deceleration," the *Martinez* said over audio speakers.

"Deceleration? When did we bloody accelerate?"

"Almost two hours ago, at four gravities."

Bradford Adams laughed. "Well, that's concentration for you."

An unmagnified view of the *Oberth* filled his screen. It was a standard three spheres on a solenoid ring design, with long grazing incidence cones ahead of each sphere. A smaller, coaxial "choke ring" that improved the plasma reflection performance lay about fifty meters forward of the main ring. Relative velocities were low enough there to allow docking on the inside surface of the ring while the starship rotated. Brad monitored the process with interest.

When he turned back to the problem, he thought he knew what was going on and why.

* * * *

Chapter 3

Near Vertex in orbit around Shiva,

23 December 2284

Brad and *Oberth's* captain, Ada Chenhansa, scanned a virtual screen showing current locations of each of the four impactors, Gunheim and DeRoot's ship, theirs, and Chandrasekhar Station. A petite woman with shiny black hair, Chenhansa moved and spoke with grace, economy, and deliberation. The aura of command, he thought.

She pointed to one of the impactors. "From Campbell, on time?"

Brad nodded. “It's a bit off center and has a little too much energy. I did what I could about that. But it will be on time. With three groups of human beings playing tug of war for it."

The *Oberth's* AI called for attention with the soft and deep tone of a large gong.

"Yes?” Chenhansa said.

"Dr. Adams wished to be notified when Hilda was about to awaken."

Chenhansa caught his eye and nodded.

Brad hurriedly left the captain for Hilda's stateroom, threading his way down from the dome to the deck below and into the tube connecting the *Oberth's* spheres. How many years had it been? About twenty-five since the Ten-Ten experiment validated her model. Most of that in relativistic spaceships for her. It would only be like a year or two for her, fifteen for him.

A robotic attendant met him at the door. “She's awake and expecting you. It may be a few minutes before she's fully oriented."

"Understand. If I might? It is urgent.” The machine smiled and stepped aside, somewhat more slowly than Brad thought was necessary, which was silly because it was just part of the *Oberth,* which bloody well knew what was going on. Probably just impatience on his part. Hilda, looking a little dazed, was rubbing her limbs. Her eyes focused on him.

"Brad!"

"How's it going, Hilda?"

"Bones and muscles ache. Brain's intact. I'll be on the net in a moment.” She looked at him carefully, then zeroed in on his eyes. “You're not supposed to be here. Something's happened."

He told her what, ending with, “If I'm right, they intend to take possession of the black hole."

"My sister, Liz, is at Campbell...."

She wouldn't know yet. Of course not, he realized. He'd have to tell her. Oh, what the hell had he been thinking? This should be Tse Wen's job, but Tse Wen wasn't available just now. A knot formed in his stomach. Things couldn't wait; he would just have to tell her and pick up the pieces later.

Hilda looked at him dumbly after he finished. “Dead?"

"It's too big a thing,” he said softly. “Too big to think we weren't going to pay a price. Bloody rotten thing to wake up to. Really sorry."

She tottered to her feet and fell into his arms. “Brad, people just don't die any more.” Tears were beginning to form in her eyes.

He nodded and held her, rocking her gently back and forth. That was what biological immortality was supposed to be all about, to live for bloody ever. “I pray to whatever runs this crazy universe that I'm wrong, but I'm not entirely sure it was all an accident."

She sobbed softly, then seemed to come out of it. “How did eliminating Liz help them? There should be a small armada of robotic craft around the impact site to take data. You've taken control of that."

Brad shook his head. “When Mutori took back the project, she arranged for the Campbell impactor to

be just a little hot. The extra momentum will pop the black hole out beyond our containment arrangements and off toward where Gunheim's positioning his starship." He explained the fake data from the Science Section video feed. "Nobody would have painted 'S2' on them, for 'simulation two.' They bummed that video right from the sim, and I almost dropped the load when I recognized it."

He watched anger flow over Hilda's face like it was morphing in some video movie. When she looked up, her eyes burned and her jaw was set. Brad had only the sketchiest details of what Hilda had been through on New Antarctica, but the coldness and resolution in her voice told him that, if anything, she had changed more in three years than he had in fifteen.

He shook his head. "I do have a surprise for them. I couldn't fully correct the perturbation from Anna Messenger's sabotage attempt, so this hole is going to squirt out a little sideways of what they thought. We can be there first."

"How long do you think before they catch on?" Hilda asked.

Brad shrugged. "The system AI's got a split personality now, half of it helping us under the security emergency codes, the rest of it pretending nothing's going on. I suspect something will give it away eventually."

The robot came in with clothes.

"Give me a few minutes."

He nodded and, with a quick hug, left. As he did, a cold cramp grew in his stomach. There had never, in any history that had reached him, been a fight between starships before. One of them may have been modified in anticipation of it—and that wasn't the one he was on.

* * * *

Peter DeRoot stood in the center of *C. E. Singer's* dome, looking at the impact site. The tiny moon seemed curiously soft in the shadowless glow of amplified starlight.

Roger Gunheim walked over to him and put a hand on his shoulder. "Do you feel like bloody Caesar looking across the Rubicon, Peter?" he asked.

DeRoot smiled and nodded. Roger might play the *boerenkinkel,* but from time to time let on that he knew more of the world. "A good analogy," he whispered. Caesar, not Moses. A lout would have said Moses.

Gunheim waved a hand toward the left of the impact site. "The *Oberth's* coming on."

A tiny speck of light lay at the head of a trail of glowing gas. He touched the net and got the flight plan. Captain Chenhansa was stationing herself safely away from the line of any impactor. DeRoot shook his head. "Magda has Operations under control?"

Gunheim paused a moment to get a report. His fellow Aussie, Dr. Bradford Adams, was apparently missing and being looked for, but otherwise Magda had no problems. "Yeah, she's right there. That bloke, Adams, is missing, but we've got him locked out of the system; there's nothing he can do there. So no worries."

"Then I would say that Hilda Kremer has come to see the show. She will see more than she's bargained for."

Gunheim laughed, perhaps a little too loudly. "Bloody right about that! Still, we're ready to deal with it if

she tries something."

DeRoot gave a quick smile. They had been busier than normal during the passage from Campbell. The *Singer* now boasted a laser array a hundred times more powerful than what was needed to ionize debris in her path. They'd also manufactured some forty homing missiles. The one-meter layer of shielding water surrounding three of the *Singer's* spheres had been jelled with fullerene tubes and frozen steel-hard at three degrees above absolute zero.

It had all been unnecessary. Their surprise had been complete, there were no station security forces to speak of, and they had complete control. In a few minutes, they could even be magnanimous.

* * * *

Hilda arrived at Sphere One and took the lift up to the park dome. The screens showed the exterior view, starlit objects amplified to dim ghosts, and symbology labeling everything. Brad and Captain Chenhansa were sitting in lawn chairs, staring at the display. Dotted lines raced across the dome to a convergent point. Hilda touched Brad's hand as she took a chair next to him, and he squeezed back.

"If Captain DeRoot were to capture the black hole first," Captain Chenhansa asked, "what can he do with it? He cannot go anywhere tied to a four-billion-ton astronomical anomaly!"

Hilda shook her head. "It's big enough that its gravity can overcome the pressure of the Hawking radiation. If you can dump mass into the hole, it should act like other spinning black holes; it will spit most of it back out in plasma jets from its poles at relativistic velocity and most of that from the pole opposite the incoming mass. From the starship's point of view, it should act like a pulse fusion drive with a higher exhaust velocity. All DeRoot needs is a mass roughly equivalent to that of the hole."

"A ring rock?" Brad asked.

Hilda shrugged. "Or something."

"What is he going to do?" Captain Chenhansa asked. "Build a fleet of black hole-powered starships and conquer the Solar System? What is he thinking?"

"We don't know with any certainty that one black hole can make others. But if it can, they don't need to conquer the Solar System; they just need to make it irrelevant."

"A bunch of dingoes trying to put their own piss on the cosmos, if you ask me," Brad added.

Hilda touched his arm. "Chaos, Brad, the Consolidationists will let them. They'll say 'we told you so' and use it to stay in power in the Solar System, which is all they care about."

Captain Chenhansa sighed. "There is much at stake ... but I have a ship full of passengers in cold sleep who cannot be risked."

They were all silent.

"We can put them on the *Martinez,"* Brad said. "You'll need to give them enough fuel to get home."

Chenhansa frowned and nodded. "We will wait until we are at lower relative velocity."

Hilda went over Brad's contingency plan and the trajectories of the impactors again, adding every factor she could think of. Unfortunately, it all came up with DeRoot closer than them. There was something she could try. In theory, it would work; in practice, it would be taking an awful risk.

"Brad, I'm thinking of a drag reduction on the Groombridge 34 and Epsilon Eridani impactors. They're coming in with the nominal drag allowed by the mission rules, but it isn't zero. Less and they would come in slightly faster and produce a component of postimpact momentum in the Earth's direction. Watch."

Lines converged on the dome again, coming together at a spot somewhat farther away from them but at less of an angle to their present course.

"We should get another kilometer per second or so of reserve," Captain Chenhansa remarked. "I like that."

Brad touched the net and pulled up the project sim. In principle there was some margin for off-center impact, but it was literally measured in nanometers. "We can try. If anything goes wrong..."

Brad looked at Hilda. Almost a century of work was at stake, and the political environment was such that it might be centuries from now before it was attempted again. If ever. Twenty years earlier, Hilda would not have taken the chance.

"It already has gone wrong," Hilda said. "We have to try to make it right. Tse Wen?"

Brad shook his head. "We don't dare try to talk to him."

"I shall wake the rest of the passengers and get the evacuation under way," Chenhansa informed them. She closed her eyes for a moment, then said, "It's done. I've ordered a lighter to meet the *Martinez* at a rendezvous point."

"Did they ask why?" Brad asked her, worried about alerting Gunheim.

Chenhansa smiled faintly. "I did not bother the duty controller, and the computer did not ask why. They seldom do."

Brad nodded and smiled. He was beginning to like this captain.

"Are Tse Wen and Sarah okay?" Hilda asked.

Brad thought of all the Campbell people around. Not tourists at all but, essentially, Campbell government forces. No, he amended that. Pirates. They were bloody pirates. He smiled at Hilda darkly. "As okay as any people staring down the barrels of loaded guns are okay."

Her eyes went wide. "Hostages?"

Brad winced. He hadn't thought of that one. Not at all.

* * * *

Anna watched the main display, biting her lip. Torsten stood behind one of the consoles in the amphitheater of the Science Section, quietly speaking into his news feed, too softly for Anna to hear. He had actually asked Magda's permission to continue with the news operation. The Campbell security people laughed and said go ahead, even letting him have her to assist him.

And why not? Any reaction from Earth would take nearly twenty years to get back here, thirty or so to get to Campbell. By then, one way or another, the situation would be entirely different. The broadcasters were still, of course, being watched very carefully.

The Campbell people, all in red coveralls now, were everywhere in the Operations Section, and everywhere else. A glance behind her showed that her own personal minder—a dark, narrow-faced man

with no hint of a smile—had his full attention on her. The guidance change had been sent, but she'd had no console access since.

One minute now. It would either work or it would not. If it did not, and if the Campbell people got the hole, Lars would be furious. He would self-righteously scream, “I told you so,” to everyone who would listen.

It would be a short-term political bonanza for him. But in the long term? Would the Solar System itself be safe from DeRoot and Gunheim? Conventional wisdom was that interstellar war was impossible. She looked around her as if seeing what had happened for the first time. Impossible? She was sitting in the middle of what was arguably the first attempt at interstellar warfare, and one that looked to be completely successful.

