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Editorial: Monsters

As civilization evolves, one of the pervasive challenges people must face is learning to deal with new things and ideas. Another is remembering how to deal with old ones. Too often, when people find themselves confronted with something they thought they'd left behind, they react on the most basic of folkloric stereotypes rather than the actual facts of the case. Sometimes the results are tragic. Sometimes they're just silly.

One of the silliest to come to my attention recently was the Great New York City Alligator Incident of 2001. Yes, there really was one. An urban legend has maintained for years that giant alligators lurked in the sewers of Manhattan. There has almost certainly never been any truth in it beyond the brief presence of an occasional baby alligator bought in a pet shop and later flushed down the toilet by an owner who tired of it or belatedly realized it was going to grow. [If you want to be technically accurate, all or most of these were South American caimans, but those are close enough relatives of alligators that I'll stick to the popular parlance for now.] It's most unlikely that any of these lasted long enough to grow to any appreciable size, because all crocodilians are tropical or subtropical critters and could not survive a New York winter outdoors.

But last summer there really and unequivocally was an alligator in Manhattan—not in the sewers, but in a small lake in Central Park. A dinky little gator, to be sure, but the news media went wild. Even though they admitted it was only a couple of feet long (probably another pet-store caiman kept a little longer than usual, until it was too big to flush), newspapers and radio and television newscasts were full of stories about the ensuing "spectacle." They told how "one person grabbed it by the tail and flung it on the ground, but the noise and confusion apparently drove it back into the water." Then, "summoned to help, police sealed off an area with yellow crime-scene tape and launched a boat, with one officer carrying a noose-like device." But despite their courageous efforts, the "scaly predator" continued to elude capture.

Floridians, for whom two-foot alligators are too commonplace to warrant comment (much less police cordons!), must have been laughing their heads off at all this, if any of the reportage reached them. And evidently it did, for a day or two after the initial announcement, the New York media announced with considerable fanfare that an alligator expert was flying in from Florida to attempt to capture the dreaded monster. He could not go directly to the park to do so, of course; first he had to meet with city officials to make sure he could be entrusted with the job. Said officials, after the meeting, announced that they were duly "impressed with his credentials and his attitude," and had "agreed to let him look for the Central Park alligator."

What happened next was, of course, anticlimactic, though reporters did their best to make it sound dramatic. The Visiting Expert (who makes his living handling alligators as part of a tourist show) took a canoe into the lake, found the gator in less than an hour, picked it up barehanded, and that was that. "There was no struggle," my newspaper reported, and the valiant rescuer "didn't immediately talk to reporters after his feat."

Well, of course he caught the animal easily, and there wasn't much to talk to reporters about. The biggest news story here was the sheer amount of ado about nothing. I don't know whether the Florida professional's rescue mission was the idea of New York officials or the gator-handler's publicist, who probably saw an opportunity for gobs of cheap publicity for him and the attraction that employs him. I *hope* that it was the latter, and that the handler's employer paid his travel expenses and charged it to "advertising." I'd hate to think that New York officials really thought it was necessary to fly in an expert from a thousand miles away to deal with a two-foot caiman. An alligator or caiman of that size is not even remotely a Big Deal. For a guy who makes his living handling much bigger ones, the job was downright trivial.

It really wasn't necessary to do *anything* about it. A two-foot alligator in a park pond poses far less

danger to humans than any one of millions of rats living much closer to New Yorkers' homes year-round. People wouldn't normally come into contact with it. If they did, the worst it could do to them would be an easily treated bite (comparable to that from, say, a dachshund, but less likely to transmit human diseases), and it wouldn't even do that unless directly provoked. It would never get much bigger because winter would kill it first.

But if the City Fathers really felt some need to Get It Out of There, they could have gotten an expert much more easily from the Bronx Zoo (a short subway ride away), or even the smaller Central Park Zoo (an even shorter stroll away). Not that a world-class expert was needed; it's true that safely handling even a small gator requires *some* care and skill, but the city undoubtedly contains hundreds of pet shop owners and reptile hobbyists who would have regarded the job as routine. But then, that wouldn't have made as good copy.

And the incident *did* provide a few minutes of amusing reading, even if not for the intended reasons. It even included side shows. One newspaper article quoted a gentleman interviewed at lakeside as saying, "A long time ago there was the legend of a snapping turtle in there." Quite probably the "legend" not only was, but is, simple fact: there probably *are* snapping turtles in there. Snappers are real survivors, quite adaptable, and likely to be found in almost any body of fresh water, large or small, in the eastern and central United States. (I've seen some very large ones in a town park in Old Greenwich, Connecticut, not far from New York City.)

For me, the real significance of this incident was just to serve as a particularly dramatic (in a Marx Brothers sort of way) example of how hysterical city folk can get about ordinary country things, and the misconceptions they acquire by stereotyping other animals (including people). "Alligators are ferocious man-eaters" is something many city people actually believe; there's precious little truth in it even for *big* alligators, and to act as if it were true of a crocodilian toddler is ludicrous. But that's just one example. Similar myths abound about other kinds of animals, such as bears, lions, wolves, and snakes—all of which do warrant a certain amount of caution and respect, but hardly ever the mindless terror with which many "civilized" people regard them.

Snakes are one example in which I have some particular interest and knowledge. I was lucky: After spending my first eight years sharing the typical city-dweller's dread of them, I was taken by an aunt to an all-reptile zoo where I was shown quite dramatically, succinctly, and convincingly that practically everything I had been told about snakes was untrue. The incident did two things for me. It awakened an interest in and sympathy for a whole category of animals that had been almost universally slandered by humans I came in contact with, and made me want to learn as much as I could about what they were *really* like. It also gave me a healthy disrespect for "authority," whether based on special credentials or mere adulthood, and taught me that a good general principle of everything is, "It ain't necessarily so."

The current abundance of nature documentaries on television may have slightly alleviated the prevailing level of snake superstition and phobia, but I still meet plenty of people who say they literally can't even bear to look at a picture of a snake. This is especially ironic and unnecessary in the United States, where the vast majority of individual snakes are completely harmless to humans and only four easily recognized types require any special caution at all.2 There are more than four species and subspecies, but they fall into four groups so distinctive that any halfway intelligent layman could easily learn to recognize a snake as belonging to one of those four groups or none of them, even if he couldn't say exactly which species it was. And on the rare occasions when the snake in front of you happens to be one of the potentially dangerous ones, the necessary precautions against being bitten are also easily learned and applied.

So when somebody hears that I've been hiking in an area with bears or cougars or poisonous snakes and asks me, "Weren't you afraid?," my usual answer is that I feel much safer hiking through wilderness than

walking down Forty-second Street—because I am. Yes, there are dangers in both places, but the ones in wilderness are generally less, and certainly easier to guard against. In more than thirty years of hiking at every opportunity, all over the world, neither I nor anyone of my personal acquaintance has ever been attacked by a wild animal bigger than a mosquito. But both I and many of my acquaintances have been attacked by other people and their domestic animals, in "civilization." In that same time I've seen a grand total of five live, wild poisonous snakes, not one of which has been the least bit threatening to anyone who knew what to look for. *Learning* what to look for should be an integral part of preparation for any wilderness trip, but it does take a little research and that takes a little time and effort. But it's worth it.

The real world turns out to be far more interesting than the world of smug stereotypes. Until quite recently most people actually believed (and too many still do) that lions and tigers and bears, to say nothing of snakes and gorillas, had no higher aim in life than to seek out human beings and try to kill them. It never occurs to most people that such behavior would make no sense from the animals' point of view. Consider a rattlesnake, for instance. It depends on its poison to kill small warm-blooded animals for food. They have to be small because a rattlesnake is physically incapable of biting off pieces of food or chewing them up, so it can only eat things it can swallow whole. It can't possibly eat a human, so biting one would simply waste poison that it needs to make a living. The only reason for it to bite a human is in defense, and it won't do that unless it feels threatened enough to expend a resource it needs to conserve.

Which kind of gorilla would you rather share the planet with: a hulking collection of muscle that attacks and kills humans for no reason that makes any sense, or a close relative that turns out to have impressively, fascinatingly, and eerily much in common with us? The former is what people used to assume was out there; the latter is what careful observers like Dian Fossey and Francine Patterson actually found. Many species have suffered fearsome reputations, and in almost all cases careful research has shown those popular images to be at best grotesquely distorted.

Nor are such "monster" stereotypes limited to other species. Human history is full of cultures viewing other cultures in simplistic, demonized terms. Sometimes that tendency is a fairly simple matter of folklore, accepted without question and keeping unnecessary hostilities alive for decades or centuries. And sometimes it's deliberately cultivated and used, as when government propaganda machines make carefully orchestrated efforts to get their own citizens to see the official enemy *du jour* in the simplest and most brutal possible terms. Thus we have, at various times and places, whites seeing blacks as monsters and blacks seeing whites as monsters; Jews seeing Arabs as monsters and vice versa; and so on, *ad nauseam* . How profoundly different would history have been if members of any of those groups could have actually been made aware of how much more complex their hate objects actually were?

And what does all this imply about our prospects for contact with extraterrestrial aliens, if that opportunity ever arises? Even science fiction readers, who often think of themselves as being particularly broad-minded and think they would love to meet aliens, are not exempt from the tendency to monsterization. Some, I think, really would handle alien contact fairly well. Others have so much trouble dealing with slightly different humans (other races, religions, sexual orientations, or even just the opposite sex) that I must view with some trepidation the chances of their actually doing well if confronted with somebody *really* different.

Yet some of the kinds of thinking done in science fiction may offer our kind its best hope of withstanding and even benefiting from such an encounter. People unfamiliar with science fiction often regard it as rife with wild conjectures about impossible things. Surely one of the more fanciful speculations we can make concerns what human history might have been like if most people had the habit of making a conscientious effort to act on fact rather than folklore—a process that must begin with *learning* the facts. The past and present clearly would have been very different. The future still can be.

—Stanley Schmidt

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Hominids by Robert J. Sawyer
Part II of IV

The same event can look very, very different from different points of view.

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The present day. **Ponter Boddit** and **Adikor Huld** are male quantum-computing researchers living on a parallel version of Earth, where Neanderthals survived to the present day and our kind of Homo sapiens did not. While attempting to factor an enormously large number, a portal opens between their timeline and ours, and Ponter, as well as all the air in the quantum-computing chamber, is transferred here.

Ponter and Adikor's lab had been built in a unique location: 2 kilometers beneath the surface, in their world's deepest nickel mine, where their sensitive equipment would be shielded from cosmic rays. For similar reasons, in this version of Earth a physics facility exists at the same subterranean location, in what we call northern Ontario: the Sudbury Neutrino Observatory. SNO consists of a giant acrylic sphere filled with heavy water suspended in a six-story-tall chamber full of regular water. The arrival of all the air transferred with Ponter bursts the sphere apart.

Ponter almost drowns in the neutrino detector, but he is rescued by **Louise Benoît** , a postdoctoral physics student from Montreal. Ponter is taken by ambulance to hospital, accompanied by **Reuben Montego** , the mine-site physician. There, an astonished doctor with a degree in osteology identifies Ponter as being a Neanderthal, based on his cranial morphology—although how he could possibly have come to be here, no one yet knows.

Meanwhile, **Mary Vaughan** , a geneticist who specializes in recovering DNA from ancient specimens, is raped on the campus of Toronto's York University, where she works. She makes her way home and finds a message waiting from Dr. Montego: he wants her to fly up to Sudbury to authenticate a Neanderthal specimen found there “in remarkable condition.” Mary, still devastated by the rape, reluctantly agrees to go.

Ponter, like all modern Neanderthals, has a Companion implant embedded in the skin of his forearm. His is a sophisticated model with significant intelligence; it goes by the name of **Hak** . Although Ponter is severely disoriented by what has happened to him, Hak manages to figure out where they are, and even begins to learn some English.

Back in the Neanderthal world, in which males and females live mostly separate lives, Adikor, who was Ponter's partner in life as well as his research partner, is stunned to be charged with murder. The disappearance of Ponter has suggested foul play, at least to **Daklar Bolbay** . Bolbay, a female, had lived with the recently deceased **Klast** , another female; Bolbay had been Klast's woman-mate. But Klast had also had a man-mate, a male she consorted with when Two became One, the four days out of each month during which male and female Neanderthals come together. Her man-mate had been Ponter, and she had had two daughters by him, of whom Bolbay is now legal guardian. And on their behalf, she has put forward the charge that Adikor has murdered their father.

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Chapter 13

Adikor Huld had forgotten what Last Five was like. He could smell them, smell all the women. They weren't menstruating—not quite yet. The beginning of that, coinciding with the new moon, would mark the end of Last Five, the end of the current month and the start of the next. But they all would be menstruating soon; he could tell by the pheromones wafting on the air.

Well, not all of them, of course. The prepubescent ones—members of generation 148—wouldn't, and neither would the postmenopausal ones—most members of generation 144, and just about everyone from earlier generations. And if any of them had been pregnant or lactating, they wouldn't menstruate, either. But generation 149 wasn't due for many months, and generation 148 had long since been weaned. Of course, there were a few who, usually through no fault of their own, were sterile. But the rest, all living together in the Center, all easily smelling each other's pheromones, all synchronized in their cycles: they were all about to begin their periods.

Adikor understood well that it was hormonal changes that made so many of them testy at the end of each month, and why his male ancestors, long before they'd started numbering generations, had headed for the hills during this time.

The driver had dropped Adikor off near the home he had been looking for, a simple rectangular building, half grown by arboriculture, half built with bricks and mortar, with solar panels on its roof. Adikor took a deep breath through his mouth—a calming breath, bypassing his sinuses and his sense of smell. He let the air out slowly and walked along the small path through the arrangement of rocks and flowers and grasses and shrubs that covered the area in front of the house. When he got to the door—which was ajar—he called out, “Hello! Anybody home?”