Whatever the political benefits of “I told you so,” the Rieds would become irrelevant. The future now looked to be Gunheim's. Ultimately, Gunheim and DeRoot would want someone who knew the Solar System, knew where the keys to power were hidden, someone whose will to power might match their own. Gunheim had women waiting in line, but DeRoot was rumored to be insatiable. She smiled to herself. She knew how to use her body. Perhaps...

Torsten's voice became loud with excitement. “If ever there was a time when everyone in the known universe was focused on one single moment, this would be it. We are in the last six seconds."

"...four, three, two, one..."

* * * *

Someone on the *Singer* started counting backward from twenty. “...nineteen, eighteen..."

Conversations hushed. “...twelve, eleven..."

"...two, one..."

Peter DeRoot may have seen the slightest flash. For the tiniest fraction of a second, the tiny moon did nothing. Then it turned into a perfect, shining sphere of plasma, only slightly marbled, which first lit up the spacecraft arrayed around the impact site, then expanded through them at incredible speed.

Peter caught his breath as the huge translucent plasma bubble struck the *Singer* and rocked it firmly. Behind the bubble, a miniature nebula formed and also expanded, though much more slowly. The prize for all their efforts should be in there somewhere. It should be a brilliant spark coming right toward them. He strained to see it.

* * * *

It had already happened, Anna thought. The light had just not gotten here yet.

There was a brief flicker as the impactors zipped across the screen and vanished into the targeted moonlet, which, after a fraction of a second, was replaced by a rapidly expanding glowing bubble. It was translucent. Anna could see stars through it. Where was the hole?

"...we have impact."

"Look at Shiva!"

Heads turned in unison to the right as the ringed planet and its moon system flashed into view from the light of the implosion. A giant blue Saturn, slightly gibbous, with huge broad white rings, hung over them, or was it below them? It faded quickly back to black.

Anna glanced back at the impact site; the plasma shell generated by the impact moved more slowly than light, but now filled a quarter of the large screen and rushed toward them. Such a perfect, pearl-like sphere, she thought. A cosmic soap bubble. A new universe? Death?

Before she could complete the thought, the front passed them without any discernible physical effect. So much for five decades worth of propaganda!

She looked toward the *C. E. Singer* and saw an invisible speck of light, unrecognizable on the screen except for the symbology that floated along with it. The hole should be brilliant, glowing with megawatts of Hawking radiation. It wasn't there.

Had she succeeded? She gripped the arms of her chair in excitement.

"The instant of impact itself was an anticlimax," Torsten announced to posterity. "The impactor rods flashed through the field of view, end to end, and vanished into the moonlet in thirty-three millionths of a second. At the vertex, what happened was done in three millionths of a second. That seems a very short time to us, but as these physicists tell us, that is an eternity of three trillion attoseconds at the nuclear scale.

"In the first few million attoseconds, the center of the impact fills up with collision-produced matter to make a nut so dense not even neutrinos can penetrate it. Nor can the force of any one impactor move it against the force of the other impactors. A stream of matter flows into the implosion at five billion tons a second, but is brought to a halt in a little less than a centimeter.

"There are no common words to describe the central pressure. Dr. Kremer's calculation was that at 4.3 with thirty zeros after it times standard atmospheric pressure, the last resistance to compression is exceeded and the entire mass collapses into one irreducibly small loop, or set of loops, separated by fractional dimensions of Planck scale. Something like that anyway. Maybe. We can't tell what happens actually, because at that density, gravity has produced a black hole.

"Which won't be black because of something called Hawking radiation, which I will not attempt to explain, but which will make this object not black but a tiny quantum-scale star that radiates its mass away with a power of millions of watts!

"So it is supposed to have happened. Most of the outer layers of the moon were vaporized and blown away in the spectacular bubble of plasma you saw. This was expected. We are not, however, seeing the brilliant speck that should be there in the center of where the moon was."

Murmuring and muttering filled the room.

Anna could hardly contain herself. Had she won? Had she? Oh yes, it had worked! She'd prevailed! *Her* will had trumped all the others! A manic grin began to spread across her face. This was better than sex. Better than sex with drugs. Oh, she would savor this moment!

* * * *

Zhau Tse Wen looked from his guard, a burly mustachioed man introduced to him as "Micky," to the stateroom wall screen, then back. After Brad had escaped to warn Hilda, the Campbell people had removed all the project management from the net. There was nothing for him to do but watch. He must be content with that. For now.

There was irony, Tse Wen reflected, that this stateroom had originally been assigned to Anna Messenger, the cousin of Lars Ried who had probably been the mysterious woman who had impersonated Hilda Kremer in a previous sabotage effort. Messenger's modus operandi, apparently. She had reappeared

after the conservative coalition had gained power and was now on station, ostensibly to assist reporter Torsten Ried. Whatever plans she'd had must have been preempted by the Campbell takeover. The usurpation seemed to be fairly complete and did not, apparently, include sabotaging the project.

"Micky, could I have a view of Shiva?" he asked.

The minder pulled on his mustache. "Instead of the impact? After all these years?"

"It may succeed, or it may not. Either way, there will not be that much to see. But when the flash of light from the implosion hits Shiva's rings, that will be a sight unlike any other."

"Yeah? Okay if I keep a corner of the screen on the vertex?"

Tse Wen nodded. "As you wish."

He almost missed the impactors' flash across the screen by blinking, but a couple of seconds later the light echo of the implosion racing across the rings and body of Shiva was, indeed, a wonder to behold. The rings and the few high clouds on the planet changed color as the flash faded from violet to deep red. The bulk of the planet itself was momentarily a brilliant blue, which darkened and darkened until it seemed that a few ruddy-gold clouds floated in the darkness of the void itself.

He looked at the Campbell man again. He was big enough, but there was a softness about him. He nodded to the man and smiled. "Imagine that for several weeks."

The man frowned. "A supernova?"

"A hypernova. That is the way nature makes black holes."

"You just want to study it, right?"

Tse Wen shrugged his shoulders innocently.

"Maybe the boss man will let you do that, if you behave yourself."

Tse Wen allowed himself the slightest frown. He had conceived the project and managed it to fruition across four star systems and this lone planet. Now, "maybe" he would be allowed to study its results. But the game was not over yet. There were hidden strategies in this game, moves placed in advance to stand guard against an unknown. A step here and a gesture there, and everything could change. But he would have to wait his turn.

"I shall have to ask him," Tse Wen said mildly.

"Do you know where the black hole is?" the man said. "I don't see anything."

Tse Wen frowned. "The light echo was beautiful. We can return to a full-screen view of the implosion area now."

* * * *

Hilda Kremer braced herself. Even ten thousand kilometers away, the wave of plasma from the vaporized moonlet grabbed their magnetic fields like a gust from a hurricane as it swept by them. The floor felt like it had been shoved sideways and everything trembled.

In a few seconds, they each gained almost a kilometer a second of velocity away from the implosion center. Both ships were fully prepared for this, of course, and the velocity increment was factored into their plans.

The plasma cleared in seconds.

Where is it? she thought as the star field faded in through the last aurora-like shreds of implosion debris. *Oh, please, please, where is it?*

Their eyes and every instrument in the ship scanned the area in front of them.

"Since when," Captain Chenhansa said very softly, "does Orion's belt have four stars?"

"Tally ho!" Brad cried as the clearing plasma revealed an impossibly brilliant spark heading right for them. "It's coming right at us!"

Hilda's estimate hadn't been perfect, but they hadn't gotten to the predicted point in time either. The errors had canceled almost exactly in space.

"The *Oberth* has acquired it. We're maneuvering to match velocities."

The maneuver went smoothly; the only thing Hilda noticed was a slight increase in weight as the rockets came on before spin reduction was complete.

Hilda looked at the *C. E. Singer,* less than five thousand kilometers away. It continued to scud away on its too-high velocity vector, but was braking at its maximum thrust.

"We will be on it about fifteen minutes before they get here, assuming they decelerate," the captain said. "Two hundred megawatts of Hawking radiation."

Hilda nodded. A gong sounded both in her ears and in her head.

We are beginning the capture sequence, the *Oberth's* voice said. *Please lie down, sit, or otherwise secure yourselves. There will be an instantaneous acceleration of approximately fifteen gravities.*

"It has the mass of a bloody asteroid," Brad said with a laugh. "We go where it goes."

They lay down on the grass and looked up at their version of the night sky. It was disconcerting to Hilda that when the acceleration came, it was in the opposite direction of the relative movement of the hole. The cameras, of course, were pointed backward. The bump was more like falling out of bed than a sustained acceleration, though. After it was done, she saw the brilliant point floating between the *Oberth's* field generators.

"It's spinning!" Hilda said. "We're picking up frame drag on the accelerometers."

"It's a ring singularity?" Captain Chenhansa asked.

"Kerr-Neumann geometry?" Brad asked.

"Near the limit, I think," Hilda said. "It's got a slight positive charge, too ... not enough electrons left within a thousand kilometers to neutralize it, I suspect ... big, strong magnetic field."

"We have secured it. Or rather, we have secured the ship around it," the captain said. Then she looked from Hilda to Brad and back to Hilda. "Now what do we do?

* * * *

Chapter 4

BHP Operations base, in orbit about Shiva, 24 December 2284

Torsten watched events unfold with the sort of awe one has for a superlative player of any sport, even if on the opposing team. In spite of everything, and it had been quite a lot in his estimation, Hilda Kremer appeared to be in possession of a mini black hole.

"Damn, damn, damn, damn," Anna said in front of him.

She had almost literally wilted when the black hole had finally turned up. He put a hand on her shoulder. She shrugged it off.

He looked around. The Campbell people were grim faced. Magda Lobacz went from urgent conversation to urgent conversation, then left the room.

On the screen, it looked as if two starships were about to contest for ownership of a black hole. Neither answered to Lars' interest. "Anna..."

"Go to hell."

"Anna, you need to let go."

She spun and looked at him. "Well, they might still knock each other off out there."

Torsten shook his head. Gunheim had anticipated even that. "Then the Campbell people here pick up the pieces."

Anna motioned him closer and whispered, *"If* they are still in charge. This is still a Solar System government project. I am, kind of, a Solar System government agent. Maybe I should be in charge."

Torsten's jaw dropped at the audacity of it. Was she now considering a rebellion here to save the project she came here to sabotage? He glanced at their minder. The man's eyes were riveted to the unfolding drama on the big display screen.

"What are you thinking?" he asked.

She grinned madly at him. "Watch. Just watch," she whispered.

Then she turned to the minder. "I need to use the head."

He motioned for one of the Campbell women to escort her, a gangling dark-haired woman with an earnest expression on her face.

His power-mad cousin could easily kill her. Or vice versa—the other woman was armed. He should say something. Stop this before it made even more of a mess. What would Lars want him to do? He opened his mouth.

The minder looked at him expectantly.

He shook his head and turned back to the screen. What would happen would happen. It was none of his doing, he told himself.

Roger Gunheim's image appeared on the screen. He was dressed casually, seated at a clean desk with a starscape behind him.

"I am addressing all of you in the Shiva system. The Campbell government that I represent is claiming possession of the black hole on behalf of the Campbell system as compensation for the Black Hole Project's interference in Campbell's internal affairs. But beyond that immediate objective is the need,

indeed the destiny manifest, for the control and direction of the expansion of the human race to come under the control of those of us who are already out here.

"Imperial Earth is a thing of the past. This marks the end of the Interplanetary Association Senate's attempts to dictate events light-years beyond its natural setting, and the beginning of an era in which the colonial worlds stand up to the home planetary system as equals and claim the right to make their own destinies.

"We know that in the hands of the government of the Solar System, the near-limitless power that black hole technology will bring would be used to further the ends of that government in places far beyond its natural reach.

"We ask for your support in this effort. Under the Campbell government, genuine scientific study of the black hole will not be inhibited. Indeed, it may proceed with more freedom than the present Consolidationist Solar System government would allow.

"Most of you have expansionist sympathies. We ask you to join us, or at least not impede what we must do to secure the future for all independent men and women.

"Specifically, we plead with Captain Chenhansa to withdraw from the hole. Our ship has been prepared, as hers has not, to move it to a more suitable location. It is also prepared, as misunderstandings were anticipated, to disable spacecraft operated in such a way as to interfere with such progress. We will do this only with great reluctance, given the risk to life involved.

"I repeat. Please withdraw peacefully.

"Those at Chandrasekhar Station who wish to declare allegiance to our cause need only explain this to one of the uniformed officials of our administration. Their declaration will be noted, and with reasonable precautions, of course, they will be integrated into the new operations; in most cases with positions and authorities similar to those exercised prior to the advent of the new administration.

"This is all I have to say for now. G'day, all."

Torsten looked around him as Gunheim's larger-than-life image faded from the screen. Already, here and there, researchers and technicians were talking to their red-shirted minders.

A chill went down his spine. The world of science and technology was still a little distant and difficult to comprehend for him, but this he understood only too well. Napoleon, Hitler, Marsdale, and Ramachandra must have sounded like that at some point in their careers.

So Lars now had a rival whose skill, ambition, and ruthlessness seemed limitless in time and space, and who was, or shortly would be, in possession of a power that not even the Solar System's hundred-billion-person economy could match. The seven light-years between here and home seemed not to matter so much—a speed bump. Whatever Anna had in mind, Torsten suddenly wished her luck.

* * * *

Brad glared back at Gunheim's image on the wall of Chenhansa's wardroom. Buried in the center of Sphere One and equipped with padded chairs and elastic restraints for use in zero gravity, it seemed a better place to ride out whatever. “That's a bunch of bloody nonsense! Catch a beam out of here!"

Gunheim's image was replaced by DeRoot's.

"This is Captain Peter DeRoot. I have been commissioned by the System Government of Campbell to take possession of the black hole. Disengage from the black hole."

"I don't believe this," Brad said. "DeRoot, just what is it you intend?"

"I have weapons and will use them. I also note that Dr. Zhau, Dr. Levine, and all the others, including those passengers you dropped off, are guests of our security people at the station."

"It's been over a hundred and eighty years since one spaceship took a shot at another; and neither of those had crew aboard! You'll be put away for the rest of eternity."

DeRoot raised an eyebrow and laughed. "I'm betting not. You have, what shall we say, thirty minutes? DeRoot out."

Hilda called up a magnified image of the *Singer*. "Brad, Captain, look at the *Singer's* deflector cones."

As they watched, sections slid away to reveal ranks of tubes. Missiles. The starships were still about four thousand kilometers from each other—too far to use lasers effectively.

Brad looked at Hilda.

"It could be an empty threat," she said. "Or not. In the larger context, it may matter politically, if we do not give in until he actually commits an act of violence, rather than merely threatens. Personally ... Liz died for this. I can take the risk."

Brad nodded. "If it were me, I'd call his bluff, too. But it's not really our call. The people on this ship didn't sign up to fight a bloody war."

Captain Chenhansa shook her head. "Dr. Adams, I am commissioned by the IPA. With Dr. Zhau unavailable, you are the legitimate representative of the Project and carry, I think, the authority of the Solar System government in this place. My ship and I are at your service. Those who stayed aboard were volunteers. We are all of one mind. *Oberth,* notify everyone to find vacuum suits and helmets. Secure the ship for despin and zero gee."

Chenhansa looked at him and Hilda. "He is, unfortunately, positioned in our roll plane. Neither the dust deflection lasers nor the particle detonator lasers can bear on him or his missiles in this geometry."

That was a challenge to Brad. How could they bend the laser light sideways? With mirrors! "Look. We can rig up a mirror to redirect one of the anti-debris lasers and send a robot up the deflector cone with it. Not much compared to what he's got, but he won't be expecting it."

Chenhansa barely paused for a moment. "I have directed it be done."

Chenhansa's *sangfroid* surprised Brad. "We can't fire first."

She was silent.

A robot brought them their helmets and vacuum suits. They put them on in silence.

Precisely thirty minutes later, DeRoot's image was on the screen.

"Brad Adams here. Mate, what is all this nonsense? This is a research station. Everyone gets to share whatever we find out here. There's not a bloody imperial thing about it."

"Where is Captain Chenhansa?"

"I am here. We have decided that Dr. Adams' authority is highest in this matter. He speaks for the Black Hole Project and the Solar System government."

DeRoot laughed. “Which is seven light-years away and has no say in the matter. Very well. It is your ship, Captain, and on your shoulders rest the consequences. Ada, we were friends once, very good friends. You know I wish harm to no one."

Chenhansa's face was unreadable. “I was eighteen, Captain. However much I idolized you then, what happened was not friendship. I have a different role to play now."

Brad looked back and forth between them, realizing they had a history. The fraternity of starship captains was a small one, filled with large egos.

"Look, no one's been hurt yet,” Brad said. “You can still back off. Take the long view, if you will. History would never see this as anything but piracy."

"That depends on who writes the history. It would be interesting to ask Francis Drake. Begin to disengage from the hole. Now."

"No,” Brad said, before he could double—and triple-guess himself. This is what we planned, so this is what we do, he thought.

The *Oberth's* gong sounded.

Missile launch, fifteen gravities acceleration. Helmets on, now. Prepare for loss of air pressure!

"You bloody bastard!” Brad screamed.

I am depressurizing to ten millibars, Captain Chenhansa sent. *This will prevent a blowout and still leave enough pressure to let us check for leaks*. She looked at Brad then Hilda, her lips tight and her eyes narrowed. *Our mirrors are deployed, and we will fire on the missile when it is close enough.*

As they watched, the approaching missile fragmented into a large number of submunitions. One vanished in a vapor that let them see laser beams striking the others, reducing the swarm, but not rapidly enough.

There was a shudder throughout the ship and a great groaning noise as if the ship itself were crying out in pain. The deck rolled sickeningly. The screen blinked momentarily, then showed a cloud of vapor expanding around part of the smaller, forward magnetic field generation ring. Suddenly, as terajoules of magnetic energy became heat, the whole ring sprouted a crown of mist that was blown away by the black hole's Hawking radiation.

"The forward ring has quenched destructively,” Chenhansa said, stating the obvious. “They've also taken out primary power in hulls one and two. I suggest we have no choice but to back off now."

Brad nodded. DeRoot had damned himself; there was no point now in losing lives.

"I'm quenching the main loop,” Captain Chenhansa informed them. “We can use its stored energy to stay at full power for another half hour. We can back away from the hole as soon as its magnetic field is down to zero."

Brad ran through the spacecraft systems status. The main drive solenoid ring ran through all the spheres; an uncontrolled quench of that much energy would be like setting off a line charge through the middle of each of them.

Without the forward ring intact, the ship's structural integrity would be badly compromised. The structure screamed like a wounded animal as auxiliary thrusters attempted to counter the angular momentum imparted by the attack.

"DeRoot, this is the *Oberth,"* screamed Captain Chenhansa. “We are leaving. Cease firing! We have to clear the black hole."

Another explosion shook the ship, and they lurched downward, then back up as the black hole's magnetic field tried to snap them back into alignment.

The floor below lurched sideways and buckled up. He felt queasy. Lights blurred and dimmed. Brad's chair broke free and he slammed into the ceiling. Everything went black except the red lights on his helmet heads-up display.

* * * *

This, decided Zhau Tse Wen, was the appropriate and auspicious time to act. His guard, Micky, was fully occupied watching the drama playing out on the screen of the stateroom.

It was a small matter to step up behind the man unnoticed and close his hand around Micky's trank gun.

Regretably, Micky chose to resist. Unable to point the gun, he tried to pull away. Tse Wen placed a leg behind Micky's ankle and Micky lost his balance. He also lost his grip on the gun as the edge of Tse Wen's hand broke the bones in his wrist.

Tse Wen did not hesitate once he had the gun. He calmly shot tranks into the three other armed men before they finished turning from the screen to see what the commotion was, moving as he did so to complicate any possible return fire. There was none. He saw Micky writhing in pain on the floor and shot him, too. The tranquilizer charge would ease the poor man's discomfort until medical help could reach him.

Then he went into the bedroom and shot the two Campbell women who were minding Sarah Levine and the three other project personnel. Sarah rushed up to him, and after a brief but embarrassingly intimate hug, said, “So you think we have a chance?"

Tse Wen nodded and motioned to the CSU parked along the bedroom partition. “Kelly Barrett, one of the duty controllers, is in there. She would be most helpful. I need to go to cybernetics before they react. The Campbell AI program is looking for a way out of the box that the contingency program Brad activated has built around it. As things stand, orders from both sides are being ignored. We need to gain full control from here."

Sarah nodded. “Tse Wen, you might grab a red shirt on your way out."

He smiled. “It is not my color. But one of you should do so and replace the person I will shoot outside the door."

Tse Wen did so and moved quickly. No Campbell person stood outside cybernetics when he reached it, a somewhat surprising circumstance, but he heard footsteps in the corridor. He moved quickly to the door, hoping. It slid open. In one motion, he stepped through, moved to the side, shot the person in a red Campbell uniform shirt in front of one of the consoles and dropped into a crouch. The person, a woman, turned in surprise. As she did, two other Campbell people entered the door, aimed at Tse Wen, missed, and shot the woman.

There was no time to do anything but react. Tse Wen shot the Campbell people before they could react. As the door slid shut, he scanned the room; a fourth Campbell man lay on the floor not too far from him. He locked the door manually and rushed to the fallen woman who had, by this point, received a potentially lethal dose of tranquilizer.

It was Anna Messenger. If Tse Wen called for medical assistance now, she might be saved, but he would be unlikely to have time to regain control of the system. With great regret, he turned to the more important task.

His part of the system had informed him that while the Campbell AI was distributed throughout the system, an essential part of it was physically located in maintenance memory module eighteen. He located the maintenance memory rack, a box barely the size of his hand installed over the maintenance console. Its access panel had already been removed.

He reached in and pulled out number eighteen. He should be in full control now.

Medical emergency, trank overdose, this location. Do not notify Magda Lobacz.

He waited beside the door in a crouch. It hissed open and a robot gurney entered.

There were no Campbell people with it.

* * * *

For Kelly Barrett, doing her job from a plush chair in front of an ordinary stateroom screen seemed surreal. But the main operations and science amphitheaters were now essentially prisons from which people were being released only with due screening. And she had a lot to do.

Two starships were inbound, one on a vector from south of Campbell, and the other from Epsilon Eridani. Neither radiated anything, not even a beacon, on her instructions. Her heart pounded; they were flying into a hornets' nest and she had to keep the hornets ignorant long enough for these ships to finish deceleration.

The *Admiral Byrd* was scheduled, but vulnerable. On a closed beam, she advised them of the situation and recommended a silent and slow approach.

The other ship was coming from the right part of the sky, but way early and well off her deceleration beam. Tendrils of worry began to pick at her. It did not look like any human starship she had seen before. Four rings—three of them arranged small-to-large in *front* of the ship. The structure connecting the rings was skeletal, and the rings seemed thicker than normal. The aft ring looked almost familiar, with a sphere at the base of each connecting truss, but the cones were truncated, with various pieces of equipment exposed. *Identify?* she asked.