A moment later, Jasmel Ket appeared. She was tall, lithe, and just past her two-hundred-and-fiftieth moon, the age of majority. Adikor could see Ponter in her face, and Klast, too; lucky Jasmel had inherited his eyes and her cheeks, instead of the other way around.

“W-w-what—” stammered Jasmel. She fought to compose herself, then tried again. “What are you doing here?”

“Healthy day, Jasmel,” said Adikor. “It's been a long time.”

“You've got a lot of neck muscle coming here—and during Last Five besides!”

“I didn't kill your father,” said Adikor. “Honestly, I did not.”

“He's gone, isn't he? If he's alive, where is he?”

“If he's dead, where is his body?” asked Adikor.

“I don't know. Daklar says you disposed of it.”

“Is Daklar here?”

“No, she's gone to the skills exchange.”

“May I come in?”

Jasmel glanced down at her Companion implant, as if to make sure it was still functioning. “I—I guess so,” she said.

“Thanks.” She stepped aside, and Adikor walked into the house. The interior was cool, a welcome relief from the summer heat. A household robot was puttering along in the background, lifting up knickknacks with its insectlike arms and sucking dust off them with a small vacuum.

“Where's your sister?” asked Adikor.

“Megameg,” said Jasmel, emphasizing the name, as if it were a slight that Adikor had apparently forgotten it. “Megameg is playing barstalk with friends.”

Adikor wondered whether to demonstrate that he did know all about Megameg; after all, Ponter talked of her and Jasmel constantly. Had this been just a social call, he'd perhaps have let it go. But it was more than that; much more. “Megameg,” repeated Adikor. “Yes, Megameg Bek. A 148, isn't she? A little small for her age, but feisty. She wants to be a surgeon when she grows up, I believe.”

Jasmel said nothing.

“And you,” said Adikor, driving the point home, “Jasmel Ket, are studying to be a historian. Your particular interest is pre-generation-one Evsoy, but you also have a fondness for generations thirty through forty here on this continent, and—”

“All right,” said Jasmel, cutting him off.

“Your father spoke of you often—and with great pride and love.”

Jasmel raised her eyebrow slightly, clearly both surprised and pleased.

“I did not kill him,” said Adikor again. “Believe me, I miss him more than I can say. It—” He stopped himself; he'd been about to point out that there hadn't yet been a Two becoming One since Ponter's disappearance; Jasmel hadn't really had to face his absence yet. Indeed, it would have been unusual for her to have seen her father in the past three days, since Two last ceased being One. But Adikor had had to deal with the reality of Ponter's absence, with the emptiness of their home, every waking moment since he'd disappeared. Still, it was pointless to argue whose grief was the greater; Adikor recognized, after all, for all that he loved Ponter, Ponter and his daughter Jasmel were genetically related.

Perhaps Jasmel had been thinking the same thing, though. “I miss him, too. Already. I—” She looked away. “I didn't spend much time with him when Two last became One. There's this boy, you see, who...”

Adikor nodded. He wasn't quite sure what it was like for a father of a young woman. He himself had no child from generation 147; oh, he'd been paired to Lurt back when that generation was conceived, but somehow she hadn't become pregnant—and, yes, they had endured the requisite jokes about a physicist and a chemist failing to understand biology. Adikor's offspring from generation 148 was Dab, a small boy still living with his mother, and Dab wanted to spend every possible moment with his father when they got together each month.

But Adikor had heard Ponter's—well, not complaints, really. He'd understood it was the natural way of things. But, still, that Jasmel had so little time for him when Two became One had saddened Ponter, Adikor knew. And now, it seemed, Jasmel was coming to grips with the fact that her father wouldn't be there ever again, that she'd missed out on time she could have spent with him, and now there was no way to make amends, no way to catch up, no way she would ever be hugged by him again, ever hear his voice praising her or telling her a joke or asking her how things were going.

Adikor looked around the room and helped himself to a seat. The chair was wooden, made by the same carpenter who supplied the ones he and Ponter had had on their deck; the woman had been an acquaintance of Klast.

Jasmel sat on the opposite side of the room. Behind her, the cleaning robot left, heading into another part of the house.

“Do you know what will happen if I'm found guilty?” asked Adikor.

Jasmel closed her eyes, perhaps to forestall them making a quick glance down. “Yes,” she said softly. But then, as if it were a defense: “What difference does it make, though? You've already reproduced; you've got two children.”

“No, I don't,” said Adikor. “I have only one, a 148.”

“Oh,” said Jasmel softly, perhaps embarrassed that she knew less about her father's partner than Adikor did about his partner's daughters.

“And, besides, it's not just me. My son Dab will be sterilized, too, and my sister Kelon—everyone who shares 50 percent of my genetic material.”

Of course, these were no longer the barbaric days of yore; this was the era of genetic testing. Normally, if Kelon or Dab could show that they hadn't inherited Adikor's aberrant genes, they would have been entitled to be spared an operation. But although some crimes had single genetic causes that were well understood, a murderous trait had no such simple markers. And, besides, murder was a crime so heinous, no possibility, however remote, of its predisposition being further passed on could be allowed.

“I'm sorry about that,” said Jasmel. “But...”

“There are no buts,” said Adikor. “I am innocent.”

“Then the adjudicator will find you so.”

Ah, the artlessness of youth, thought Adikor. It would almost be endearing, if it weren't for what he had on the line. “This is a most unusual case,” Adikor said. “Even I admit that. But there is no reason I would have killed the man I love.”

“Daklar says it was difficult for you to always be downwind of my father.”

Adikor felt his back stiffen. “I wouldn't say that.”

“I would,” said Jasmel. “My father—let's be honest—was more intelligent than you. You didn't like being an adjunct to his genius.”

“‘We contribute as best we can,’”said Adikor, quoting the Code of Civilization.

“Indeed we do,” said Jasmel. “And you wanted your contribution to be the principal one. But in your collaboration, it was Ponter's ideas that were being tested.”

“That's no reason to kill him,” snapped Adikor.

“Isn't it? My father is gone, and you were the only one with him when he disappeared.”

“Yes, he's gone. He's gone, and—” Adikor felt tears welling at the corners of his eyes, tears of sadness and tears of frustration. “I miss him so much. I say this with my head tilted back: I did not do this. I

couldn't have."

Jasmel looked at Adikor. He could see her nostrils dilating, taking in his scent, his pheromones. "Why should I believe you?" she said, crossing her arms in front of her chest.

Adikor frowned. He'd made his grief plain; he'd tried arguing emotions. But this girl had more than Ponter's eyes; she had his mind, too—a keen, analytical mind, a mind that prized logic and rationality.

"All right," said Adikor. "Consider this: if I am guilty of murdering your father, I will be sentenced. I will lose not just my ability to reproduce, but my position and my holdings. I will be unable to continue my work; the Gray Council will surely demand a more direct and tangible contribution from a convicted killer if I am to remain part of society."

"And well they should," said Jasmel.

"Ah, but if I'm not guilty—if no one is guilty, if your father is missing, if he's lost, he needs help. He needs my help; I'm the only one who might be able to ... to retrieve him. Without me, your father is gone for sure." He looked at her golden eyes. "Don't you see? The sensible position is to believe me: if I am lying, and I did murder Ponter—well, no punishment will bring him back. But if I am telling the truth, and Ponter was not murdered, then the only hope he has is if I can continue to search for him."

"The mine has been searched," said Jasmel, flatly.

"The mine, yes, but—" Did he dare tell her? It sounded crazy when the words echoed inside his head; he could only imagine how insane they would seem when given voice. "We were working with parallel universes," said Adikor. "It's possible—remotely possible, I know, but I refuse to give up on him, on the man who is so very important to both you and me—that he has, well, slipped, somehow, into another of those universes." He looked at her, imploring. "You must know something of your father's work. Even if you made little time for him"—he saw those words cut deep—"he must have told you about our work, about his theories."

Jasmel nodded. "He told me, yes."

"Well, then, there might—just might—be a chance. But I need to get this reeking dooslarm basadlarm over with; I need to get back to work."

Jasmel said nothing for a long time. Adikor knew from his own occasional arguments with her father that just letting her consider quietly would be more effective than pressing his point, but he couldn't help himself. "Please, Jasmel. Please. It's the only sensible wager to make: assume that I'm not guilty, and there's a chance that we might get Ponter back. Assume that I am guilty, and he is surely gone for good."

Jasmel was silent a while longer, then: "What do you want from me?"

Adikor blinked. "I, ah, I should have thought it was obvious," he said. "I want you to speak on my behalf at the dooslarm basadlarm."

"Me?" exclaimed Jasmel. "But I'm one of those accusing you of murder!"

Adikor held up his left wrist. "I've carefully reviewed the documents I was given. My accuser is your mother's woman-mate, Daklar Bolbay, acting on behalf of your mother's children: you, and Megameg Bek."

"Exactly."

“But she cannot act on your behalf. You've seen 250 moons now; you're an adult. Yes, you can't vote yet—neither can I, of course—but you are responsible for yourself. Daklar is still the tabant of young Megameg, but not of you.”

Jasmel frowned. “I—I hadn't thought of that. I've gotten so used to Daklar looking after my sister and me...”

“You are your own person under the law now. And no one could better persuade an adjudicator that I did not murder Ponter than his own daughter.”

Jasmel closed her eyes, took a deep breath, and let it out slowly in a long, shuddery sigh. “All right,” she said at last. “All right. If there's a chance, any chance at all, that my father still lives, I have to pursue it. I have to.” She nodded once. “Yes, I'll be the one to speak on your behalf.”

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Chapter 14

The conference room at the Creighton Mine had wall diagrams showing the network of tunnels and drifts. A hunk of nickel ore sat as a centerpiece on a long wooden table. A Canadian flag stood at one end of the room; the other had a large window overlooking the parking lot and the rough countryside beyond.

At the head of the table was Bonnie Jean Mah—a white woman with lots of brown hair who was married to a Chinese-Canadian, hence her last name. She was the director of the Sudbury Neutrino Observatory, and had just flown in from Ottawa.

Along one side of the table sat Louise Benoît, the tall, beautiful postdoc who'd been down in the SNO control room when the disaster had occurred. And on the other side sat Scott Naylor, an engineer from the company that had manufactured the acrylic sphere at the heart of SNO. Next to him was Albert Shawwanossoway, Inco's top expert on rock mechanics.

“All right,” said Bonnie Jean. “Just to bring everyone up to date, they've started draining the SNO chamber, before the heavy water gets any more polluted. AECL is going to try to separate the heavy water from the regular water, and, in theory, we should be able to reassemble the sphere and load it up with the recovered heavy water, getting SNO back online.” She looked at the faces in the room. “But I'd still like to know exactly what caused the accident.”

Naylor, a balding, tubby white man, said, “I'd say the sphere containing the heavy water burst apart because of pressure from the inside.”

“Could the displacement caused by a man entering the sphere have done that?” asked Bonnie Jean.

Naylor shook his head. “The sphere held eleven hundred tonnes of heavy water; you add a human being, weighing a hundred kilos—one-tenth of a ton—and you've only increased the mass by one ten-thousandth. Human beings have about the same density as water, so the displacement increase would only be about one ten-thousandth, as well. The acrylic could easily handle that.”

“Then he must have used an explosive of some sort,” said Shawwanossoway, an Ojibwa of about fifty, with long, black hair.

Naylor shook his head. “We've done assays on the water recovered from the tank. There's no evidence

of any explosive—and there aren't that many that would work soaking wet, anyway."

"Then what?" asked Bonnie Jean. "Could there have been, I don't know, a magma incursion or something, and the water boiled?"

Shawwanossoway shook his head. "The temperature of SNO, and the whole mine complex, is closely monitored; there was no change. In the observatory cavern, it held steady at its normal value of a hundred and five degrees—Fahrenheit, that is; forty-one Celsius. Hot, but nowhere near boiling. Remember, too, that the mine is a mile and a quarter underground, meaning the air pressure is about thirteen hundred millibars—30 percent above that at sea-level. And at higher pressures, of course, the boiling point goes up, not down."

"What about the flip side?" asked Bonnie Jean. "What if the heavy water froze?"

"Well, it would indeed have expanded, just like regular water," said Naylor. He frowned. "Yes, that would have burst the sphere. But heavy water freezes at 3.82 Celsius. It just couldn't possibly get that cold that far down."

Louise Benoît joined the conversation. "What if more than just the man entered the sphere? How much material would have to be added before it would burst?"

Naylor thought for a moment. "I'm not sure; it was never speced for that. We always knew exactly how much heavy water AECL was going to loan us." He paused. "Maybe ... I don't know, maybe 10 percent. A hundred cubic meters, or so."

"Which is what?" asked Louise. She looked around the conference room. "This room's about six meters on a side, isn't it?"

"Twenty feet?" said Naylor. "Yeah, I guess."

"And it's got ten-foot ceilings—that's three meters," continued Louise. "So you're talking about a volume of material as big as the contents of this room."

"More or less, I suppose."

"That's ridiculous, Louise," said Bonnie Jean. "All you found down there was one man."

Louise nodded, conceding that, but then she lifted her arched eyebrows. "What about air? What if a hundred cubic meters of air were pumped into the sphere?"

Naylor nodded. "I'd thought about that. I thought maybe a belch of gas had somehow welled up into the sphere, although how it would get inside I have no idea. The water samples we took were somewhat aerated, but..."

"But what?" asked Louise.