Unrecognized, the system said.

She smiled. The ship transformed as she watched it. Then structures began to vanish as if being eaten away. But the empty space that replaced it seemed distorted somehow.

What is that star field? she asked.

It is the one that lies behind us, as if reflected from a spherical mirror.

Or a shield, Kelly thought. A shield. It had to be her.

"Dr. Levine, come look at this. Peter DeRoot isn't the only starship captain who can rebuild his ship in flight!"

Sarah Levine looked at the strange ship, eyes wide. "Who...?"

"That is, or was," Kelly said, "the *Farseeker* out of Big Red, Kate Avonford commanding."

"How do you know?" Levine asked.

"I was one of her mates on the Tau Ceti mission. She wanted to come in unannounced, so she asked me to get the deceleration trail laid and tell no one."

"So here comes the cavalry," Sarah whispered, her voice full of wonder.

* * * *

In the *Singer's* wardroom, Gunheim looked at DeRoot. "What are you bloody waiting for, Peter?"

"Patience. I want a little more clearance between the wreck and the black hole."

Gunheim frowned at him. "Magda's lost control of the station. It's only a matter of time before they come up with something effective. The *Vulpetti's* lasers, for example."

"We are the only armed spacecraft in the area, and in a few hours, we will be the most powerful armed spacecraft in history. We will deal with that situation then. This has to be done right. While the hole is minute, it has enough gravity to exceed all countervailing forces. It can, and will, suck in any matter that comes within a meter or so."

"Huh? The electron shells of atoms withstand..."

"The electron shells of atoms will be eaten first, then electrostatic forces will add to gravity. I must proceed carefully. If I do not..."

An attention tone from the *Singer* interrupted him. *A mass of about four thousand tons is approaching at twenty kilometers per second. On its present trajectory, it will pass ... has passed, by within three kilometers.*

"What the bloody hell? On screen, magnify."

The screen showed nothing but a distorted star field.

It is almost perfectly reflecting, the *Singer* told them. *Doppler measurements indicate the reflections are decelerating at eight gravities.*

"Bloody aliens, Peter. They must have been watching."

"That doesn't seem reasonable to me, but if so, there will be very little we can do. If they want something, they will let us know. More likely, Hilda Kremer is playing some kind of trick."

The *Singer's* approach to the hole was agonizing. Two minutes went by, then four. The unknown vessel was now accelerating toward them.

Finally, they were hailed. A stern woman in a full vacuum suit stared from the screen at them. Incredibly, there was music in the background.

"Captain DeRoot, Roger Gunheim, crew of the *C. E. Singer,* and occupation forces aboard the Chandrasekhar Station: This is Captain Katherine Avonford of the Solar System Starship *Farseeker.* I am declaring this area to be under martial law under IPA code, Chapter Four. Any Lacaille 9352 residents holding weapons are ordered to put them down now. *C. E. Singer,* close your weapons bays."

Gunheim turned to DeRoot. "What the bloody hell is *she* doing here? What kind of starship is that? And why the background music?"

DeRoot looked at Gunheim in surprise, then straightened his face. “I would venture that what we see reflects modifications she made while traveling here. The music was Wagner's *Ride of the Valkyries*, which could have several meanings in this context. But I'd say she knows about Elizabeth and is ready for hostilities."

Gunheim raised an eyebrow. “Then we should shoot first, Peter.” Gunheim flipped his hand as he would against a fly.

DeRoot's shook his head. “That mirror is over ten kilometers across. The *Farseeker* is only two hundred meters across. We don't know where she is behind there."

"Well, shoot the bloody missiles through it. They'll find ‘er."

"Not in time to prevent her from shooting back, Roger."

Gunheim laughed. “Well, that's why we built this fort, isn't it, mate? You're giving her too much time to think. Get rid of ‘er."

Peter nodded. He had much less confidence in the result than Roger, but it was either fight or lose the whole effort. And if to fight, best to strike first.

* * * *

Kate Avonford sat tense in front of her screens. Hailing was a calculated risk, designed to save lives. DeRoot knew his classics; *Valkyries* should unsettle him a little, reinforce the notion that she was crazy enough to fight. So he should know he was in deep trouble—but there was always a chance that wouldn't matter to him.

"Oberth, this is *Farseeker.* Katherine Avonford in command. How are you doing, Ada?"

Kate heard Chenhansa's distinctive voice, “Kate, Ada. Please stand by.... We're a mess. We didn't get the main quenched in time to detach from the hole, and the last blast from DeRoot got us resonating with it. The sphere shells are intact, but everything inside was wrecked. Sphere Two is leaking, Three has minor damage, and our floor got bent up and back again, with lots of torn composite. Muck from the park pond is all over everything. We're in suits."

The *Farseeker's* parks were frozen solid. “Sorry to hear. I'll try to give you some time. Hilda?"

"Mother, I'm here. I know about Liz."

Oh, to want to hold your child or have her hold you! And there was no time, no time.

"A heroine's death, Hilda. We honor it now. Are you injured?"

"I got a bump on the head, but it seems okay now."

About the same time as Hilda said bump, Kate felt a hard pull to the left.

Incoming missiles. Six, ten, fourteen. We are initiating evasive maneuvers and engaging them with lasers.

Kate's blood ran cold. “Later, Hilda, I'm under attack."

She would have to launch her counterstrike while she still could. The hundred relativistic kinetic energy weapons in her trail were now entering the Shiva system at fifteen-minute intervals. The bottle-sized objects were calculated to punch holes—to cripple, not destroy—but that was only a calculation. People

would die. She sighed.

Activate the trailers, two groups. Take out the forward ring and the missile magazines in the cones.

Kate was shoved down and forward as she sent that. Behind its reflective screen, pushed by the thrust of its fusion engines in two directions, the *Farseeker* began to accelerate on a complex compound curve with continuous random changes designed to confuse the guidance of incoming missiles.

But there were limits. The homing missiles were literally a million times more agile than the massive *Farseeker*. Despite evasion, lasers, and last-second warhead-disabling magnetic pulses, three of DeRoot's missiles got lucky. One cone-based laser battery, then another, went off line. The third smashed the fusion rocket module off the bottom of Sphere Two, with shrapnel damage to the other two. The *Farseeker* was down to lateral thrusters only until repairs could be made.

The flood of missiles stopped. The screen was essentially intact—the pinprick points where the missiles went through healed themselves in seconds, and the magnetic fields kept the screen in shape and in its well off-center position. With luck DeRoot wouldn't even know the results of his strike.

The trailer command system is off line, the *Farseeker* reported. *Mode A went with the Cone Two laser battery, and mode B was damaged by shrapnel from the Cone Three hit. Estimate time of repair: three hours.*

Kate bit her lip. Until then she had one laser battery and a flimsy mirror. Reality sank in. Bravado had not worked, her brilliant bubble had not worked, and she was down to her last chance and only one shot at that. Meanwhile, another strike from DeRoot could arrive at any moment. She told the crew to abandon ship while the robots did the repairs.

* * * *

"Did we get her?"

Peter DeRoot frowned at Gunheim, hesitated, then nodded. “The mirror screen's still there, but there's been no response. I think so."

"Okay, now let's stop yabbering and take the black hole before anything else happens!"

A warning clang and red lights erupted through the ship. *Interstellar debris deflection system activated.*

"What the bloody hell? We aren't moving,” Gunheim said.

But Peter, trained to react instead of question in such circumstances, already had his helmet on.

One, two, three, four loud explosions echoed through the ship in rapid succession before a brilliant flash filled the room, followed by a blast from the bulkhead behind Roger. It threw Roger's body into DeRoot with a force that knocked the wind out of him. Chairs tore off their mountings. Debris flew past him and bounced off walls, ceilings, and floors. A tremendous low-toned howl drowned out all other sounds.

Incredibly, in the direction of the blast, Peter glimpsed a patch of empty space, maybe six centimeters across, through the metal and ice. Objects streamed out through it. A relativistic kinetic energy weapon, he thought, an RKEW. A grim smile spread over his face. Too fast. The real explosion must have taken place a kilometer or so beyond where the mass flew through the ship.

What was left of the wardroom filled with damage control robots. Moving with incredible rapidity, they

plugged the holes and began taking out the debris.

One look at Roger confirmed the worst. The RKEW had punched a hole right through where the man's heart had been.

"Thanks for the ride, Roger," he said to himself quietly, and left the cleanup to the robots.

Damage, casualties, status? he asked the ship.

The forward ring quenched, estimate six days to return to operational. Major damage to all missile batteries. After repair, we may have ten missiles left.

There would, he thought, probably be a second wave.

Shed the cones and fly the rest of us away from them on fusion rockets. Casualties?

Five dead by decompression. All in this sphere.

I'll move command to Sphere Two, if the passage is clear. What's the status elsewhere?

There's another starship inbound, unannounced. The Admiral Byrd, *from Epsilon Eridani.*

Captain Lee, he recalled, who was as cool-headed as Kate was hot blooded. There was only one way to success now. The black hole itself could be used as a power source and a weapon, with the proper preparations. They had made the preparations—once they had the hole, they would be invincible. But they had to get it *now.*

After getting out of the wreckage of the wardroom, DeRoot was a little more heartened. The structure had pretty much held two meters away from the strike line.

In Sphere Two, he watched the second wave of RKEWs punch holes through what was left of the *Singer's* cones and his remaining missiles. He addressed the remaining crew.

"I have every reason to believe that was the *Farseeker's* best shot, and it may well have been posthumous—they are silent. Our maneuvering engines are intact. We have three batteries of lasers, two intact spheres with one repairable. Once we possess the hole, nobody will be able to interfere with us. We are going to proceed with the mission. Just in case Avonford is not done, we will approach the black hole so that the wreck of the *Oberth* lies between us and the direction of her RKEWs. Once in position, we'll use the sphere base laser batteries to quench the *Oberth's* main ring, blow holes in her spheres, and vaporize her shielding water. The reaction of escaping steam should be sufficient to push it away from the hole. DeRoot out."

* * * *

Chapter 5

On the *Oberth* in orbit about Shiva,

25 December 2284

What was left of the ship was a complete wreck, Brad thought. Utilities were off line; there was still energy in the main ring, but no way to distribute it. Cybernetics had fallen off line for lack of power. Some robots were still active, uselessly trying to bail an ocean of debris. Captain Chenhansa, to do something, was trying to help them.

Kate Avonford, in the immobile *Farseeker,* was trying to keep them informed over their suit radios.

“What's left of him is coming for you,” she said. “Can you get out of the way? I should be maneuvering again in ten minutes. I may outgun him now."

Captain Chenhansa answered. “Almost everything here is down from the shaking. Our maneuvering engines are probably intact, but we can't get power or data to them. This ship was not designed to fight battles."

"The two that were, kind of, are wrecks as well,” Kate said. “In hindsight, this was all a very bad idea. Fortunately, so far, everyone was shooting to disable. So you're still stuck to the black hole?"

"With our systems down, we have no way to quench the main ring field,” Chenhansa replied, “so it is still coupled to the black hole's field. That is just as well—we do not want to drift into it."

"Also,” Hilda added, “the particle component of the Hawking radiation would be bad if it were not for the field's protection."

Brad unstrapped and pushed himself away from the chair. The ceiling above was almost touching the wardroom's small central table. “There's more elbow room here near the walls, mates. I've got an idea. It's a bit dicey, but if we dump some water on that thing, it should behave like a small version of a galactic nucleus, with a bipolar pair of plasma balls."

"I can't do any simulations,” Hilda said as she joined him, “but I don't think you get symmetric outflow unless the input is equatorial."

"Exactly. If I dump stuff in the north end, it gets spit out the south end faster. We get a big plasma ball behind us and that should push us away from the hole with more force than the magnetic field holds onto it."

"It could work ... if the ship can take the stress,” Hilda said.

"It should if the stress is small, steady, and on axis,” Captain Chenhansa said. “Large oscillations are the problem.” There was a creak and a groan as the captain pushed a piece of intruding partition out of the way and joined Brad and Hilda.

"Hi everyone, Sarah Levine here. Sorry for the delay; we had some fun figuring out the *Oberth's* suit radio protocol. The Project is fully back in control of the base. We're trying to come up with a way to aid you with the propulsion beam drivers, but they aren't pointed anywhere near the right direction. It takes hours to rotate them a milliradian. Brad, Hilda, we *can* do simulations and your mass dump into the hole will work, though exactly how well is very dependent on initial conditions. Brad, more help is on the way. *Admiral Byrd* is inbound. Captain Lee Hyun Sil and Dr. Bruce Macready."

"Brad Adams here. Hi, Sarah. This ship won't endure another blast from DeRoot either. He's taken casualties, and my guess is he won't be aiming to wound this time. Regards to Dr. Macready and tell them to bloody *hurry*."

"Zhau Tse Wen on. The *Admiral Byrd's* arrival may have already forced this move on DeRoot's part. He may believe that gaining the black hole is his only option now. That is not incorrect."

"Captain Chenhansa on. At this point, we would give it to him, but it is magnetically stuck to us. Dr. Adams ... Dr. Adams has left the area."

There was very little time, Brad realized. He pulled himself out of the wardroom into the central section of the sphere. The park floor had split, dumping tons of wet soil and dirty water into the area. It was pitch black and turning on his helmet light didn't improve things.

"Adams on. I'm going to try to find some way to throw water into the black hole. The resulting plasma blast should push us free." It also might do a number of other things, Brad thought, but there was no time for analysis. "I'm on my way to the rotary joint between the sphere and the ring. That's the strongest place on these ships and should be intact. There's a galley and a head there, so maybe water and something to put it in."

"Chenhansa on. I'll try to get some people there to help. We have several with extravehicular activity experience, but as you can tell, it's difficult to move around."

"Adams on. Roger that. No problems there, but I'll likely have as much EVA time as anyone."

He didn't add that he was inventing what to do as he went along, and that went more efficiently alone. He worked his way through debris and around a collapsed floor section to the galley. The part near the sphere's hull was reasonably intact, but everything was badly bent and twisted inboard.

He felt a hand on his shoulder and turned his body to see a long spacesuited figure.

"Dr. Adams, Jomo Oboto." The male voice was very faint in the rarefied atmosphere. "I'm a botanist, but cooking's my hobby. I was hoping to salvage something, but..."

"It's a bloody mess," Brad said, in sympathy. "Look, we're looking to feed some mass into the black hole. There's plenty of water, but we need some kind of container. Something that will hold up to a lot of radiation for a few seconds, at any rate."

"Understood. One of our standard trash bags might do. They're designed to withstand a drive flare long enough to avoid splattering the hull. Properly sealed, they might hold up to a dozen atmospheres in vacuum."

"That sounds good," Brad said. It would have to do.

Oboto rotated his body and reached for a cabinet door under the counter. The whole structure was warped, and it wouldn't open. He motioned for Brad to help. "Grab the sink with one hand and hold my belt with the other."

Brad maneuvered into position and grabbed Oboto's belt firmly.

Oboto gave a mighty kick at the reluctant door. It broke open with a loud snap.

"Kremer on. Careful of Ada's spaceship, Brad."

That produced a round of ironic laughter.

They were able to pull the pieces off separately. In the cabinet, there were three rolls of bags of different sizes.

"Looks good," Brad said. "Where do I get water?"

Oboto tried the kitchen tap. Nothing. "A safety valve probably cut off the line. There's a feed/drain line outside the main connecting ring that will open mechanically from inside the ring opposite the emergency access hatch. You'll need a hose." He reached under the sink, disconnected one of the water lines and handed it to Brad. "Standard push/pull fitting."

Brad recognized it and smiled to himself about the contrast between this ordinary object and the extraordinary circumstance in which it would be used. "Right. Bag sealers?"

Oboto shook his head. “Just twist it around and stretch it a bit. The stuff will bind itself."

"Right. I best get at it."

Hilda Kremer appeared. “Nothing to do where I was."

It took all three to push open the door from the sphere into the connecting tube just outside the rotary joint. In contrast to the devastation in the sphere, the passageway in the tube showed no sign of damage. They closed the door after them to limit air loss to the connecting passage.

Brad found the emergency exit in the “forward” side of the tube that would be overhead under thrust. He removed the access panel, revealing a tiny view port and a levered sliding seal designed to be opened manually against pressure.

"We'll need a tether,” he said.

Oboto nodded. “There should be an emergency kit in a red box near the hatch. In it will be a tether spool, space tape, a spare recycle catalyst canister, an EVA maneuver pack, and a net."

"Roger that,” Brad said. He found the red box and opened it.

"Let's see. Hilda, you can belay the line while Oboto operates the valve."

"That sounds like a plan,” Hilda said.

Brad nodded and Oboto opened the hatch, creating a small gale as what was left of the atmosphere in the connecting tube rushed into space.

They put the net out first and shoved the roll of water bags into it. Hilda attached the EVA maneuver pack over the life support unit on Brad's back. Its telltales blinked green in Brad's helmet display as it came on line. She gave him a hug and touched her helmet to his.

"Brad, if we get out of this..."

He gave her a brief, one-armed squeeze back. “She'll be right. Just you watch."

Then he exited the hatch feet first, letting himself be blown into the net on top of the water bags. His radiation alarms went off—the Hawking radiation was still over limits with the black hole a hundred meters away.

That, he thought grimly, was nothing compared to what he was about to get.

The rush of air from the hatch helped push him out and gave him the feeling of hanging down. Oboto handed him the tether reel, and he clipped its free end to a stanchion near the hatch and the reel to his belt. Then he shut the hatch.

He had no time to feel isolated. He found recessed handholds in the connecting tube hull and used them to pull himself over to the outboard side of the ring. With the ring between him and the hole, it was suddenly very dark. His helmet light came on, illuminating an almost featureless hull.

He spotted the spigot cover about ten meters from where he'd come round the hull.

"Adams on. Got it."

The cover popped open at his touch, revealing a handhold as well as the spigot. He attached the hose

Oboto had given him and felt the connector click hold.

"Adams on. Give me just a bit of water, mate," he said, holding the thumb of his suit glove over the end of the line.

"Oboto on. Wilco."

When Brad felt the tube stiffen with pressure, he released his thumb and a cloud of steaming water jetted out. The temperature of the water was barely over freezing, but that was enough to make it boil in vacuum.

"Close," he said.

"Oboto. Wilco."

Brad hooked his toes under the handhold to steady himself, pulled a bag off the roll, and worked the end of the tube into the open end. Then he gathered the material around it and wrapped space tape around that.

"Adams on. Okay, give me a little again." The bag inflated instantly with water vapor, rigid and spherical. It looked like it might hold almost a cubic meter of water, if it would fill.

It was too dark to see anything in the bag. He would just have to trust. "Okay, more."

The line vibrated and the bag began to feel heavier if he moved it. The volume of vapor would get less, condensing back to liquid as the pressure in the bag increased. With luck, he would end up with a bag full of cold water.

He did. As his eyes adapted to the night, he could see the brighter stars through it, distorted as if through a great lens. The internal pressure kept it stiff, more like a huge basketball than a blob of jelly.

He filled four bags altogether and put them into the net. Then he worked his way back over the hull into the brilliance of the black hole's Hawking radiation.

The gravity of the black hole was very slight at the distance of the ring, but enough to give direction and pull the tether taut as Brad lowered himself and the water bags toward it.

"Hilda on. Brad, we've got AI restored. I can give you guidance."

Her face filled the tiny view port in the emergency hatch. She sounded much more confident, Brad thought. He used his maneuvering unit to gently push himself a little bit forward of the spin plane. He stared through one of the bags. It formed an ersatz lens, providing a distorted, magnified view of DeRoot's *C. E. Singer,* approaching.

"Adams on. I can see the *Singer.* It's missing its cones. No radiator area—they'll be limited in how much power they can use."

"Avonford on. We're maneuvering, but not fast. Maybe thirty minutes to laser range. Give us some time if you can."

"Chenhansa on. Roger that. We're going to try to push ourselves free of the hole."

Brad watched the *Singer* approach. If it kept on that course, he thought, it would be within a degree or two of the black hole's spin axis in a minute. Of course. Since they meant to get the hole, they would approach on its spin and magnetic axis. There was no saying for sure, but the results could be bad.

Should he warn the *Singer?* It was a volunteer crew, he told himself.

"Kremer on. Come forward four degrees if you can, tether taut."

"Adams. Roger."

Damn, he told himself. Keeping silent would be murder. Simple bloody murder. “Adams on. Check the geometry. If we get polar jets, we might toast the whole mob."

"Kremer on, roger that. Brad, push the bag directly toward the hole from your present position. I'll start the countdown."

"Starship *C. E. Singer,* this is Captain Chenhansa, *Oberth,* issuing a maneuver exhaust warning. Clear aft. Now. Repeat, maneuver warning. Clear our aft now."

"Kremer on. Four, three, two, one..."

Brad released the bubble forward with a gentle push as Hilda hit zero and held his breath. The bubble moved toward the hole with ever increasing speed. He immediately began reeling in tether, damping the swing with his maneuvering unit. He wanted to be in the equatorial plane of the hole when the bag hit. “Hilda, the bag is rotating. Will it...?"

"It's on course. Hang tight, Brad. Watch through the other water bags."

"Wilco.” At twenty meters, the bubble began to accelerate. It took on the shape of a teardrop, pointed end at the hole. The back end of the bag burst as it accelerated into the hole, but it was too late for any of the mass to escape. Suddenly it was gone.

* * * *

Captain Peter DeRoot played the message again with a sardonic grin on his face. “Starship *C. E. Singer.* This is Captain Chenhansa, *Oberth.* Maneuver warning. Clear aft. Now. Repeat Maneuver warning. Clear our aft now."

"Don't believe it,” Peter DeRoot told his crew. “They just want us to give the next waves of RKEWs a clear shot at us. This we are not going to allow. We will fire presently."

DeRoot's view of his target was not clear. The black hole's brilliant Hawking radiation cast everything in harsh contrast, and the area was cluttered with all sorts of debris. The main spheres of and ring of the helpless *Oberth* showed up well enough, however. He would fire his three laser weapons in two rounds. The first would quench the *Oberth's* main ring, releasing the hole. The next would turn the habitat spheres into steam rockets, pushing the remainder of the doomed ship away.

He'd known Ada Chenhansa for over a century. If circumstances were different ... But this was no time for sentimentality—the project people were back in control of the operations base, all his bridges were burned, and Roger's legacy was at stake—the vision of a humanity spurred on by great thoughts and great deeds, rather than the mundane compromises of timorous bureaucrats. No, this was no time for weakness. Still, he did not want Ada on his conscience for eternity. The great man controls events to his will, he told himself, rather than lets events control him.

"Ada, Peter. Sorry, but this is a bigger thing that I am about than either of us. Abandon your ship now if you can. Someone will pick you up in ... what?"

The black hole appeared to have exploded, with brilliant plasma covering everything before the screen went dark. Alarms and red lights burst out everywhere.