"Well, they were indeed aerated, with nitrogen, oxygen, and some CO2, as well as some gabbroic rock dust and pollen. In other words, just regular mine air."

"Then it couldn't have come from the SNO facility," said Bonnie Jean.

"That's right, ma'am," said Naylor. "That air is all filtered; it's free of rock dust and other pollutants."

"But the only parts of the mine connecting to the detector chamber are in the SNO facility," said Louise.

Naylor and Shawwanossoway both nodded.

“OK, OK,” said Bonnie Jean, steepling her fingers in front of her. “What have we got? The volume of material inside the sphere was increased by, at a guess, 10 percent or more. That might have been caused by an infusion of a hundred cubic meters or more of unfiltered air—although unless the air was pumped in very rapidly, it would have been compressed by the weight of the water, no? And, in any event, we don't know where the air came from—it certainly wasn't from SNO—or how it was conveyed into the sphere, right?”

“That's about the size of it, ma'am,” said Shawwanossoway.

“And this man—we don't know how he got into the sphere, either?” asked Bonnie Jean.

“No,” said Louise. “The access hatch between the inner heavy-water sphere and the outer regular-water containment tank was sealed tight even after the sphere broke apart.”

“All right,” said Bonnie Jean, “do we know how this—this Neanderthal, they're calling him—even got down into the mine?”

Shawwanossoway was the only one present who actually worked for Inco. He spread his arms. “The mine-security people have reviewed the security-camera tapes and access logs for the 48 hours prior to the incident,” he said. “Caprini—that's our head of security—swears that heads will roll when he finds out who screwed up by letting that guy in, and he says even worse will happen when he finds out who's been trying to hide it.”

“What if no one is lying?” said Louise.

“That's just not possible, Miss Benoît,” said Shawwanossoway. “No one could get down to SNO without it being recorded.”

“No one could if he came down by the elevator,” said Louise. “But what if he didn't come that way?”

“You think maybe he climbed down two kilometers of vertical air shafts?” said Shawwanossoway, scowling. “Even if he could do that—and it would take nerves of steel—security cameras still would have recorded him.”

“That's my point,” said Louise. “He obviously didn't go down into the mine. As Professor Mah said, they're calling him a Neanderthal—but he's a Neanderthal with some sort of high-tech implant on his wrist; I saw that with my own eyes.”

“So?” said Bonnie Jean.

“Please!” exclaimed Louise. “You all must be thinking the same things I'm thinking. He didn't take the elevator. He didn't go down the ventilation shafts. He materialized inside the sphere—him, and a roomful of air.”

Naylor whistled the opening notes of the original Star Trek theme.

Everyone laughed.

“Come on,” said Bonnie Jean. “Yes, this is a crazy situation, and it might be tempting to jump to crazy conclusions, but let's stay down to earth.”

Shawwanossoway could whistle, too. He did his rendition of The Twilight Zone theme.

“Stop that!” snapped Bonnie Jean.

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Chapter 15

Mary Vaughan was the only passenger on the Inco Learjet flying from Toronto to Sudbury; she'd noted on boarding that the plane, painted with dark-green sides, was labeled “The Nickel Pickle” on its bow.

Mary used the brief flight time to review research notes on her notebook computer; it had been years since she'd published her study of Neanderthal DNA in Science. As she read through her notes, she twirled the gold chain around her neck that held the small, plain cross she always wore.

In 1994, Mary had made a name for herself recovering genetic material from a 30,000-year-old bear found frozen in Yukon permafrost. And so, two years later, when the Rheinisches Amt für Bodendenkmalpflege—the agency responsible for archeology in the Rhineland—decided it was time to see whether any DNA could be extracted from the most famous fossil of all, the original Neanderthal man, they called on Mary. She'd been dubious: that specimen was desiccated, having never been frozen, and—opinions varied—it might be as old as 100,000 years, three times the age of the bear. Still, the challenge was irresistible. In June 1996, she'd flown to Bonn, then headed to the Rheinisches Landesmuseum, where the specimen was housed.

The best-known part—the brow-ridged skullcap—was on public display, but the rest of the bones were kept in a steel box, within a steel cabinet, inside a room-sized steel vault. Mary was led into the safe by a German bone preparator named Hans. They wore protective plastic suits and surgeons’ masks; every precaution had to be taken against contaminating the bones with their own modern DNA. Yes, the original discoverers had doubtless contaminated the bones—but after a century and a half, their unprotected DNA on the surface should have degraded completely.

Mary could only take a very small piece of bone; the priests at Turin guarded their shroud with equal jealousy. Still, it was extraordinarily difficult for both her and Hans—like desecrating a great work of art. Mary found herself wiping away tears as Hans used a goldsmith's saw to cut a semicircular chunk, just a centimeter wide and weighing only three grams, from the right humerus, the best preserved of all the bones.

Fortunately, the hard calcium carbonate in the outer layers of the bone should have afforded some protection for any of the original DNA within. Mary took the specimen back to her lab in Toronto and drilled tiny pieces out of it.

It took five months of painstaking work to extract a 379-nucleotide snippet from the control region of the Neanderthal's mitochondrial DNA. Mary used the polymerase chain reaction to reproduce millions of copies of the recovered DNA, and she carefully sequenced it. She then checked the corresponding bit of mitochondrial DNA in 1,600 modern humans: Native Canadians, Polynesians, Australians, Africans, Asians, and Europeans. Every one of those 1,600 people had at least 371 nucleotides out of those 379 the same; the maximum deviation was just eight nucleotides.

But the Neanderthal DNA had an average of only 352 nucleotides in common with the modern specimens; it deviated by a whopping 27 bases. Mary concluded that her kind of human and Neanderthals must have diverged from each other between 550,000 and 690,000 years ago for their DNA to be so different. In contrast, all modern humans probably shared a common ancestor 150,000 or

200,000 years in the past. Although the half-million-year-plus date for the Neanderthal/modern divergence was much more recent than the split between genus Homo and its closest relatives, the chimps and bonobos, which occurred five to eight million years ago, it was still far enough back that Mary felt Neanderthals were probably a fully separate species from modern humans, not just a subspecies: Homo neanderthalensis, not Homo sapiens neanderthalensis.

Others disagreed. Milford Wolpoff of the University of Michigan was sure that Neanderthal genes had been fully co-opted into modern Europeans; he felt any test strand that showed something different was, therefore, an aberrant sequence or a misinterpretation.

But many paleoanthropologists agreed with Mary's analysis, although everyone—Mary included—said that further studies needed to be done to be sure ... if only more Neanderthal DNA could be found.

And now, maybe, just maybe, more had been found. There was no way this Neanderthal man could be real, thought Mary, but if it were...

Mary closed her laptop and looked out the window. Northern Ontario spread out below her, with Canadian Shield rocks exposed in many places and aspen and birch dotting the landscape. The plane was beginning its descent.

* * *

Reuben Montego had no idea what Mary Vaughan looked like, but since there were no other passengers aboard the Inco jet, he didn't have any trouble spotting her. She turned out to be white, in her late thirties, with honey-blond hair showing darker roots. She was perhaps ten pounds overweight, and, as she came closer, Reuben could see that she clearly hadn't gotten much sleep the night before.

“Professor Vaughan,” Reuben said, offering his hand. “I'm Reuben Montego, the M.D. at the Creighton Mine. Thank you so very much for coming up.” He indicated the young woman he'd picked up on the way to the Sudbury airport. “This is Gillian Ricci, the press officer for Inco; she's going to look after you.”

Reuben thought Mary looked inordinately pleased to see the attractive young woman who was accompanying him; maybe the professor was a lesbian. He reached out to take the suitcase Mary was holding. “Here, let me help you.”

Mary relinquished the bag, but she fell in beside Gillian, rather than Reuben, as they walked across the tarmac, the summer Sun beating down. Reuben and Gillian were both wearing sunglasses; Mary was squinting against the brightness, evidently having forgotten to bring a pair.

When they arrived at Reuben's wine-colored Ford Explorer, Gillian politely began to get in the back seat, but Mary spoke up. “No, I'll sit there,” she said. “I—ah—I want to stretch out.”

Her odd statement hung between them for a second, and then Reuben saw Gillian shrug a little and move up to the front passenger's seat.

They drove directly to St. Joseph's Health Centre, on Paris Street, just past the snowflake-shaped museum Science North. Along the way, Reuben briefed Mary about the accident at SNO and the strange man who had been found.

As they pulled into the hospital parking lot, Reuben saw three vans from local TV stations. Surely hospital security was keeping reporters away from Ponter, but, just as surely, the journalists would be following this story closely.

When they arrived at room 3-G, Ponter was standing up, looking out the window, his broad back to them. He was waving—and Reuben realized that TV cameras must be trained up at his window. A cooperative celebrity, thought Reuben. The media are going to love this guy.

Reuben coughed politely, and Ponter turned around. He was backlit by the window and still hard to make out. But as he stepped forward, the doctor enjoyed watching Mary's jaw drop when she got her first good look at the Neanderthal. She'd briefly seen Ponter on TV, she'd said, but that seemingly hadn't prepared her for the reality.

“So much for Carleton Coon,” Mary said, after apparently recovering her wits.

“Say what?” said Reuben sharply.

Mary looked puzzled, then flustered. “Oh, my, no. Carleton Coon. He was an American anthropologist. He's the guy who said if you dressed a Neanderthal up in a Brooks Brothers suit, he'd have no trouble passing for a regular human.”

Reuben nodded. “Ah,” he said. Then: “Professor Mary Vaughan, I'd like you to meet Ponter.”

“Hello,” said the female voice from Ponter's implant.

Reuben saw Mary's eyes go wide. “Yes,” he said, nodding. “That thing on his wrist is talking.”

“What is it?” asked Mary. “A talking watch?”

“Much more.”

Mary leaned in for a look. “I don't recognize those numerals, if that's what they are,” she said. “And—say—aren't they changing too fast for seconds?”

“You've got a good eye,” said Reuben. “Yeah, they are. The display uses ten distinct numerals, although none of them look like any I've ever seen. And I timed it: it increments every 0.86 seconds, which, if you work it out, is exactly one one-hundred-thousandth of a day. In other words, it's a decimal-counting Earth-based time display. And, as you can see, it's a very sophisticated device. That's not an LCD; I don't know what it is, but it's readable no matter what angle you look at it or how much light is falling on it.”

“My name is Hak,” said the implant on the strange man's left wrist. “I am Ponter's Companion.”

“Ah,” said Mary, straightening up. “Um, pleased to meet you.”

Ponter made a series of deep sounds that Mary couldn't understand. Hak said, “Ponter is pleased to meet you, too.”

“We spent the morning having a language lesson,” said Reuben, looking now at Mary. “As you can see, we've made some real progress.”

“Apparently,” said Mary, astonished.

“Hak, Ponter,” said Reuben. “This is Gillian.”

“Hello,” said Hak. Ponter nodded in agreement.

“Hello,” said Gillian, trying, Reuben thought, to remain composed.

“Hak is—well, I guess computer is the right term. A talking, portable computer.” Reuben smiled. “Beats all hell out of my Palm Pilot.”

“Does—does anyone make a device like that?” asked Gillian.

“Not as far as I know,” said Reuben. “But she—Hak—has an apparently perfect memory. Tell her a word once, and she's got it for good.”

“And this man, this Ponter, he really doesn't speak English?” asked Mary.

“No,” said Reuben.

“Incredible,” said Mary. “Incredible.”

Ponter's implant bleeped.

“Incredible,” repeated Reuben, turning to Ponter. “It means not believable"—another bleep—"not true.” He faced Mary again. “We worked out the concepts of true and false using some simple math, but, as you can see, we've still go a ways to go. For one thing, although it clearly seems easier for Hak, with her perfect memory, to learn English, than for us to learn her language, neither she nor Ponter can make the ee sound, and—”

“Really?” said Mary. She looked quite earnest, Reuben thought. He nodded.

“Your name is Mare,” said Hak, demonstrating the point. “Her name is Gill'an.”

“That's—that's amazing,” said Mary.

“Is it?” said Reuben. “Why?”

Mary took a deep breath. “There's been a lot of debate over the years about whether Neanderthals could speak, and, if they could, what range of sounds they could have made.”

“And?” said Reuben.

“Some linguists think they couldn't have made the ee phoneme, because their mouths would have been much longer than ours.”

“So he is a Neanderthal!” declared Reuben.

Mary took another breath, then let it slowly out. “Well, that's what I'm here to find out, isn't it?” She set down the small bag she'd been carrying and opened it up. She then pulled out a pair of latex gloves and snapped them on. Next, she removed a plastic jar full of cotton swabs and extracted one.

“I need you to get him to open his mouth,” said Mary.

Reuben nodded. “That one's easy.” He turned to Ponter. “Ponter, open mouth.”

There was a second's lag—Hak, Reuben had learned, could convey the translation to Ponter without the others hearing it. Ponter rolled his continuous blond eyebrow up his browridge—quite a startling sight—as if surprised by the request, but did as he was asked.

Reuben was astonished. He'd had a friend in high school who could stuff his own fist all the way into his mouth. But Ponter's mouth went back so far and was so capacious, he probably could have stuffed in not just his fist but a third of his forearm as well.

Mary moved in tentatively and reached her swab into Ponter's mouth, swiping it across the inside of his long, angled cheek. “Cells in the mouth slough off easily,” she said, by way of explanation, apparently noting Gillian's quizzical expression. “It's the simplest way to take a DNA specimen.” She pulled out the swab, immediately transferred it to a sterile container, sealed, then labeled the container, and said, “OK, that's all I need.”

Reuben smiled at Gillian then at Mary. “Great,” he said. “When will we know for sure?”