"Oh, shit.” He felt like he had a terrible fever and saw objects all around bursting into flames. In one last moment he saw that he, himself, was burning and lifted one flaming hand in wonder. Then a thunderous boom ended it all.

* * * *

Brad found himself suddenly in a shadow. It was as if the black hole had vanished for a moment. Then two violet searchlights lanced out from where it had been—along the ship's and the hole's lateral axis. The rearward one might have been the brighter, but he couldn't be sure. The tether jerked him firmly. In a moment of recovered focus, he dumped the net and jetted forward and out toward the ring hatch. He had only time for a glance in the *Singer's* direction and saw only what looked like a cloud at the end of the violet beam.

The emergency hatch opened as he arrived, and a robot's arm reached out and pulled him in with ruthless, painful efficiency. He realized he was hot and feverish. The robot pulled him along into the galley. He felt queasy, sick. He couldn't see.

Someone jammed a hypo against his arm, right through the pressure suit.

"Hey, ouch..."

He was suddenly tired, very tired. He managed to retch once into his helmet.

"Sorry for the mess..."

* * * *

In the Operations Section amphitheater, Zhau Tse Wen watched the screen fill with the expanding cloud of vapor that had been the *C. E. Singer*. Somebody cheered.

It was, he reflected, his fault in a way. Had he anticipated an effort to steal the black hole, the people on that ship might still be alive. He raised a hand for silence and sent his voice through the address system.

"Friends. Whatever the flaws of his last adventure, Captain Peter DeRoot was legend among the stars. He was an extraordinary astronaut who opened five new planetary systems, rescued three disabled starships, and had a vast love for the history and continuity of the urge for humanity to explore and seek beyond what we know. What has just happened is tragic on many levels. I ask all to observe a moment in silence for those who are no more and to contemplate our own misadventures."

Quiet spread among the project staff, reporters, and Campbell people who had surrendered weapons and pretense of authority—some literally ripping the red shirts from their bodies.

After what he thought was a decent time, Tse Wen set people about the work of adjusting the carefully prepared postimpact plan to actual events.

Kelly Barrett was still on station.

"You seem to need no rest,” he observed.

She turned to look at him with a smile that took any sense of irritation out of her words. “Dr. Zhau, I slept through the most important event in human history, damn it. I may never sleep again!"

He had to smile at that.

"Farseeker is in her final approach to Dock Seven. The hatches should be open in ten minutes. The *Admiral Byrd* is due in fifteen minutes at Dock Three."

"Thank you," Tse Wen said. "I will go to the Science Section and get Dr. Levine. We shall go up to meet it together."

The door to the Science Section slid open as he walked in. The mood here was one of quiet business. They had lost a heartbreaking amount of data, but what they had still filled banks of qubit memory files. There was not a little element of tension in here; if any radically new science was to be found, the chances were that it would show up in these first hours, and everyone wanted to be the first to spot it.

Sarah walked by Torsten Ried, who was talking to his pickup. He turned toward her, but she passed by, barely acknowledging his presence. Tse Wen frowned. Ried was still, after all, a chronicler of the event and an important person in the long run.

"He gives me the creeps," Sarah Levine said when she reached him, as if she had read his mind.

He simply nodded and followed her to the central docking complex to await the arrival of *Farseeker* and its load of radiation and trauma casualties from the *Oberth*.

When the lock opened, the crews of two damaged starships emerged, some heavily bandaged, others obviously not feeling well, many seeming dazed, but almost all with smiles of a victory that at least for now anesthetized their discomfort. Tse Wen greeted each of them with a handshake, thanking them for their efforts and sacrifice. Sarah Levine hugged everyone who seemed willing to receive one. Finally, Hilda Kremer and Ada Chenhansa came out. Sarah got to Hilda first, so Tse Wen took Captain Chenhansa's hand.

"We haven't met before. I am honored," he said.

Her eyes glistened. "And I as well," she said.

Sarah brought Hilda over to them. Hilda looked like she should be on a stretcher, and had she not been in zero gravity, Tse Wen thought, she might well be.

Then a ghostly parade of coffin-like CSUs emerged. Many inside were clinically dead before freezing, though for a short enough time that revival in some form at least seemed possible. Moving on magnetics and turning with flywheels, they floated out of the *Farseeker,* across the anteroom, into the cargo lift door, rotated ninety degrees, and vanished down the tube headed for the station infirmary. Bradford Adams would be in one of those. *Which one?* Tse Wen asked.

F29. It is exiting the lock now.

Tse Wen pointed to it and Hilda rushed forward to put her hand on it, then walked it across the anteroom with tears in her eyes. Tse Wen touched the CSU briefly as it went by. He collected Hilda at the exit and gently pulled her back to the group.

As the last CSU left, an average sized man in a trim dark tunic and trousers entered.

"Glad I'm nae in one of those!"

His accent identified him instantly. Dr. Bruce Macready, the Scottish science historian who had inherited leadership of the Epsilon Eridani impactor project and managed his way to a successful launch under extraordinary difficulty.

"Bruce!" Tse Wen exclaimed. "You help lift a heavy heart. Welcome!"

"Aye, but if we could have only been a bit earlier."

Tse Wen stepped forward to embrace the Scot—a gesture so out of place for both of them that it signified the most profound of circumstances. They released each other and shook hands.

"Do you have any left?" Tse Wen asked.

"One bottle," Macready said, shaking his head. "Which I fear will be gone tonight!"

Sarah smiled and held up her hand. "Okay guys, I have some physics news. You heard it here first. They've just finished the before-and-after mass and energy totals for the water Brad dumped into the black hole. And, by the way, we need to thank Peter DeRoot for putting his starship where it could provide a calibration point in the bipolar flow."

"Sarah," Tse Wen said, reprovingly.

She laughed and a brief smile flashed across Chenhansa's face.

"Anyway," Sarah continued, "we're short about three kilograms."

"Three?!" Tse Wen was intrigued. While it might sound small, it was, in fact, enormous. If the result held up, two hundred seventy thousand terajoules of mass-energy had simply vanished.

"Where did the rest of the mass go?" Captain Chenhansa asked.

Tse Wen shook his head. "For almost three hundred years, people have speculated that there is no way to know what happens to mass that enters a spinning, charged black hole along its polar axis. The singularity is ring shaped. There is an event horizon, but it is essentially flat within the ring—what goes that way is not crushed into a three-dimensional singularity."

"For all we know, it may have left this universe without a trace," Sarah said.

"Left this universe?" someone asked.

Tse Wen shook his head. "That is very speculative. We will have to review the bookkeeping of mass-energy very carefully."

"Tse Wen, Sarah," Hilda said. "If that can happen here, it would happen elsewhere. Much of cosmology assumes that the mass/energy density of the universe is constant. If it can change like this, cosmological issues that have been thought settled for centuries would be open again."

Tse Wen still felt very skeptical about this, but it was good to see some life in Hilda's eyes.

"Well, maybe," he said. "There is no good model for what happens on the other side of a Kerr-Neumann geometry."

Captain Chenhansa smiled benignly, hands folded. "I have always wanted a wormhole drive."

"We would not know how to build one," Tse Wen said.

"Yet," Hilda added pensively. "But we've paid a high enough price for one, I think."

"Hello from Big Red!" Kate Avonford's voice rang out as she walked from the access tube. She wore a tight-fitting, coal black jumpsuit with a flashing diamond captain's badge over her left breast. Platinum hair cascaded dramatically over her shoulders. She looked around and shook her head. "You would have thought you'd lost the battle instead of saving the culminating achievement of human history!"

"Mom!" Hilda said.

"Hilda, cheer up. The dragon is dead, the would-be gods are vanquished, our fallen will be immortalized, our wounded are being cared for, and we Rhine maidens have our ring back! So let's head for the *Melbourne* and raise a pint to Brad!"

Even Tse Wen had to smile for a moment, before his mind went back to questions of missing mass and missing people. The culminating achievement of human history? He considered Big Red, a star that would still be shining a trillion years from now. They stood, he thought, not at the culmination of human history, but at its very beginning.

(EDITOR'S NOTE: Earlier stories of the Black Hole Project include "Kremer's Limit" [July/August 2006], "Imperfect Gods" [December 2006], "The Small Pond" [March 2007], and "Loki's Realm" [July/August 2007].)

* * * *

We welcome your letters, which should be sent to **Analog,** 475 Park Avenue South, Floor 11, New York, NY 10016, or e-mail to **analog@dellmagazines.com**. Space and time make it impossible to print or answer all letters, but please include your mailing address even if you use e-mail. If you don't want your address printed, put it only in the heading of your letter; if you do want it printed, please put your address under your signature. We reserve the right to shorten and copy-edit letters. The email address is for editorial correspondence *only*—please direct all subscription inquiries to: 6 Prowitt Street, Norwalk, CT 06855.

[Back to Table of Contents]

THE REFERENCE LIBRARY by Tom Easton

The Execution Channel, Ken MacLeod, Tor, $24.95, 285 pp. (ISBN: 0-765-31332-4).

Bright of the Sky, Kay Kenyon, Pyr, $25, 459 pp. (ISBN: 978-1-59102-541-2).

Hydrogen Steel, K. A. Bedford, Edge, $19.95, 367 pp. (ISBN: 1-894063-20-1).

The Outback Stars, Sandra McDonald, Tor, $25.95, 416 pp. (ISBN: 0-765-31643-9).

Land of Mist and Snow, Debra Doyle and James D. MacDonald, EOS, $7.99, 304 pp. (ISBN: 0-06-081919-7).

Soon I Will Be Invincible, Austin Grossman, Pantheon, $22.95, 279 pp. (ISBN: 978-0-375-42486-1).

Fantasms, Len Bailey, Tor Starscape, $17.95. 299 pp. (ISBN: 0-765-30982-3).

The Arkham Alphabet Book for Children, Darrell Schweitzer, Zadok Allen:

* * * *

Ken MacLeod has the knack of writing exciting fiction with a strong socialist/anarchist bent. His latest novel, **The Execution Channel**, saves that for the punch line. Leading up to it, he gives us a world where 9/11 happened in Boston and Al Gore led the nation into war, as if to say the mess that is the current war on terror is too situational to blame on Bush. That said, MacLeod's extensions of the war on terror look far too likely for comfort. The US has declined economically, but still wages war wherever terrorists are to be found. Surveillance is omnipresent, and security agencies spend an enormous amount of time spreading disinformation via the blogosphere, something that should sound familiar if you've been paying attention to the news.

So here is Roisin Travis, a peacenik spying on an airbase in Scotland, now owned by the US. Her brother Alec has blogged that something funny has been going on in the ‘stans. She is taking pictures as a plane lands and disgorges a mysterious device. Shortly after she leaves the scene, an enormous explosion turns the landscape bright as day. Scotland has apparently been nuked! Meanwhile, her father James, a British patriot who has been serving the French as a spy, has got the word and hit the road to find a hiding place. Unfortunately, the highways are blocked, and all too soon explosions are setting off refineries and bringing down bridges. Surveillance reveals that Roisin is near one site, and James near another.

What is going on? Was it a nuke? Strange tech that blew when someone goofed? Stolen tech with a remote switch? Does it have anything to do with the Chinese and Korean cities that have just been roofed over with Fuller domes and equipped with what are rumored to be anti-missile defenses? Is Armageddon at hand? Everyone wants to know, and the Travises look suspicious as hell. Soon Alec is being brutally tortured. Roisin is being pursued in hope that she will lead the troops to her dad. And an American blogger is trying eagerly to sort through the documents that have been “leaked” to him. Sure it's disinformation. Mark Dark knows that, but there's a pattern, and as he puts things together he discovers that the world is deep in “WTF” territory. When those domed Chinese and Korean cities are replaced by smoking holes in the ground, he announces the advent of “Battlestar America."