“Well, I've got to get back to Toronto, and—”

“Of course, if you want,” said Reuben, “but, well, I called a friend of mine in Laurentian's Department of Chemistry and Biochemistry. Laurentian's a tiny university, but they've got a great lab that does contract DNA forensics work for the RCMP and the OPP. You could do your work there.”

“Inco will certainly put you up at the Ramada,” added Gillian.

Mary was clearly taken aback. “I...” But then she seemed to reconsider. “Sure,” she said. “Sure, why not?”

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Chapter 16

Now that Jasmel had agreed to speak on Adikor's behalf, the next step should have been for him to take her out to the Rim and show her the scene of the so-called crime. But Adikor begged Jasmel's indulgence for a daytenth or so, saying there was one more errand he had to run here in the Center.

Ponter, of course, had had Klast as his woman-mate; Adikor remembered her fondly, and had been very sad when she'd died. But Adikor had a woman of his own, and she, wonderfully, was still very much alive. Adikor had known the lovely Lurt Fradlo as long as he'd known Ponter, and he and Lurt had one son, Dab, a 148. Still, despite knowing her that long, Adikor had only occasionally been to Lurt's chemistry lab; after all, when Two became One, it was a holiday and nobody went to work. Fortunately, his Companion knew the way, and it directed him there.

Lurt's lab was made entirely of stone; although there was only a small chance of an explosion in any chemistry lab, safety dictated making the structure out of something that could contain blasts and fires.

The front door to the lab building was open. Adikor walked in.

“Healthy day,” said a woman, doing, Adikor thought, an admirable job of hiding her surprise at seeing a man here at this time of month.

“Healthy day,” replied Adikor. “I'm looking for Lurt Fradlo.”

“She's down that hall.”

Adikor smiled and headed along the corridor. “Healthy day,” he called, as he stuck his head in the door to Lurt's lab.

Lurt turned around, a big grin on her lovely face. “Adikor!” She closed the distance between them and gave him a hug. “What a pleasant surprise!”

Adikor couldn't remember ever seeing Lurt during Last Five before. She seemed perfectly sane and rational—and so had Jasmel, for that matter. Maybe this whole Last Five thing was overblown in men's minds...

“Hello, beautiful,” said Adikor, squeezing her again. “It's good to see you.”

But Lurt knew her man well. “Something's wrong,” she said, releasing him. “What is it?”

Adikor looked back over his shoulder, making sure they were alone. He then took Lurt's hand and led her across the room to a couple of lab chairs next to a chart of the periodic table; the only other animate entities in the lab were a pair of spindly robots, one pouring liquid between beakers; another assembling a structure out of pipes and glassware. Adikor sat down, and Lurt took the seat next to him.

“I've been accused of murdering Ponter,” he said.

Lurt's eyes went wide. “Ponter is dead?”

“I don't know. He been missing since yesterday afternoon.”

“I was at a flensing party last night,” said Lurt. “I hadn't heard.”

He told her the whole story. She was sympathetic, and never expressed disbelief in Adikor's innocence; Lurt's trust in him was something Adikor could always count on.

“Would you like me to speak for you?” asked Lurt.

Adikor looked away. “Well, that's the thing. You see, I've already asked Jasmel.”

Lurt nodded. “Ponter's daughter. Yes, that would impress an adjudicator, I should think.”

“That was my thought. I hope you don't feel slighted.”

She smiled. “No, no, of course not. But, look, if there's anything else I can do to help...”

“Well, there is one thing,” said Adikor. He pulled a small vial out of his hip pouch. “This is a sample of a liquid I collected at the site of Ponter's disappearance; there were buckets of it on the floor. Could you do an assay on it for me?”

Lurt took the vial and held it up to the light. “Sure,” she said. “And if there's anything else I can do, just ask.”

* * *

Ponter's daughter Jasmel accompanied Adikor back to the Rim. They went straight to the nickel mine; Adikor wanted to show Jasmel exactly where her father had disappeared. But when they got to the mine-shaft elevator station, Jasmel looked hesitant.

“What's wrong?” asked Adikor.

“I—um, I've got claustrophobia.”

Adikor shook his head, confused. “No, you don't. Ponter told me how when you were little, you liked to hide inside dobalak cubes. And he took you caving last tenmonth.”

“Well, um...” Jasmel trailed off.

“Oh,” said Adikor, nodding his head, getting it. “You don't trust me, do you?”

“It's just that ... well, my father was the last person to go down there with you. And he never came back up.”

Adikor sighed, but he could see her point. Somebody—some private citizen—had to accuse Adikor of the crime, or the legal proceedings could not continue. Why, if he now got rid of Jasmel and Megameg and Bolbay, perhaps there would be no one left to press the accusation...

“We can get someone to go down with us,” said Adikor.

Jasmel considered, but she, too, must have been thinking about how everything took on new significance during a time like this. Yes, she could ask for an escort—someone she really knew, someone she trusted implicitly. But that person might be called for questioning, too, if this went to a full tribunal. “Yes, adjudicators, I know that Jasmel is speaking on behalf of Adikor, but even she was too frightened of him to go down into the mine alone with him. And can you blame her? After what he did to her father?”

Finally, though, she managed a small smile—a smile that reminded Adikor a bit of Ponter's own. “No,” she said. “No, of course not. I'm just edgy, I guess.” She smiled more, making light of it. “It is that time of month, after all.”

But as they approached the elevator station, a particularly burly man emerged from behind it. “Stop right there, Scholar Huld,” he said.

Adikor felt sure he'd never seen the man before in his life. “Yes?”

“You're thinking of going down to your lab?”

“I am, yes. Who are you?”

“Gaskdol Dut,” said the man. “My contribution is enforcement.”

“Enforcement? Of what?”

“Of your judicial scrutiny. I can't let you go underground.”

“Judicial scrutiny?” said Jasmel. “What's that?”

“It means,” said Dut, “that the transmissions from Scholar Huld's Companion are being monitored directly by a living, breathing human being as they are received at the alibi-archive pavilion—and they will be so, ten tenths a day, twenty-nine days a month, until if and when his innocence is proven.”

“I didn't know you were allowed to do that,” said Adikor, shocked.

“Oh, yes, indeed,” said Dut. “The moment Daklar Bolbay lodged her complaint against you, an adjudicator ordered you placed under judicial scrutiny.”

“Why?” said Adikor, trying to control his anger.

“Didn't Bolbay transfer a document to you explaining this?” asked Dut. “An oversight, if she didn't. Anyway, judicial scrutiny ensures that you don't attempt to leave this jurisdiction, tamper with potential evidence, and so forth.”

“But I'm not trying to do any of those things,” said Adikor. “Why won't you let me go down to my lab?”

Dut looked at Adikor as if he couldn't believe the question. “Why not? Because your Companion's signals won't be detectable from down there; we wouldn't be able to keep you under scrutiny.”

“Marrowless bone,” said Adikor, softly.

Jasmel crossed her arms in front of her chest. “I'm Jasmel Ket, and—”

“I know who you are,” said the enforcer.

“Well, then, you know that Ponter Boddit was my father.”

The enforcer nodded.

“This man is trying to rescue him. You have to let him go down to his lab.”

Dut shook his head in astonishment. “This man is accused of killing your father.”

“But it's possible he didn't,” said Jasmel. “My father might still be alive. The only way to find out is to repeat the quantum-computing experiment.”

“I don't know anything about quantum experiments,” said Dut.

“Why doesn't that surprise me?” said Adikor.

“My, you are a mouthy one, aren't you?” said Dut, looking Adikor up and down. “Anyway, my orders are simple. Keep you from leaving Saldak, and keep you from going to your lab. And I received a call from the alibi-archive pavilion saying you were heading off to do precisely that.”

“I have to go down there,” said Adikor.

“Sorry,” said Dut, crossing his own massive arms in front of his massive chest. “Not only can't you be monitored from down there, but you might try to get rid of evidence that hasn't yet been found.”

Jasmel did indeed have her father's quickness of mind. “There's nothing preventing me from going down to the lab, is there? I'm not under judicial scrutiny.”

Dut considered this. “No, I suppose not.”

“All right,” said Jasmel, turning now to Adikor. “Tell me what to do to try to bring my father back.”

Adikor shook his head. “It's not that easy. The equipment is very complex, and, since Ponter and I assembled it ourselves, half the control buds aren't even labeled.”

Jasmel was clearly frustrated. She looked at the big man. “Well, what if you went down with us? You'd be able to see what Adikor was doing.”

“Go down there?” Dut laughed. “You want me to go to the one place my Companion can't be monitored—and to do so with a person who may well have committed murder there previously? You're ruffling my back hair.”

“You have to let him go down there,” Jasmel said.

But Dut just shook his head. “No. What I have to do is keep him from going down there.”

Adikor thrust out his jaw. “How?” he said.

“I—I beg your pardon?” replied Dut.

“How? How are you going to keep me from going down there?”

“By whatever means necessary,” said Dut, his tone even.

“All right, then,” said Adikor. He stood motionlessly for a moment, as if thinking about whether he really wanted to try this. “All right, then,” he said again, and started walking purposefully toward the entrance to the elevator.

“Stop,” said Dut, with no particular force to the word.

“Or what?” said Adikor, without looking back. He tried to sound fearless, but his voice cracked, which didn't really give the effect he wanted. “Are you going to stave in my skull?” Despite himself, his neck muscles contracted, already preparing for the blow.

“Hardly,” said Dut. “I'll just put you to sleep with a tranquilizer dart.”

Adikor stopped walking and turned around. “Oh.” Well, he'd never run up against the law before—nor had he known anyone who ever had. He supposed it made sense that they had a way to stop people without actually hurting them.

Jasmel interposed herself between Dut's dart launcher, which was now in his hand, and Adikor. “You'll have to shoot me first,” she said. “He's going down there.”

“If you like. But I should warn you: you'll wake up with an awful headache.”

“Please!” said Jasmel. “He's trying to save my father—don't you understand?”

For once Dut's voice had some warmth in it. “You're clutching at smoke. I know it must be very hard to deal with, but you have to face reality.” He gestured with his launcher for the two of them to start walking away from the mine. “I'm sorry, but your father is dead.”

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Chapter 17

The genetics lab at Laurentian didn't have the special equipment for extracting degraded DNA from old specimens that Mary's lab at York did. But none of that would be needed. It was a straightforward matter to take the cells from Ponter's mouth and extract DNA from one of the mitochondria; any genetics facility in the world could have done it.

Mary introduced two primers—small pieces of mitochondrial DNA that matched the beginning of the sequence that she had identified years ago in the German Neanderthal fossil. She then added the enzyme DNA-polymerase, triggering the polymerase chain reaction, which would cause the section she was interested in to be amplified, reproducing itself over and over again, doubling the quantity each time. She would soon have millions of copies of the string to analyze.

As Reuben Montego had said, the Laurentian lab did a lot of forensic work, and so had sealing tape that could be applied to the glassware. The tape was used so that geneticists could truthfully testify that there was no way the contents of a vial could have been tampered with while out of their sight. Mary sealed the container in which the PCR amplification was happening and wrote her signature on the seal.

She then used a web terminal in the lab to access her email at York. She'd received more emails in the last day than she had in the preceding month, and many of them were from Neanderthal experts around the world who had somehow gotten wind of the fact that she was now in Sudbury. There were messages from Washington University, the University of Michigan, UCB, UCLA, Brown, SUNY Stony Brook, Stanford, Cambridge, Britain's Natural History Museum, France's Institute of Quaternary Prehistory and Geology, her old friends at the Rheinisches Landesmuseum, and more—all asking for samples of the Neanderthal DNA while, at the same time, making a joke of it, as if, of course, this couldn't really be happening.

She ignored all those messages, but she did feel a need to send a note to her grad student back at York:

Daria:
Sorry to leave you in the lurch, but I know you can handle things. I'm sure you've seen the reports in the press, and all I can say right now is, yes, there really does seem to be a chance that he might be a Neanderthal. I'm running DNA tests right now to find out for sure.
I don't know when I'll be back. I'll probably stay here a few more days at least. But I wanted to tell you ... to warn you really ... that I think a man was trying to follow me when I left the lab on Friday night. Be careful ... if you are going to work late, have your boyfriend come and meet you at the end of the day or call for a walking companion to escort you back to the residence.

Take care.

MNV

Mary read the note over a couple of times, then clicked “Send Now.”

It was the least she could do.

She then simply sat, staring at the screen for a long, long time.

Damn it.

Damn it. Damn it. Damn it.

She couldn't get it out of her head—not for five minutes. She guessed that fully half her waking thoughts today had been devoted to the horrible events of—My God, had it really only been yesterday? It seemed so much longer ago than that, although the memories of the horrible things he'd done to her were still scalpel sharp.

Had she been down in Toronto, she might have talked it over with her mother, but—

But her mother was a good Catholic, and there was no way to avoid unpleasant issues when discussing a rape. Mom would be worried about whether Mary might be pregnant—not that she'd ever countenance an abortion; Mary and she had argued about John Paul's edict that raped nuns in Bosnia had to bring their children to term. And telling her mother that there was nothing to worry about because Mary was on the Pill would hardly be better. As far as Mary's parents had been concerned, the rhythm method was the only acceptable form of birth control—Mary thought it was a miracle that she only had three siblings instead of a dozen.

And, indeed, she could speak to her siblings, but ... but ... but there was no way she could talk to a man—any man—about this. That left out her brothers Bill and John. And her one sister, Christine, had moved to Sacramento, and somehow this didn't seem to be the sort of thing she wanted to talk about over the phone.

And yet, she had to speak to someone. Someone in person.

Someone here.

There was a copy of the Laurentian calendar sitting on a table in the lab; Mary found the campus map in it, and located what she was looking for. She got up and made her way down the corridor to the stairs, crossed over from Science One to the Classroom Building, then headed down to what she'd learned Laurentian students called “the bowling alley"—the long ground-floor glass corridor that ran between the Classroom Building and the Great Hall. She walked down its length, afternoon sun streaming in, past a Tim Hortons donut stand and a few kiosks devoted to student activities. She finally turned left at the bowling alley's far end, going past the liaison office, up the stairs, past the campus bookstore, and down a short corridor.

Going to the rape-crisis center at York University would have been out of the question. The counselors there were volunteers mostly, and, although they all were doubtless supposed to keep things confidential, the gossip that a faculty member had been attacked might prove irresistible. Plus, she might be seen entering or leaving the facility.

But Laurentian University, small as it was, had a rape-crisis center, too. The sad truth was that every university needed to have one; she'd heard there was even one at Oral Roberts University. Nobody here knew Mary, and she hadn't yet been interviewed on TV, although she doubtless would be once she had results of Ponter's DNA tests. So, if she wanted any anonymity at all, this couldn't wait.

The door was open. Mary entered the small reception area. “Hello,” said the young black woman behind the desk. She stood up and walked over to Mary. “Come in, come in.” Mary understood her solicitousness. Many women probably made it to the threshold, but then scurried away, unable to give voice to what had happened to them.

Still, the woman could probably tell that if Mary were a rape victim, it hadn't just happened. Mary's clothes weren't disheveled, and her make-up and hair were all fine. And the center must get visitors who weren't victims: people coming in to volunteer, to do research, to service the photocopier.

“Have you been hurt?” asked the woman.

Hurt. Yes, that was the right approach. It was easier to admit you'd been hurt than to accept the R-word.

Mary nodded.

“I have to ask,” said the woman. She had large brown eyes, and a small jeweled stud in her nose. “Did it happen today?”

Mary shook her head.

For half a second, the woman looked—well, disappointed would be the wrong word, Mary thought, but things were doubtless much more interesting if it had just occurred, if the rape kit was to be employed to gather evidence, if...

“Yesterday,” said Mary, speaking for the first time. “Last night.”

“Was it—was it someone you know?”

“No,” said Mary ... but then she paused. Actually, she wasn't sure of the answer to that question. The monster had worn a ski mask. It could have been anyone: a student she'd taught; another faculty member; someone from the support staff; a punk from the Jane-Finch corridor. Anyone. “I don't know.

He—he had a mask on."

"I know he hurt you," said the young woman, putting an arm through Mary's and leading her further inside, "but did he injure you? Do you need to see a doctor?" The woman held up a hand. "We've got an excellent female doctor on call."

Mary shook her head again. "No," she said. "He had a—"Mary's voice broke, surprising herself. She tried again. "He had a knife, but he didn't use it."

"Animal," said the woman.

Mary nodded in agreement.

They moved into an inner room, with walls painted a soft pink. There were two chairs, but no couch—even here, even in this sanctuary, the sight of a couch might be too much. The woman gestured for Mary to take one of the chairs—a padded easy chair—and she took the other one, sitting opposite her, but reaching over and gently taking Mary's left hand.

"Would you like to tell me your name?" asked the woman.

Mary thought about giving a fake name, or maybe—she didn't want to lie to this sweet young person who was trying so hard to help; maybe she'd tell the woman her middle name, Nicole—that wouldn't really be a lie, then, but it would still conceal her identity. But when she opened her mouth, "Mary" came out. "Mary Vaughan."

"Mary, my name is Keisha."

Mary looked at her. "How old are you?" she asked.

"Nineteen," said Keisha.

So young. "Were you ... were you ever...?"

Keisha pressed her lips together and nodded.

"When?"

"Three years ago."

Mary felt her own eyes go wide. She would have been just sixteen then; it might—my God, her first time might have been a rape. "I'm so sorry," said Mary.

Keisha tilted her head, accepting the comment. "I won't tell you you'll get over it, Mary, but you can survive it. And we'll help you to do just that."

Mary closed her eyes and took a deep breath, then let it out slowly. She could feel Keisha gently squeezing her hand, transfusing strength into her. At last, Mary spoke again. "I hate him," she said. She opened her eyes. Keisha's face was concerned, supportive. "And..." said Mary, slowly, softly, "I hate myself for letting it happen."

Keisha nodded and reached over with her other arm, taking and gently holding Mary's right hand, as well.

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Chapter 18

Adikor and Jasmel walked back from the mine to Adikor's home, the house he'd shared with Ponter. The electric lighting ribs came on in response to Adikor's spoken request, and Jasmel looked around with interest.

This was Jasmel's first time visiting what had been her father's residence; Two always became One by the men coming into the Center, rather than the women going out to the Rim.

Jasmel was fascinated in a melancholy sort of way as she poked about the house, looking at Ponter's collection of sculptures. She'd known he liked stone rodents, and had indeed made a habit of giving him such carvings every time there was a lunar eclipse. Jasmel knew Ponter particularly liked rodents made of minerals that weren't indigenous to the animal's own area—his pride and joy, judging by its place next to the wadlak slab—was a half-size beaver, a local animal, molded from malachite imported from central Evsoy.

While she continued to putter around, Adikor's Companion made a plunk sound. “Healthy day,” he said into it. “Oh, wonderful, love. Great news! Be patient a beat...” He turned to Jasmel. “You'll want to hear this; it's my woman-mate, Lurt. She's got an analysis of that liquid I found in the quantum-computing lab after your father disappeared.” Adikor pulled out a control bud on his Companion, activating the external speaker.

“Jasmel Ket—Ponter's daughter—is with me now,” said Adikor. “Go ahead.”

“Healthy day, Jasmel,” said Lurt.

“And to you,” said Jasmel.

“All right,” continued Lurt, “This should surprise you. Do you know what the liquid you brought me is?”

“Water, I'd thought,” said Adikor. “Isn't it?”

“Sort of. It's in fact heavy water.”

Jasmel raised her eyebrow.

“Really?” said Adikor.

“Yes,” said Lurt. “Pure heavy water. Of course, heavy-water molecules do occur in nature; they make up about point-zero-one percent of normal rain water, for instance. But to get a concentration like this—well, I'm not sure how it would be done. I suppose you could devise a technique to fractionate naturally occurring water, based on the fact that heavy water is indeed about 10 percent heavier, but you'd have to process an enormous amount of water to separate out the amount you said you found. I don't know of any facility that can do that, and I can't think of any reason why someone would want to do it.”

Adikor looked at Jasmel, then back at his wrist. “There's no way it's naturally occurring? No way it could have welled up from the rocks?”

“Not a chance,” said Lurt's voice. “It was slightly contaminated with what I eventually realized was the cleaning solution used on the floors of your lab; there must have been a dried residue of it that dissolved in the water. But otherwise it was absolutely pure. Ground water would have minerals dissolved in it; this was manufactured. By whom, I don't know, and how, I'm not sure—but it absolutely isn't something that

occurred naturally."

"Fascinating," said Adikor. "And there was no trace of Ponter's DNA?"

"No. There was a little of your own—doubtless you sloughed off some cells while mopping up the water—but none of anyone else's. No traces of blood plasma or anything else that might have come from him, either."

"All right. Many thanks!"

"Healthy day, my dear," said Lurt's voice.

"Healthy day," repeated Adikor, and he pulled the control bud that broke the connection.

"What is heavy water?" asked Jasmel.

Adikor explained, then: "It must be the key," he said.

"You're telling the truth about the source of the heavy water?" asked Jasmel.

"Yes, of course," Adikor said. "I collected it from the floor of the computing chamber after Ponter disappeared."

"It's not poisonous, is it?"

"Heavy water? I can't imagine why it would be."

"What uses does it have?"

"None that I know of."

"There's no way my father's body could have been—I don't know—converted somehow into heavy water?"

"I highly doubt it," said Adikor. "And there's no trace of the chemicals that made up his body. He didn't disintegrate or spontaneously combust; he simply disappeared." Adikor shook his head. "Maybe tomorrow, at the dooslarm basadlarm, we can explain to the Adjudicator why we need to go down to the lab. Until then, I hope Ponter is all right, wherever he might be."

* * *

After getting Mary Vaughan set up in the genetics lab at Laurentian, Reuben Montego grabbed some lunch at a Taco Bell, then headed back to St. Joseph's Health Centre. In the lobby he saw Louise Benoît, that beautiful French-Canadian postdoctoral student from SNO. She was arguing with someone who appeared to be from the hospital's security department.

"But I saved his life!" Reuben heard Louise exclaim. "He'd certainly want to see me!"

Reuben walked up to the young woman. "Hello," he said. "What's the problem?"

The woman turned her lovely face toward him, her brown eyes going wide with gratitude. "Oh, Dr. Montego!" she said. "Thank God you're here. I came to see how our friend is doing, but they won't let me go up to his floor."

"I'm Reuben Montego," said Reuben to the security man, a muscular fellow with red hair. "I'm Mr. Ponter's..." Well, why not? "...general practitioner; you can confirm that with Dr. Singh."

“I know who you are,” said the security man. “And, yes, you're on the approved list.”

“Well, this young lady is with me. She did indeed save Ponter's life at the Sudbury Neutrino Observatory.”

“Very well,” said the man. “Sorry to be a pain, but we've got reporters and curious members of the public trying to sneak in all the time, and—”

At that moment, Dr. Naonihal Singh walked by, sporting, today, a dark-brown turban. “Dr. Singh!” called Reuben.

“Hello,” said Singh coming over and shaking Reuben's hand. “Escaping from the telephone, are we? Mine has been ringing off the hook.”

Reuben smiled. “Mine, too. Everybody wants to know about our Mr. Ponter, it seems.”

“You know I'm delighted that he is well,” said Singh, “but, really, I would like to discharge him. We don't have enough hospital beds as it is, thanks to Mike Harris.”

Reuben nodded sympathetically. Harris, the tightwad premier of Ontario, had closed or amalgamated many hospitals across the province.

“And,” continued Singh, “not putting too fine a point on it, but if he could be gone from here, perhaps I would stop being pestered by the media.”

“Where should we take him?” asked Reuben.

“That I am not knowing,” replied Singh. “But if he is well, he does not belong in a hospital.”

Reuben nodded. “All right, OK. We'll take him with us when we leave. Is there a way to sneak him out without the press seeing?”

“The whole idea,” said Singh, “is for the press to know he is gone.”

“Yes, yes,” said Reuben. “But we'd like to get him somewhere safe before they realize.”

“All right,” said Singh. “Take him out via the underground garage. Park in there; take the staff elevator down to B2, and exit through the corridor there. As long as Ponter keeps his head down in your car, no one will see him departing.”

“Excellent,” said Reuben.

“Please to take him today,” said Singh.

Reuben nodded. “I will.”

“Thank you,” said Singh.

Reuben and Louise headed upstairs.

“Hello, Ponter,” said Reuben, as he came into the hospital room. Ponter was sitting up on the bed, wearing the same clothes he'd been found in.

At first Reuben thought Ponter had been watching TV, but then the doctor noticed the way he was holding up his left arm, with Hak's glass eye faced toward the monitor. More likely, the Companion had

been listening to further language samples, trying to pick up more words from context.

“Hello, Reuben,” said Hak, presumably on behalf of Ponter. Ponter turned to look at Louise. Reuben noted that he didn't react the way a normal human male might; there was no smile of delight at the unexpected visit from a gorgeous young woman.

“Louise,” said Reuben. “Meet Ponter.”

Louise stepped forward. “Hello, Ponter!” she said. “I'm Louise Benoît.”

“Louise pulled you out of the water,” Reuben said.

Ponter now did smile warmly; perhaps everyone here looked the same to him, thought Reuben. “Lou—” said Hak's voice. Ponter shrugged apologetically.

“He can't make the ee sound in your name,” said Reuben.

Louise smiled. “That's all right. You can call me Lou; lots of my friends do.”

“Lou,” repeated Ponter, speaking for himself in his deep voice. “I—you—I...”

Reuben looked at Louise. “We're still building up his vocabulary. I'm afraid we haven't gotten to social niceties yet. I'm sure he's trying to say thank you for saving his life.”

“My pleasure,” said Louise. “I'm glad you're all right.”

Reuben nodded, “And speaking of being all right,” he said, “Ponter, you from here go.”

Ponter's one continuous eyebrow rolled up his browridge. “Yes!” said Hak, speaking again for him. “Where? Where go?”

Reuben scratched the side of his shaved head. “That's a good question.”

“Far,” said Hak. “Far.”

“You want to go far away?” said Reuben. “Why?”

“The—the...” Hak trailed off, but Ponter moved a hand up, covering his giant nose—perhaps the Neanderthal equivalent of pinching one's nostrils.

“The smell?” said Reuben. He nodded and turned to Louise. “With a honker like that, I'm not surprised that he's got a keen sense of smell. I hate the smell of hospitals myself, and I spend a lot of time in them.”

Louise looked at Ponter, but spoke to Reuben. “You still have no idea where he's from?”

“No.”

“I'm thinking parallel world,” said Louise, simply.

“What?” said Reuben. “Oh, come on!”

Louise shrugged. “Where else could he be from?”

“Well, that's a good question, but...”

“And if he is from a parallel world,” said Louise, “suppose that world doesn't have internal-combustion

engines, or any of the other things that pollute our air. If you really did have a very sensitive nose, you'd never adopt stinking technologies."

"Perhaps, but that hardly means he's from another universe."

"Either way," said Louise, brushing her long, brown hair out of her eyes, "he probably wants to go somewhere away from civilization. Somewhere where it doesn't smell as bad."