But he's wrong, in a way that will both delight and frustrate everyone who remembers the work of James Blish. The frustration has a lot to do with the punch line I mentioned above, but if I go into detail, I will frustrate you in another way. So I won't. If you want to know what the heck I mean, you'll have to go

buy the book. You'll enjoy it.

* * * *

Kay Kenyon begins her "Entire and the Rose" series with **Bright of the Sky**, and it looks like her readers will have a good ride despite a few "waitaminnit" moments. There's superscience, hypercosmology, and adventure galore, and the characters are sufficient to maintain the reader's interest.

In Kenyon's future, humanity travels the stars in Kardashev (hyperspace) tunnels maintained by the Minerva Corp. Unfortunately, ships are being lost, and as the novel opens, a space station is in trouble: Its artificial intelligence has apparently dived into its navel and stopped maintaining life support. Some of the crew makes it into the escape capsules in time, but not before young and ruthless Helice Maki grabs a data dump which, when analyzed, reveals that the AI had detected and promptly focused on—to the exclusion of all else—evidence of a parallel universe.

Jump to the home of Titus Quinn. Years before, he was on a ship that vanished in a K-tunnel. A bit later he turned up on a distant planet, claiming to have been in a parallel universe and to have lost his wife and child there. However, his memories were full of lacunae and no one believed him, despite the mystery of how he got from where he disappeared to where he turned up. He became a batty recluse. But now a Minerva rep and old friend, Lamar Gelde, has arrived to say he can be believed after all, and the bosses would like him to go back. With the K-tunnels failing, a way to travel from hither to distant yon via a parallel universe shortcut may be just the ticket. He could investigate, negotiate, and bring home the bacon.

It takes a while, and Helice Maki has to display a nasty talent for exerting pressure, but eventually he agrees. Maybe he can find his wife and daughter and recover the missing memories. And soon he is learning about the Entire, a universe that tunnels through our own and is ruled by the monstrous Tarig who discovered the Entire eons ago and filled it with copies of beings from the Rose. That's our universe, so called because Earth has roses and the Entire does not, and here is the first waitaminnit—the Tarig can copy people but not plants? But never mind. My objection is hardly crucial when the author's point is art and it works pretty well on that level. More important is that the Tarig do not remember Titus Quinn fondly. He needs allies and disguise if he is going to get anywhere, and since this is Book One, the reader can be confident that he will find those and make rapid progress. And so he does. He even learns where his daughter is—blinded by the Tarig and sent off to the land of the Inyx, telepathic herd beasts who crave riders but insist that they be dependent on their steeds' senses. He is even well on his way to find her when a friend finds a message left by his wife—who may or may not be dead—reporting on a colossal danger to the Rose. He must, if he can, stymie it. But long before he can do that, he is fleeing for his life, back to the Rose with neither daughter nor wife in hand. Memories, however, he has in plenty.

The shape of the next volumes seems clear. Titus Quinn must return. The threat to the Rose must be removed. The daughter must be found. Friends must be reconnected, especially the one who seems to hold some promise of romance. Questions must be answered: Will the Entire devour the Rose? Will the Rose try to conquer the Entire? Peace or war? And is Titus's wife alive or dead?

K. A. Bedford is an Australian writer who has received considerable attention in his native land. Judging from his latest, **Hydrogen Steel**, he has a little ways to go before he has complete command of his material—but only a little ways. Keep an eye on him. He's already good and should get much better.

Hydrogen Steel begins with retired police detective Zette McGee telling the reader that her dad was fictitious. She is, you see, an android or "disposable" who woke up and became fully conscious. She doesn't know what or who she really is or where she fits into the human world around her, and she agonizes endlessly over her existential plight. To me this is an example of Bedford lacking command, for if he had cut back a bit the book would have been much more readable. Be that as it may, she gets a

message from a Kell Fallow, who says he is accused of killing his wife and kids, he didn't do it, he's on his way to her, stowed away in a cargo container, and oh, yes, he knew her back at the factory.

Zette enlists the aid of old friend Gideon Smith, a man of intriguing past and spookish capabilities, and they get to the spaceport just in time to learn that Fallow had a bomb in his guts and has blown up. Immediately thereafter, Zette's home is trashed, and her security system doesn't react because it thinks she's the trasher—at least till "she" sets the place on fire. When Zette and Gideon take his Victorianized spaceship to go to Fallow's home world and investigate, an infowar attack overcomes the ship's military-grade defenses and nearly kills them. And that's only the beginning.

What's going on? It's hard to tell, for Earth has been destroyed, the "Silent" have been parked in human space ever since humans destroyed an intelligent species in order to claim a colony world, war is no longer permitted, and the "tubes" (wormholes) used for interstellar travel are vanishing. Disposables apparently have the capability of waking up. But the villain is neither alien nor android. Soon a visitation from Hydrogen Steel, a firemind—an artificial intelligence escaped from human control to live on vacuum energy—reveals that something very strange and powerful is involved, although it seems constrained to play by something resembling human rules of engagement. The scene is complicated with the entry of the remnants of Otaru, another firemind that went to the stars and returned with news it thought humanity should have, even though it knew the at-home fireminds like Hydrogen Steel would immediately try to kill it. Now McGee and Smith have a fighting chance to track down the reason why Fallow and his family were killed.

And so they do. Unfortunately, there remain so many loose ends that Bedford feels obliged to wrap everything up with twenty pages of exposition as dry as a lecture. Some other writers would have used those loose ends as the excuse for a sequel or two, so Bedford's approach has its points. But better command of material—leaving out the Silent, the vanishing tubes, and most of the existential angst—would mean a sharper focus, fewer loose ends, and less of a slog to wrap things up.

I know. Reviewers aren't supposed to tell writers how they should have done it. But sometimes...

* * * *

Sandra McDonald's first novel bodes well for her future. **The Outback Stars** is space opera with a bit of a fresh flavor, for while Earth is in sad shape, Australians discovered a spur branch of the highway to the stars—the Alcheringa—out near Mars, and now the colony worlds, known as the Seven Sisters, bear names like Kookaburra and Waipata. Each of the Sisters is marked by clusters of strange domes, apparently built by the same mysterious and ancient aliens that built the Alcheringa. Huge ships named after Earthside environmental disasters ferry goods and colonists, and sometimes...

Lieutenant Jodenny Scott is on Kookaburra, getting over the bad case of twitches she picked up when the *Yangtze* blew up. She also picked up a medal, for when things went bad she displayed considerable competence and guts. Now she's eager to get back into space, and when she has a chance at a slot on the *Aral Sea*, even though the ship is not a happy one, she grabs it. She soon finds out what's wrong with the ship, for her department is a thorough cock-up, her underlings are miserably motivated, and there appear to be some pretty crooked schemes running in the background. It doesn't help when a fellow from the science section comes to her with a wild-eyed idea: It wasn't a separatist bomb that did the *Yangtze* in; it had something to do with the aliens! But Jodenny Scott doesn't want to hear it. She has a department to knock into order, and she has a powerful attraction to fight. She is drawn to one of her underlings, Myell, and there are rules against fraternization.

But of course events conspire. That attraction just cannot be resisted. She and Myell are drawn inexorably together even as the schemes become more obvious, death threatens, the alien domes step front and center, and figures from the Dreamtime invade Myell's head with advice. That struck me as a

bit much, but there are hints that this tale will be followed by more. Certainly there is more to be told. If sequels do follow, I suspect those Dreamtime figures will turn out to represent the aliens. And the Alcheringa will have enough extensions and branches to let McDonald write an epic series.

And since she's already good, she will only get better. Right?

* * * *

Debra Doyle and James D. MacDonald are New Hampshire-dwelling Yankees, so it is perhaps no surprise that when in **Land of Mist and Snow** they posit a Confederate ship powered by magic, it is a dark and bloody magic indeed, and the *Alecto*'s scuppers run with blood and her wood reeks of the slaughterhouse. Yankees, as all right-thinking people know, are a kinder people, though they have a flinty sternness born of their stony land that brooks no compromise. Thus we get William R. Sharpe, a magus who convinces Cornelius Vanderbilt to fund and the U.S. government to authorize a secret project that quite deliberately reminds the reader of the Manhattan Project of nuclear fame. Details are scarce, but when Navy Lieutenant John Nevis is sent to frigid Thule with cannons forged of virgin brass and Miss Columbia Abrams is enlisted for the sake of her virgin virtue, we begin to gain an inkling. In due time we learn that the ship *Nicodemus* is powered by an elemental of the air. It can achieve great speeds with neither sail nor steam, and soon it is off to play its part against blockade-runners and other Rebel ships.

But there are reports of the *Alecto* and soon the *Nicodemus* has a special mission. Meanwhile, the Rebels are hearing reports of the *Nicodemus* and plotting their own nefarious attacks. The result must be a magical duel on the high seas, and since virtue must triumph, the *Alecto* is doomed.

But Yankee virtue is hardly pure. The spirit that animates the *Nicodemus* is as thoroughly enslaved as any Southern plantation worker. It hates its captivity even though it is forging a bond with Miss Adams (as is John Nevis, of course!), and in the end that bond will be tested.

Doyle and MacDonald do an excellent job—as they generally do—of delivering character, plot, suspense, and excitement. Any reader with a taste for magical adventure will enjoy this one.

* * * *

You like superheros? Game developer Austin Grossman must too, for he serves up a world positively infested with them, as well as supervillains, and everyone seems to have more neuroses than Bruce Wayne and Peter Parker combined. **Soon I Will Be Invincible** begins with Doctor Impossible, locked away in his twelfth maximum-security cell, taking advantage of a momentary lapse to bust loose and begin once more on his grand ambition, to conquer the world. This time, however, his arch-nemesis, the hero CoreFire, is missing and the Champions, the premier heroes' league, must reform to hunt him down and—they hope!—lock him away someplace *really* secure. However, it will take more than that to stop the Doc from scheming.

The backstories are familiar—laboratory accidents, mutant bug bites, aliens, ancient fairies, surgical interventions. Some of the heroes used to be villains, and vice versa. You can't tell who's on what team without a scorecard, and perhaps this is Grossman's point. Heroes and villains are equally bizarre and driven, and it is perhaps no more than an accident of fate that puts them on one team instead of the other. Or maybe it's a matter of how one defines "conquering the world." The villain wants an emperor's crown and a chance to go mwa-ha-ha-ha! The hero wants applause and a kiss from the appropriate guy or girl.

* * * *

Len Bailey has a taste for the zany and bizarre that would stand him in good stead writing for Nickelodeon. Instead he gave us *Clabbernappers*, and now the sequel, **Fantasms**. As it begins, Danny Ray, rodeo cowboy (junior division), has just been tossed and now must suffer the taunts of Billy Whitehorse as he takes Caroline Robertson, last year's rodeo queen, off for a soda. Hanky the Clown

tells him “some days you're a cowboy, some day's (sic) you're a clown,” and points him toward the magical mystical doorway to the kingdom of Elidor where the Princess Amber has been stolen away by the evil *and* wicked fantasms and must be rescued. So what's an adventurous kid to do but say aw, shucks, dust off his cowboy hat and chaps, twirl his magic blue lariat, and hie off with Prince Blue, the devil Tuk, and Princess Amber's bratty Traveling Maiden Cherry Quiggs to board a bishop and sail off with the treacherous Commodore Mumblefub and Captain Giddyfickle across the checkerboard sea. In due time they meet up with an incompetent magician, a dragonfly maiden, a fairy queen, and masses of giant bloodsucking whiners. Danny collects a few necessary magical tokens and disappoints a stinky girl or two. As for the Princess ... Of *course* she winds up safe!