"Well, I can get a leave from Inco," said Reuben. "The beauty of being the staff physician is that you get to write your own leave authorizations. I'd really like to keep working with him."

"I've got nothing to do, either," said Louise, "while they're draining the SNO facility."

Reuben felt his heart pound. Damn, he was still a hound dog! But surely Louise was thinking of coming with them because of her scientific interest in Ponter. Still, it would be lovely to spend more time with her; her accent was incredibly sexy.

"I wonder if the authorities will try to take him again," said Reuben.

"It's only been a day since he got here," said Louise, "and I bet no one in Ottawa is really taking it seriously yet. It's just another crazy National Enquirer-type story. Federal agents and military types don't show up every time someone claims a UFO has been sighted. I'm sure they haven't even begun to think this might be real."

* * *

The smells are indeed awful, thought Ponter, as he looked at Lou and Reuben. They made a stark contrast: him with dark skin and completely bald, and her with skin even paler than Ponter's own, and with thick, brown hair cascading past her narrow shoulders.

Ponter was still frightened and confused, but Hak whispered soothing words into his cochlear implants whenever the Companion detected that Ponter's vital signs were getting too agitated. Without Hak's aid, Ponter felt sure he would have gone mad by now.

So much had happened in such a short time! Just yesterday, he had awoken in his own bed with Adikor, had fed his dog, had gone to work...

And now he was here, wherever here might be. Hak was right; this must be Earth. Ponter rather suspected there were other habitable planets in the infinite reaches of space, but he seemed to weigh the same here as he had at home, and the air was breathable—breathable, in the way that his beloved Adikor's cooking might be said to be edible! There were foul aromas, gaseous smells, fruity smells, chemical smells, smells he couldn't even begin to identify. But, he had to admit, the air did sustain him, and the food they had given him was (mostly!) chemically compatible with his digestive system.

So: Earth. And surely not Earth of the past. There were parts of modern Earth, especially in equatorial regions, that were little explored, but, as Hak had pointed out, the vegetation here was largely the same as that in Saldak, meaning it was unlikely that he was on another continent, or in the southern hemisphere. And although it was warm, many of the trees he'd seen were deciduous; this couldn't be an equatorial area.

The future, then? But no. If humanity faded from existence, for some unfathomable reason, it wouldn't be Gliksins that rose to take its place. Gliksins were extinct; a revival of them would be as unlikely as one of dinosaurs.

If this was not just Earth, but in fact the same part of Earth Ponter himself had come from, then where

were the vast clouds of passenger pigeons? He'd seen not a single one since arriving here. Maybe, thought Ponter, the nauseating smells drove them away.

But no.

No.

This was neither the future, nor the past. It was the present—a parallel world, a world where, incredibly, despite their innate stupidity, the Gliksins had not gone extinct.

* * *

“Ponter,” said Reuben.

Ponter looked up, a vaguely lost expression on his face, as if a reverie had been broken. “Yes?” he said.

“Ponter, we will take you somewhere else. I'm not sure where. But, well, for starters, we'll get you out of here. You, um, you can come stay with me.”

Ponter tipped his head, listening to Hak's translation, no doubt. He looked puzzled at a few points; presumably Hak wasn't quite sure how to render some of the words Reuben had used.

“Yes,” said Ponter, at last. “Yes. We go from here.”

Reuben gestured for Ponter to take the lead.

“Open door,” said Ponter, speaking on his own behalf, with evident delight, as he pulled open the hospital room's door. “Go through door,” he said, following the words with the appropriate deed. He then waited for Louise and Reuben to exit as well. “Close door,” he said, shutting the door behind them. And then he smiled broadly, and when Ponter smiled broadly, it measured almost a foot from edge to edge. “Ponter out!”

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Chapter 19

Following Dr. Singh's instructions, Reuben Montego, Louise Benoît, and Ponter made it safely down to Reuben's car, which he'd moved to the staff garage. Reuben had a wine-colored SUV, the paint chipped from the gravel roads at the Inco site. Ponter got into the back seat and lay down, covering his head with an opened section of today's Sudbury Star. Louise—who had walked to the hospital—sat up front with Reuben. She'd accepted Reuben's invitation to join him and Ponter at his place for dinner; he'd said he'd give her a lift back home later in the evening.

They drove along, CJMX-FM playing softly on the car's stereo; the current song was Geri Halliwell's rendition of It's Raining Men. “So,” said Reuben, looking over at Louise, “make me a believer. Why do you think Ponter came from a parallel universe?”

Louise pursed her full lips for a moment—God, thought Reuben, she really is lovely—then: “How much physics do you know?”

“Me?” said Reuben. “Stuff from high school. Oh, and I bought a copy of A Brief History of Time when Stephen Hawking came to Sudbury, but I didn't get very far into it.”

“All right,” said Louise, as Reuben made a right-hand turn. “let me ask you a question. If you shoot a single photon at a barrier with two vertical slits in it, and a piece of photographic paper on the other side shows interference patterns, what happened?”

“I don't know,” said Reuben, truthfully.

“Well,” Louise said, “one interpretation is that the single photon turned into a wave of energy, and, as it hit the wall with the slits, each slit created a new wave front, and you got classical interference, with crests and troughs either amplifying each other or canceling each other out.”

This all rang a vague bell in Reuben's mind. “All right.”

“Well, as I said, that's one interpretation. Another is that the Universe actually splits, briefly becoming two universes. In one, the photon—still a particle—went through the left slit, and in the other, the photon went through the right slit. And, because it doesn't make any conceivable difference which slit the photon went through in this or the other universe, the two universes collapse back into one, with the interference pattern being the result of the universes rejoining.”

Reuben nodded, but only because that seemed the right thing to do.

“So,” said Louise, “we have an experimental physical basis for possibly believing in the temporary existence of parallel universes—those interference patterns really do show up, even if you only send one photon toward a pair of slits. But what if the two universes didn't collapse back into one? What if, after splitting, they continued to go their separate ways?”

“Yes?” said Reuben, trying to follow.

“Well,” said Louise, “imagine the Universe splitting into two, who knows, tens of thousands of years ago, back when there were two species of humanity living side by side: our ancestors, which were the Cro-Magnons” (Reuben noted she said this just as a French-speaker should, with no g sound), “and Ponter's ancestors, ancient Neanderthals. I don't know how long the two kinds coexisted, but—”

“From 100,000 years ago until maybe 27,000 years ago,” said Reuben.

Louise made an impressed face, clearly surprised that Reuben had this tidbit at hand.

Reuben shrugged. “We've got a geneticist up from Toronto named Mary Vaughan. She told me.”

“Ah. OK, well, at some point during that time, perhaps a split occurred, and the two universes continued to diverge. In one, our ancestors became dominant. And in the other, Neanderthals went on to become dominant, creating their own civilization and language.”

Reuben felt his head swimming. “But ... but then how did the two universes come back into contact?”

“Je ne sais pas,” said Louise, shaking her head.

They exited Sudbury, heading down a country road to the misnamed town of Lively, near where the mine was actually located.

“Ponter,” said Reuben. “You can probably get up now; we won't be stuck in traffic anymore.”

Ponter didn't move.

Reuben realized he'd been too complex. “Ponter, up,” he said.

He heard the sound of newspaper rustling and saw Ponter's massive head emerge in the rearview mirror. “Up,” confirmed Ponter.

“Tonight,” said Reuben, “you will stay at my house, understand?”

After a pause, presumably in which a translation was rendered, Ponter said, “Yes.”

Hak spoke up. “Ponter need food.”

“Yes,” said Reuben. “Yes, we eat soon.”

They continued to Reuben's home, arriving there about twenty minutes later. It was a modern two-story house on a couple of acres of land just outside Lively. Ponter, Louise, and Reuben headed indoors, with Ponter watching in fascination as Reuben unlocked the front door, then bolted and chained it shut from the inside once they were within.

Ponter smiled. “Cool,” he said, with delight.

At first, Reuben thought he was complimenting him on his decor, but then he realized Ponter meant it literally. He was evidently quite pleased to find Reuben's house to be air conditioned.

“Well,” said Reuben, smiling at Louise and Ponter, “welcome to my humble abode. Make yourselves comfortable.”

Louise looked around. “You're not married?” she asked.

Reuben wondered at the question; the first, best interpretation was that she was checking on his availability. The second, more likely, interpretation was she had suddenly realized that she had gone out into the country with a man she hardly knew, and was now alone with him and a Neanderthal in an empty house. And the third interpretation, Reuben realized, as he took stock of his own messy living room, with magazines scattered here and there and a plate with the remnants of a pizza crust sitting on the coffee table, was that obviously Reuben lived alone; no woman would have put up with such a mess.

“No,” said Reuben. “I was, but...”

Louise nodded. “You've got good taste,” she said, looking at the furnishings, a mixture of Caribbean and Canadian, with lots of dark stained wood.

“My wife did,” said Reuben. “I haven't changed it much since we split.”

“Ah,” said Louise. “Can I help you with dinner?”

“No, I thought I'd just put on some steaks. I've got a barbecue out back.”

“I'm a vegetarian,” said Louise.

“Oh. Um, I could grill you some vegetables—and, um, a potato?”

“That would be great,” said Louise.

“OK,” said Reuben. “You keep Ponter company.” He headed off to the bathroom to wash his hands.

Working on the deck behind the house, Reuben could see Louise and Ponter having an increasingly animated conversation. Presumably, Hak was picking up more words as they went along. Finally, when the steaks were done, Reuben tapped on the glass to get Louise and Ponter's attention, and waved for

them to come on out.

A moment later, they did so. “Dr. Montego,” said Louise, excitedly, “Ponter is a physicist!”

“He is?” said Reuben.

“Yes. Yes, indeed. I haven't got all the details yet, but he's definitely a physicist—and, I think, actually a quantum physicist.”

“How did you determine that?” asked Reuben.

“He said he thinks about the way things work, and I said—guessing he might be an engineer—did he mean big things, and he said, no, no, little things, things too small to be seen. And I drew some diagrams—basic physics stuff—and he recognized them, and said that's what he did.”

Reuben looked at Ponter with renewed admiration. The low forehead and the prominent browridge made him look, well, a little dim, but—a physicist! A scientist! “Well, well, well,” said Reuben. He motioned for them to sit at a circular deck table with an umbrella, and he transferred steaks and grilled veggies he'd wrapped in aluminum foil to plates and set them on the table.

Ponter smiled his wide smile. This, clearly, was real food to him! But then he looked around again, just as Reuben had seen him do this morning, as if something were missing.

Reuben used his knife to slice a piece off his steak, and brought it to his mouth.

Ponter, awkwardly, mimicked what Reuben had done, although he sliced off a much bigger piece.

After Ponter had finished chewing, he made some sounds that must have been words in his language. They were immediately followed by a male voice Reuben hadn't heard before. “Good,” it said. “Good food.” The voice seemed to have come from Ponter's implant.

Reuben raised his eyebrows in surprise, and Louise explained. “I was getting confused talking to them, trying to keep straight what was the implant speaking on its own, and what was the implant translating for Ponter. It's now using a male voice for Ponter's translated words, and a female voice for its own words.”

“Simpler this way,” said Hak's familiar female voice.

“Yes,” said Reuben, “it certainly is.”

Louise gingerly used her long fingers to unwrap the foil around her grilled veggies. “Well,” she said, “let's see what else we can find out.”

And for the next hour Reuben and Louise talked with Ponter and Hak. But by then, the mosquitoes were out in abundance. Reuben lit a citronella candle to drive them away, but the smell made Ponter gag. Reuben extinguished the candle, and they went back into his living room, Ponter sitting in a big easy chair, Louise at one end of the couch with her long legs tucked underneath her body, and Reuben at the other end.

They continued talking for another three hours, slowly piecing together what had happened. And, once the full story had emerged, Reuben sank back into the couch, absolutely amazed.

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Chapter 20

DAY THREE

Sunday, August 4

148/118/26

—

NEWS SEARCH

Keyword(s): Neanderthal

Word this morning from Sudbury, Canada, that marriage proposals are outnumbering death-threats two-to-one for the Neanderthal visitor. Twenty-eight women have sent letters or E-mails c/o this newspaper proposing to Mr. Boddit, while Sudbury police and the RCMP have recorded only thirteen threats against his life...

USA Today poll:

• Percentage who believe the so-called Neanderthal is a fake: 54.
• Who believe he's really a Neanderthal, but came from somewhere on this Earth: 26.
• Who believe he came from outer space: 11.
• Who believe he came from a parallel world: 9.

Police today defused a bomb left at the entrance to the mineshaft elevator leading down to the cavern containing the Sudbury Neutrino Observatory, where the so-called Neanderthal first appeared...

A religious sect in Baton Rouge, Louisiana, is hailing the arrival of the Neanderthal in Canada as the Second Coming of Christ. “Of course he looks like an ancient human,” said the Rev. Hooley Gordwell. “The world is 6,000 years old, and Christ first came among us fully a third of that span ago. We've changed a bit, perhaps due to better nutrition, but he hasn't.” The group is planning a pilgrimage to the mining town of Sudbury, Ontario, where the Neanderthal is currently living.

* * *

Early the next morning, after taking care not to be seen en route, Ponter and Dr. Montego rendezvoused with Mary in the lab at Laurentian. It was time to analyze Ponter's DNA, to answer the big question.

Sequencing 379 nucleotides took meticulous work. Mary sat hunched over a milky-white plastic desktop, the surface illuminated by fluorescent tubes beneath it. She'd placed the autorad film on the desktop and, with a felt-tip marker, wrote out the letters of the genetic alphabet for the string in question: G-G-C—one of the triplets that coded for the amino acid glycine; T-A-T, the code for tyrosine; A-T-A, which in mitochondrial DNA, as opposed to nuclear DNA, specified methionine; A-A-A, the recipe for lysine...