Devils and monsters, evil wannabe overlords, a world that doesn't make much sense (a checkerboard sea sailed by gigantic chess pieces? C'mon!), a maiden to rescue, and a bit of derring to do. Just the thing to feed a young boy's dreams, and a suitable gift for my nephew when I'm done with this review. Suitable as well for your young kin, who will be pleased as punch with your gift.

* * * *

If you have any taste for the Cthulhu running joke as maintained by Darrell Schweitzer, you will love **The Arkham Alphabet Book for Children**. Not that it's really for the kiddies, of course. In these enlightened days, even the Arkham-Dunwich School District, the chairman of whose Board of Education penned the introduction, must surely gibber in fear of parental lawsuits if they put it where the little blighters could reach it. But suitable adults must bare their teeth in ivory rictus at anything that begins “A is for Arkham, B for the book, a Curious fool from the library took. D for the demon, which filled him with dread. Eldritch, of course, it bit off his head...."

I think I will give this to that nephew I mentioned. He has a little sister, you see, and even though his parents will surely admonish him not to share this delightful tidbit with Marian, he will, oh he will, and her screams in the dark of night will delight Yogge-Sothothe.

[Back to Table of Contents]

BRASS TACKS

Dear Editors,

I am writing to you as a subscriber to both *Analog* and *Asimov's,* and because I'm starting to wonder just what it is I signed up for. Let me explain.

I am in the U.S. Army, and last year I was in training for my job at Fort Huachuca. The PX there just happened to carry *Analog* and *Asimov's,* and I bought both issues each month as they came out. When I got home as a Reservist, I was told I'd be deploying for Afghanistan. So before I left, I subscribed to both magazines so that I could be treated and dazzled by the science fiction I had been reading, stuff like what John Barnes had turned out, and many other countless short stories that fired my imagination.

Is it just my imagination, or are there a lot of political overtones to your approved stories over the past few issues? I haven't read your submission guidelines, but a lot of stories seem to be getting approved if they work in hysteria on:

1) Global warming

2) The Administration of Bush and Cheney

3) 1 & 2 combined, and we're all gonna die!

Is this really the focus of science fiction these days? I don't remember current politics being the focus of either magazine over the years. It wouldn't be so bad if it was balanced, but some of these stories look like they could have been written by Rosie O'Donnell or Noam Chomsky. Here I am, sitting in Afghanistan, wanting to read and be enlightened, and it's like I'm being subjected to the latest screed from moveon.org or the Democratic National Committee.

I'll be specific: The January/February 2007 issue is usually a treat, as a double-issue is packed with stories. If one story isn't to a reader's taste, you just go to the next one and are dazzled. “The Unrung Bells of the Marie Celeste” is a science fiction classic, delightful and thought provoking. And of course there are the science articles I love to read, such as “After Gas? Are We Ready for the End of Oil?” is as non-partisan as you can get. Then I get stuff like “If We Only Knew,” to quote: “Immigration and Naturalization Service. They could argue that I'm an illegal alien. Right now is a really crappy time to be different in America."

Based on what? What civil liberties have been abridged? None! How many Muslims have been tossed into concentration camps? None! So you wait an extra hour at the airport, and I've got news for you: the only people profiled at airports are soldiers and grandmas with hand lotion. But absolutely no racial profiling for potential Islamic terrorists, no. Our country is too politically correct to profile like that, that's how little the war on terror has affected life at home. And this author thinks life in America is crappy? Soldiers like myself have our rights and freedoms severely abridged in places like Afghanistan where I am now so that Americans can live their lives as free as they want. Including writers like this guy.

That's just one story. I go on to read the next one, “Double Helix, Downward Gyre,” which opens with a polemic on the board of Kansas and creationism. What part of the scientific method calls for telling the religious that they are IDIOTS and STUPID if they don't go along with evolution? I grew up with scientists like Carl Sagan arguing that “there is another explanation” to creationism and supernatural interventions. But the story gets even more insulting: “Soon it'll be impossible to do any scientific research at all in this country."

I suppose this is a swipe at President Bush signing a bill restricting federal funding on embryonic stem cell research. As anyone who has researched the topic knows, the Federal government has not banned embryonic stem cell research in the slightest. Funding it is an entirely separate matter, with political overtones. The fact is, the only promising stem cell therapies have been on adult lines. Despite the claims of people like former VP candidate John Edwards, there has not been a single proven cure offered by embryonic stem cell research. The only proven ones that exist have been on adult cells. Take the recent article in *Scientific American,* "The Brain Becomes a Target in Stem Cell Clinical Trials."

The issue is so politicized you'll note that *Scientific American* doesn't even tell the reader that the stem cell line in question is adult. The "Double Helix" story continues: "You do know that the Genetic Patriotism Act has been renewed?"

This about made me toss the magazine across the room. The provisions of the Patriot Act have been attacked for purely partisan reasons, with hysterical cries that our civil liberties are being taken away, we're all gonna die, and similar Chicken Little panic attacks from the left. Ironically, the conclusions of the 9/11 Commission Hearings were that the individual provisions of the Patriot Act should have been implemented before September 11th 2001, at which the same Civil Liberties critics screamed that Bush didn't act soon enough. They like having it both ways; I guess it's easier to carp from the sidelines when you're out of power. (Which the Leftists will no longer be able to do, by the way.)

Now I am not arguing that I want science fiction stories written by Trent Lott. (Although I remember Newt Gingrich writing a WWII alternate history). I don't want uncritical, jingoistic patriotism from science fiction authors either. But if I wanted thinly veiled leftist politics disguised as entertainment, I'd watch Keith Olberman or Jon Stewart. Why read *Analog* for that?

The excesses of government has always been a science fiction topic, and science fiction has always been a showcase to warn the people of today the dangers that a overly-protective government could inflict on the people of tomorrow. I think back to Charlton Heston kneeling in the sand before a buried Statue of Liberty, politics in science fiction is nothing new. And I recognize that. But come on, dire warnings about the Patriot Act, or how Bush and Cheney want to make The Day After Tomorrow (the movie) come true? Come on.

Like I said, as any reader, I can just flip to the next story if something isn't my cup of tea. But I'd hope something more goes into your submission guidelines than just general Bush-bashing. The man cannot run for president again, and enlightened, pro-embryonic research, pro-religion (if that religion is Islam), pro-civil liberties, pro-Kyoto protocols, pro-big government leftists now run congress. Why should stories in *Analog* or *Asimovs* look like they came from a crass political campaign? Right now, many of them do.

To go out on a positive note, the physics of "Shielding a Lunar Base" are over my head, but that's what I love about your science fact articles. I loved "The Face of Hate" and "Exposure Therapy" because it's so true about humanity in general. (Look in Afghanistan and Iraq; we're a long way from being civilized). I like the two page story "The Taste of Miracles"—never underestimate the power of a short-short story. "Emerald River, Pearl Sky" made me think of the ultimate result of World of Warcraft. And thanks for the "Alternate View." Could it be I'm not the first to notice a lack of balance? Thanks for the inclusion of that great essay.

I've talked very long, and I apologize for my verbosity. Would it have been easier to say that I don't want to read science fiction stories about President Bush? That's as simple and direct as I can get. And I'd like to think other readers might agree.

Sincerely,

Specialist John Baber

377th MI BN

Afghanistan

* * * *

I'm sorry you've been thinking too many recent are stories political and unbalanced, though I find it ironic that (a) some of your points seem to me just as simplistic as the ones you're complaining about, and (b) you yourself cite examples of balance in the very issue you criticize for being unbalanced. I won't try to respond to all your points, but my short answer to your big one is that (a) I don't agree with your appraisal, (b) if you think one kind of viewpoint is getting too much coverage in one issue, another is likely to reverse the situation, and (c) if you think your kind of viewpoint isn't getting enough coverage, write me a good enough story espousing it and I'll buy that. The longer and better answer, which I hope you'll take time to reread carefully, is my December 2005 editorial, "No Politics, Please."

* * * *

Dear Stan,

I find myself writing a fan letter for the first time in many years! The occasion is "Cool Neighbor," by Shara and McDevitt (March 2007).

This is not only the best *hard* science fiction I've read in years, it is an extremely good example of science fiction that celebrates the humanity of its characters. Hal Clement meets Lois McMaster Bujold, eh?

I am equally fond of both approaches, and seldom see them combined. Thanks!

Tom Pace

Boynton Beach, FL

* * * *

Dr. Schmidt,

Tin foil hats! I couldn't believe Burstein and Greenberger worked tin foil hats into a legitimate SF story! ("Things That Aren't," April 2007.) I laughed out loud. The story was great. Tell them I loved it. I'm looking forward to more. Better than Shyamalan's sight gag with them in *Signs*.

Bill Seiler

Chambersburg, PA

* * * *

"I am always ready to learn, but I do not always like to be taught."—Winston Churchill

[Back to Table of Contents]

UPCOMING EVENTS by ANTHONY LEWIS

* * * *

5—8 July 2007

READERCON (Literary-oriented SF conference) at Burling Marriott, Burlington, MA. Guests of Honor: Lucius Shepard, Karen Joy Fowler; Memorial Guest of Honor: Angela Carter. Registration: $40 until 15 June 2007. Info: www.readercon.org; Post Office Box 38-1246; Cambridge MA 02238-1246.

* * * *

30 August—3 September 2007

NIPPON 2007 (65th World Science Fiction Convention) at Pacifico Yokohama, Yokohama, Japan. Guests of Honor: Sakyo Komatsu and David Brin. Artist Guests of Honor: Yoshitaka Amano and Michael Whelan. Fan Guest of Honor: Takumi Shibano. Registration: USD 220; JPY 26,000; GBP 125; EUR 186 until 30 June 2007; supporting membership USD 50; JPY 6,000; GBP 28; EUR 45. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Nominate and vote for the Hugos. This is only the third time Worldcon will be held in a non-English speaking country and the first time in Asia. Info: www.nippon2007.org; info@nippon2007.us. Nippon 2007/JASFIC, 4-20-5-604, Mure, Mitaka, Tokyo 181-0002. North American agent: Peggy Rae Sapienza, Nippon 2007, PO Box 314, Annapolis Junction, MD 20701, USA. UK agent: Mike Rennie, 68 Crichton Avenue, Burton Stone Lane, York, Great Britain YO30 6EE (sparks@lspace.org). European agent: Vincent Doherty, Koninginnegracht 75a, 2514A Den Haag, Netherlands (VJ1709@hotmail. com). Australian agent: Craig Macbride, Box 274, World Trade Centre, Victoria, 8005 Australia (nippon07@f8d.com).

* * * *

1—4 November 2007

WORLD FANTASY CONVENTION at Saratoga City Center and Saratoga Hotel & Conference Center, Saratoga Springs, NY. Guests of Honor: Carol Emshwiller, Kim Newman, Lisa Tuttle; Special Guests of Honor: Barbara & Christopher Roden, George Scithers; MC: Guy Gavriel Kay. Registration $135 until 31 March 2007, $35 supporting. Info: www.lastsfa.org/wfc2007/; World Fantasy 2007, Post Office Box 1086, Schenectady NY 12301.

* * * *

Running a convention? If your convention has a telephone, FAX, email, or Web page URL, please let us know so that we can publish this information. We must have your information in hand SIX months before the date of your convention.

Attending a convention? When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an International Reply Coupon if the convention is in a different country.