At last she was done: all 379 bases from a specific part of Ponter's control region were identified. Mary's notebook computer had a little DNA-analysis program on it. She started by typing in the 379 letters she'd just written on the film, and then she asked Reuben to type them in again, just to make sure they'd been entered correctly.

The computer immediately reported three differences between what Mary had entered and what Reuben had, noting—it was an intelligent little program—a frameshift caused by Mary accidentally leaving off a U at one point; the other two errors were typos by Reuben. When she was sure they had all 379 letters entered correctly, she had the program compare Ponter's sequence to the one she'd extracted from the Neanderthal type specimen at the Rheinisches Landesmuseum.

“Well?” said Reuben. “What's the verdict?”

Mary leaned back in her chair, astonished. “The DNA I took from Ponter,” she said, “differs in seven places from the DNA recovered from the Neanderthal fossil.” She raised a hand. “Now, some individual variation was to be expected, and naturally there'd be some genetic drift over time, but...”

“Yes?” said Reuben.

Mary lifted her shoulders. “He's a Neanderthal, all right.”

“Wow,” said Reuben, looking at Ponter as if seeing him for the first time. “Wow. A living Neanderthal.”

Ponter spoke a bit in his own language, and his implant interpreted: “My kind gone?” said the male voice.

“From here?” asked Mary. “Yes, your kind is gone from here—for at least 27,000 years.”

Ponter lowered his head, contemplating this.

Mary contemplated it, too. Until Ponter had shown up, the nearest living relatives Homo sapiens had were the two members of genus Pan: the chimpanzee and the bonobo. Both were equally closely related to humans, sharing about 98.5 percent of humanity's DNA. Mary was nowhere near finished with her studies on Ponter's DNA, but she guessed he shared as much as 99.5 percent with her kind of H. sapiens.

And that 0.5% accounted for all the differences. If he was a typical Neanderthal, his braincase probably was larger than a normal man's. And he was better muscled than just about any human Mary had ever met: his arms were as thick around as most men's thighs. Plus, his eyes were an incredible golden brown; she wondered if there was any eye-color variation among his kind.

He was also quite hairy, although it seemed less so because of its light color. His forearms, and, she presumed, his back and chest, were well thatched. And he had a beard, and a full head of hair, parted in the center.

It hit her then: where she'd seen that sort of part before. Bonobos, those lithe apes sometimes called pygmy chimpanzees, all sported the same ‘do. Fascinating. She wondered whether all his people had hair like that or if it was just a style he cultivated.

Ponter spoke again in his own language, his voice low, perhaps really just talking to himself, but the implant rendered the words in English anyway: “My kind gone.”

Mary made her tone as gentle as she could. “Yes. I'm sorry.”

More syllables spilled from Ponter's lips, and his Companion said, “I ... no others. I ... all...” He shook his head, and spoke again. The Companion switched to its female voice, speaking for itself. “I don't have the vocabulary to translate what Ponter is saying.”

Mary nodded slowly, sadly. “The word you're looking for,” she said gently, “is alone.”

* * *

Adikor Huld's dooslarm basadlarm was held in the Gray Council building, on the periphery of the Center. Males could get to it without crossing deep into female territory; females could enter it without technically leaving their land. Adikor wasn't sure what having the preliminary inquiry during Last Five would do for his chances, but the adjudicator, a woman named Komel Sard, looked to be from generation 142, and so would be long past menopause.

Adikor's accuser, Daklar Bolbay, was now holding forth in the large square chamber. Fans blew air from the chamber's north side to its south, and Adjudicator Sard sat at the south end, watching the action unfold with a neutral expression on her lined, wise face. The blowing air served a double purpose: it brought pheromones to her from the accused, which could often convey as much meaning as the words being spoken, and it kept her own pheromones—which might have betrayed which arguments were impressing her—from being detectable by the accuser or the accused, both of whom were positioned on the north side.

Adikor had met Klast many times, and had always gotten along well with her; her man-mate, after all, had been Ponter. But Bolbay, who had been Klast's woman-mate, seemed to have none of Klast's warmth or easy humor.

Bolbay was wearing a dark orange pant and a dark orange top; orange had always been the color of the accuser. For his part, Adikor wore blue, the color of the accused. Hundreds of spectators, equally split between male and female, sat on either side of the room; a dooslarm basadlarm for murder was clearly considered well worth seeing. Jasmel Ket was there, as was her young sister, Megameg Bek. Adikor's own woman-mate, Lurt, was present as well; she'd given him a big hug when she'd arrived. Seated next to Lurt was Adikor's son Dab, the same age as little Megameg.

And, of course, almost all of Saldak's Exhibitionists were present; there was no more interesting event going on right now than this hearing. Despite his current situation, Adikor was pleased to see Hawst in the flesh, having used his Voyeur to look in on so much of his life in the past. He also recognized Lulasm, who had been Ponter's favorite, and Gawlt and Talok and Repeth and a couple of others. The Exhibitionists were easy to spot: they had to wear silver clothes, signaling to everyone around them that their implant broadcasts were publicly accessible.

Adikor was sitting on a stool; there was plenty of room on all sides of it for Bolbay to circle him as she spoke, and she did so with great theatrical relish: “So tell us, Scholar Huld, did your experiment succeed? Did you successfully factor your target number?”

Adikor shook his head. “No.”

“So doing it beneath the surface did not help,” said Bolbay. “Whose idea was it to perform this factoring experiment far underground?” Her voice was low for a female's, a deep rumbling sound.

“Ponter and I jointly agreed to it.”

“Yes, yes, but who initially suggested the idea? You, or Scholar Boddit?”

“I'm not sure.”

“It was you, wasn't it?”

Adikor shrugged. “It might have been.”

Bolbay was now in front of him; Adikor refused to acknowledge her presence by shifting his gaze to her. “Now, Scholar Huld, tell us all why you chose this location.”

“I didn't say I chose it. I said I might have.”

“Fine. Tell us, then, why this location was selected for your work.”

Adikor frowned, thinking about how much detail was appropriate. “Earth,” he said at last, “is constantly bombarded by cosmic rays.”

“Which are?”

“Ionizing radiation coming from outer space. A stream of protons, helium nuclei, and other nuclei. When they collide with nuclei in our atmosphere, they produce secondary radiation—mostly pions, muons, electrons, and dutar rays.”

“And these are dangerous?”

“Not really—at least, not in the small quantities produced by cosmic rays. But they do interfere with delicate instruments, and so we wanted to set up our equipment somewhere that was shielded from them. And, well, the Debral nickel mine was nearby.”

“Couldn't you have used another facility?”

“Conceivably, I suppose. But Debral is unique not only for its depth—it is the deepest mine in the world—but also for the low background radiation of its rocks. The uranium and other radioactives present in many other mines give off charged particles that would have impaired our instruments.”

“So you were well shielded down there?”

“Yes—from everything except neutrinos, I suppose.” Adikor caught the expression on Adjudicator Sard's face. “Minuscule particles that stream right through solid matter; nothing can shield against them.”

“Now, weren't you also shielded against something else down there?” asked Bolbay.

“I don't understand,” said Adikor

“A thousand armspans of rock between you and the surface. No radiation—not even cosmic-ray particles that had traveled unimpeded for huge distances—could get down to you.”

“Correct.”

“And no radiation could make it up from the surface to where you were working, isn't that right?”

“How do you mean?”

“I mean,” said Bolbay, “that the signals from your Companions—yours, and Scholar Boddit's—could not be transmitted out of there to the surface.”

“Yes, that's true, although I hadn't really given it any thought until an enforcer mentioned it to me yesterday.”

“Hadn't given it much thought?” Bolbay's tone was one of incredulity. “Since the day you were born, you've had a personal recording cube in the alibi-archive pavilion adjacent to this very Council building. And it has recorded everything you've done, every moment of your life, as transmitted by your Companion. Every moment of your life, that is, except the time you spent far, far below Earth's surface.”

“I'm no expert on such matters,” said Adikor, somewhat disingenuously. “I really don't know much about the transmission of data from a Companion.”

“Come now, Scholar Huld. A moment ago you were regaling us with stories of muons and pions, and now you expect us to believe you don't understand simple radio broadcasting?”

“I didn't say I don't understand it,” said Adikor. “It's just that I've never thought about the issue that's been raised.”

Bolbay was behind him again. “Never thought about the fact, that, while down there, for the first time since your birth, there would be no record available of what you were doing?”

“Look,” said Adikor, speaking directly to the adjudicator, before the orbiting Bolbay blocked his line-of-sight again. “I haven't had cause to access my own alibi archive for countless months. Sure, the fact that my actions are normally being recorded is something I'm aware of, in an abstract sense, but I just don't think about it every day.”

“And yet,” said Bolbay, “every day of your life, you enjoy the peace and safety made possible by that very recording.” She looked at the adjudicator. “You know that as you walk at night, the chances of you being the victim of robbery or murder or lasagklat are almost zero, because there's no way to get away with such a crime. If you charged that—well, say, that I had attacked you in Peslar Square, and you could convince an adjudicator that your charge was reasonable, the adjudicator could order your alibi archive or mine unlocked for the timespan in question, which would prove that I am innocent. But the fact that a crime cannot be committed without a record of it being made lets us all relax.”

Adikor said nothing.

“Except,” said Bolbay, “when someone contrives a situation to secrete himself and his victim in a place—practically the only place—in which no record of what happens between them could have been made.”

“That's preposterous,” said Adikor.

“Is it? The mine was dug long before the beginning of the Companion Era, and, of course, we've used robots to do the mining for ages now. It's almost unheard of for a human to have to go down into that mine, which is why we've never addressed the problem of lack of communication between Companions there and the alibi-archive pavilion. But you set up a situation in which you and Scholar Boddit would be in this subterranean hideaway for great spans of time.”

“We didn't even think about that.”

“No?” said Bolbay. “Do you recognize the name Kobast Gant?”

Adikor's heart pounded, and his mouth went dry. “He's an artificial-intelligence researcher.”

“Indeed he is. And he will state that seven months ago he upgraded both your Companion and Scholar Boddit's, adding sophisticated artificial-intelligence components to them.”

“Yes,” said Adikor. “He did that.”

“Why?”

“Well, um...”

“Why?”

“Because Ponter hadn't liked being out of touch with the planetary information network. With our Companions cut off from the network down there, he thought it would be handy to have a lot more processing power localized in them, so that they could help us more with our work.”

“And you somehow forgot this?” said Bolbay.

“As you said,” replied Adikor, his tone sharp, “it was done months ago. I'd gotten quite used to having a

Companion that was more chatty than usual. After all, I'm sure Kobast Gant will also state that, although these were early versions of his companionable artificial-intelligence software, his intention was to make it available for all those who wanted it. He expected people to find it quite helpful, even if they are never cut off from the network—and he felt people would get used to it quickly, so that it would soon be as natural to them as having a dumber Companion." Adikor folded his hands in his lap. "Well, I rapidly got used to mine, and, as I said at the outset, I didn't give much thought to it, or to why it had originally been necessary ... but ... wait! Wait!"

"Yes?" said Bolbay.

Adikor looked directly at Adjudicator Sard, seated across the room. "My Companion could tell you what happened down there!"

The adjudicator leveled a steady stare at Adikor. "What is your contribution, Scholar Huld?" she asked.

"Me? I'm a physicist."

"And a computer programmer, is that not so?" said the adjudicator. "Indeed, you and Scholar Boddit were working on complex computers."

"Yes, but—"

"So," said the adjudicator, "I hardly think we can trust anything your Companion might say. It would be a trivial enough matter for one of your expertise to program it to tell us whatever you wanted it to."

"But I—"

"Thank you, Adjudicator Sard," said Bolbay. "Now, tell us, Scholar Huld, how many people are normally involved in a scientific experiment?"

"That's a meaningless question," said Adikor. "Some projects are undertaken by a single individual, and—"

"—and some are undertaken by tens of researchers, isn't that true?"

"Sometimes, yes."

"But your experiment involved just two researchers."

"That's not correct," said Adikor. "Four other people worked on various stages of our project."

"But none of them were invited down into the mineshaft. Only the two of you—Ponter Boddit and Adikor Huld—went down there, isn't that right?"

Adikor nodded.

"And only one of you returned to the surface."

Adikor was impassive.

"Isn't that right, Scholar Huld? Only one of you returned to the surface."

"Yes," he said, "but, as I've explained, Scholar Boddit disappeared."

"Disappeared," said Bolbay, as if she'd never heard the word before, as if she were struggling to

comprehend its meaning. “You mean he vanished?”

“Yes.”

“Into thin air.”

“That's right.”

“But there's absolutely no record of this disappearance.”

Adikor shook his head slightly. Why was Bolbay pursuing him so? He'd never been unpleasant to her, and he couldn't imagine that Ponter had ever presented him to Bolbay in unfavorable terms. What was motivating her?

“You've found no body,” said Adikor, defiantly. “You've found no body because there is no body.”

“That's your position, Scholar Huld. But a thousand armspans underground, you could have disposed of the body in any number of places: putting it in an airtight bag to keep its smell from escaping then throwing it down a fissure, burying it under loose rock, or tossing it into a rock-grinding machine. The mine complex is huge, after all, with tens of thousands of paces worth of tunnels and drifts. Surely you could have gotten rid of the body down there.”

“But I didn't.”

“So you say.”

“Yes,” said Adikor, forcing calmness into his tone, “so I say.”

* * *

The previous night, at Reuben's, Louise and Ponter had tried to devise an experiment that could prove to others whether what Ponter had claimed was true: that he came from a parallel world.

Chemical analysis of his clothing fibers might do it. They were synthetic, Ponter had said, and presumably didn't match any polymer developed here. Likewise, some of the components of Ponter's strange Companion implant would almost certainly prove unknown to this world's science.

A dentist might be able to show that Ponter had never been exposed to fluoridated water. It might even be possible to prove that he'd lived in a world without nuclear weapons, dioxins, or internal-combustion engines.

But, as Reuben had pointed out, all those things would simply demonstrate that Ponter didn't come from this Earth, not that he came from another Earth. He could, after all, be an alien.

Louise had argued that there was no way life from any other planet would so closely resemble the random results evolution had produced here, but she conceded that for some, the idea of aliens was more acceptable, and certainly more familiar, than the notion of parallel universes—a comment that prompted Reuben to say something about Kira Nerys looking better in leather.

Finally, Ponter himself had come up with a suitable test. His implant, he said, contained complete maps of the nickel mine that was supposedly located near here in his version of Earth; after all, this had been the site of the facility where he worked, too. Of course, most of the major ore bodies had been found by both his people and the Inco staff, but, by comparing the Companion's maps to detailed ones on the Inco web site, Ponter's implant identified a spot it said contained a rich copper deposit that had eluded Inco's detection. If true, it was precisely the sort of information that only someone from a parallel universe might

have.

So now Ponter Boddit—they had learned his full name—Louise Benoît, Bonnie Jean Mah, Reuben Montego, and a woman Louise was meeting for the first time, a geneticist named Mary Vaughan, were all standing in the middle of dense woods precisely 372 meters away from the SNO surface building. With them were two Inco geologists, who were operating a core-sampling drill. One of them insisted Ponter could not be right about there being copper at this spot.

They drilled down 9.3 meters, just as Hak had said they should, and the sampling tube was drawn back up. Louise was relieved when the diamond-tipped drill finally shut off; the grinding sound had given her a headache.

The group took the wrapped core back to the parking lot, everyone holding on to it at some point along its length. And there, where there was room to do so, the geologists removed its opaque outer membrane. At the core's top, of course, was humus, and, beneath that, a glacial till of clay, sand, gravel, and pebbles. Below that, said one of the geologists, was Precambrian norite rock.

And beneath that, at precisely the depth Hak had said it would be found at, was—

Louise clapped her hands together in excitement. Reuben Montego was grinning from ear to ear. The doubting geologist was muttering to himself. Professor Mah was shaking her head slowly back and forth in astonishment. And the geneticist, Dr. Vaughan, was staring at Ponter with wide eyes.

It was there, precisely where he said it would be: native copper, twisted and bulbous, dull but clearly metallic.

“High-grade ore,” said the second geologist, examining the reddish-orange material. “Well worth mining.”

Louise smiled at Ponter as she thought about the verdant, unspoiled world he had described to her the night before. “Pennies from heaven,” she said softly.

Professor Mah came over to Ponter and took his giant hand in hers, shaking it firmly. “I wouldn't have believed it,” she said, “but welcome to our version of Earth.”

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Chapter 21

Everyone except the geologists adjourned to a conference room at the Creighton Mine: Mary Vaughan, the geneticist who'd come up from Toronto; Reuben Montego, the Inco doctor; Louise Benoît, the SNO postdoc who had been on hand when the detector had been destroyed; Bonnie Jean Mah, director of the SNO project; and, most important of all, Ponter Boddit, physicist from a parallel world, the only living Neanderthal to be seen on this Earth since at least 27,000 years ago.

Mary had chosen to sit beside Bonnie Jean Mah, the only woman in the room who'd had an empty chair next to her. Holding forth, standing at the front of the room, was Reuben Montego. “Question,” he said in that Jamaican accent Mary found delightful. “Why is there a mining operation on this site?”

Mary herself had no clue, and none of those who obviously did know looked inclined to play games, but at last Bonnie Jean Mah replied. “Because 1.8 billion years ago,” she said, “an asteroid hit here, resulting in huge deposits of nickel.”

“Exactly,” said Reuben. “An event that happened long before there was any multicellular life on Earth, an event both Ponter's world and ours share in their common pasts.” He looked from face to face, coming at last to Mary's own. “One has little choice in where mines will be built,” Reuben said. “You put them where the ores are. But what about SNO? Why was it built here?”

“Because,” said Mah, “the two kilometers of rock over the top of the mine provide an excellent shield against cosmic rays, making it an ideal location for a neutrino detector.”

“But it's not just that, is it, ma'am?” said Reuben, who, Mary assumed, had become quite the expert thanks to the help of Louise. “There are deep mines elsewhere on the planet,” continued Reuben. “But this mine also has very low background radiation, right?In fact, this site is uniquely qualified for housing instruments that would be adversely affected by natural radiation.”

This sounded reasonable to Mary. Professor Mah nodded once, and then, steepling her fingers in front of her, she said, “There's no doubt that it's a unique site—here, and I would presume, in the Neanderthal universe as well. Isn't that so?”

“Yes, ma'am, it's exactly that—a one-of-a-kind combination of traits. And because of that, Ponter says that in his world a deep mine was also built on this very spot, to excavate the same nickel deposits. And eventually he himself recognized the value of the site and convinced his government to set up a physics facility underground here.”

“So he would have us believe that there's a neutrino detector at the same place in this other universe?” asked Mah.

Reuben shook his head. “No,” he said. “No, there isn't. Remember, the choice of using this facility for a neutrino observatory also had to do with a historical accident: that Canada's nuclear reactors, unlike those of the U.S. or the U.K. or Japan or Russia, happen to use heavy water as a moderator. That set of circumstances isn't duplicated in Ponter's world—in fact, they don't seem to use nuclear power. But this underground facility is equally good for another very delicate kind of instrument.” He paused and looked from face to face, then he said, “Ponter, where do you work?”

Ponter replied, “Dusble korbul to kalbtadu.”

And the implant, using its male voice, provided the translation: “In a quantum-computing facility.”

“Quantum computing?” repeated Mary, but feeling uncomfortable doing so; she wasn't used to being the most ignorant one in the room.

“That's right,” said Reuben, grinning. “Dr. Benoît?”

Louise got up and nodded at the M.D. “Quantum computing is something we're just starting to play with ourselves,” she said, pushing hair out of her eyes. “A regular computer can determine the factors of a given number by trying one possible factor to see if it works, then another, then another, then another: brute-force calculation. But if you used a conventional computer to factor a big number—say, one with 512 digits, like those used to encrypt credit-card transactions on the World Wide Web—it would take countless centuries to try all the possible factors one at a time.”

She, too, looked from face to face, making sure she hadn't lost her audience. “But a quantum computer uses superposition of quantum states to check multiple possible factors simultaneously,” said Louise. “That is, in essence, new short-lived duplicate universes are spun off specifically to do the quantum calculation, and, once the factoring is complete—which would be virtually instantaneously—all those universes collapse back down into one again, since, except for the candidate number they tested to see if

it was a factor, they're otherwise identical. And so, in the time it takes to try just one factor, you actually get them all tried simultaneously, and you solve a previously intractable problem." She paused. "At least, until now, that's how we've believed quantum computing works—relying on the momentary superposition of quantum states effectively creating different universes."

Mary nodded, trying to follow along.

"But suppose that isn't how it really happens," said Louise. "Suppose that instead of creating temporary universes for a fraction of a second, a quantum computer instead accesses already existing parallel universes—other versions of reality in which the quantum computer also exists."

"There's no theoretical basis for believing that," said Bonnie Jean, sounding annoyed. "And, besides, there's no quantum computer at this location, in the only universe that we know does exist."

"Exactly!" said Louise. "What I propose is this: Dr. Boddit and his colleague were trying to factor a number so large that to check every possible factor of it required more versions of the quantum computer than there were in separate already existing long-term universes. Do you see? It reached into thousands—millions!—of existing ones. And in each of those parallel universes, the quantum computer found a duplicate of itself, and that duplicate tried a different potential factor. Right? But what if you were factoring a huge number, a gigantic number, a number with more possible factors than there are parallel universes in which the quantum-computing facility already exists? What then? Well, I think that's what happened here: Dr. Boddit and his partner were factoring a gigantic number, the quantum computer found its siblings in all—every single one—of the parallel universes in which it already existed, but it still needed more copies of itself, and so it went looking in other parallel universes, including ones in which the quantum-computing facility had never been built—such as our universe. And when it reached one of those, it was like hitting a wall, causing the factoring experiment to abort. And that crash caused a large part of Ponter's computing facility to be transferred into this universe."

Mary noted that Dr. Mah was nodding slowly, reluctantly, as if coming around despite herself. "The air that accompanied Ponter."

"Exactly," said Louise. "As we'd guessed, it was mostly just air transferred to this universe—enough air to burst open the acrylic sphere. But, in addition to the air, one person, who happened to be standing in the quantum-computing facility, was transferred, as well."

"So he didn't know he was going to come here?" asked Mah.

"No," said Reuben Montego, "he didn't. If you think we were shocked, imagine how shocked he was. The poor guy instantly found himself submerged in water, in absolute darkness. If there hadn't been that massive bubble of air transferred with him, he would have drowned for sure."

Your whole world turned inside out, thought Mary. She looked at the Neanderthal. He was certainly doing a good job of hiding the disorientation and fear he must feel, but the shock surely had been enormous.

Mary gave him a small, empathetic smile.

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Chapter 22

Adikor Huld's dooslarm basadlarm continued. Adjudicator Sard still sat at the south end, and Adikor remained in the hot seat, with Daklar Bolbay stalking around him in circles.

“Has a crime really been committed?” asked Bolbay, looking now at Adjudicator Sard. “No dead body has been found, and so one might argue that this is simply a case of a missing individual, no matter how improbable such a circumstance seems today. But we have searched the mine with portable signal detectors, and so we know that Ponter's implant is not transmitting. If he were injured, it would be transmitting. Even if he were dead by natural causes, it would continue to transmit, using stored power, for days after Ponter's own biochemical processes ceased. Nothing short of violent action can account for the disappearance of Ponter and the silence of his Companion.”

Adikor felt his stomach knotting. Bolbay was right, as far as her reasoning went: the Companions were designed to be foolproof. Before they existed, people did sometimes just go missing, and only after many months were they declared dead, usually simply for lack of a better explanation. But Lonwis Trob had promised his Companions would change that, and they had. No one just disappeared anymore.

Sard obviously agreed. “I'm satisfied,” she said, “that the lack both of a body and of Companion transmissions suggests criminal activity. Let's get on with it.”

“Very well,” said Bolbay. She looked briefly at Adikor, then turned back to the adjudicator. “Murder,” Bolbay said, “has never been common. To end the life of another—to put a complete and utter stop to someone's existence—is heinous beyond compare. But, still, there are cases known, most, I grant you, from before the time of the Companions and the alibi-archive recorders. And in previous cases, the tribunals asked for three things to be shown to support a charge of murder.

“The first is a chance to commit the crime—and this Adikor Huld had in a way that no one else on this planet did, for he was beyond the capabilities of his Companion to transmit his actions.

“The second is a technique, a way in which the crime might have been committed. Without a body, we can only speculate on how it might have been done, although, as you will see later, one method is particularly likely.

“And, finally, one needs to show a reason, a rationale for the crime, something that would cause one to commit so awful, so permanent an act. And it's that question of reason I'd like to explore now, Adjudicator.”

The old female nodded. “I'm listening.”

Bolbay swung to face Adikor. “You and Ponter Boddit lived together, isn't that true?”

Adikor nodded. “For six tenmonths.”

“Did you love him?”

“Yes. Very much indeed.”

“But his woman-mate had died recently.”

“She was also your woman-mate,” said Adikor, taking the opportunity to emphasize Bolbay's conflict of interest.

But Bolbay was up to the occasion. “Yes. Klast, my beloved. She is no longer alive, and for that I feel great sorrow. But I blame no one; there is no one to blame. Illness happens, and the life-prolongers did all they could to make her final months comfortable. But for the death of Ponter Boddit, there is someone

to blame."

"Be cautious, Daklar Bolbay," said Adjudicator Sard. "You haven't proven that Scholar Boddit is dead. Until I rule on that, you may speak of that possibility only in hypothetical terms."

Bolbay turned toward Sard and bowed. "Apologies, Adjudicator." She faced Adikor again. "We were discussing another death, one about which no doubt exists: that of Klast, who was Ponter's—and my own—woman-mate." Bolbay closed her eyes. "My own grief is too great for expression, and I will not parade it for anyone. And Ponter's grief, I'm sure, was equally large. Klast often spoke of him; I know how much she loved Ponter, and how much he loved her." Bolbay was silent for a moment, perhaps composing herself. "Given this recent tragedy, though, we must raise another possibility about Ponter's disappearance. Could he have taken his own life, despondent over the death of Klast?" She looked at Adikor. "What is your opinion, Scholar Huld?"

"He was very sad at the loss, but the loss was also some time ago. Had Ponter been suicidal, I'm sure I would have known."

Bolbay nodded reasonably. "I won't pretend to say I knew Scholar Boddit anywhere near as well as you did, Scholar Huld, but I do share your assessment. Still, could there have been any other reasons for him to commit suicide?"

Adikor was taken aback. "Such as?"

"Well, your work—do forgive me, Scholar Huld, but I see no gentle way to phrase this: your work was a failure. A Gray Council session was imminent, at which you and he would have had to discuss your contributions to society. Could he have so feared that your work might be terminated that, well, that he chose to terminate himself?"

"No," said Adikor, stunned by the suggestion. "No, in fact, if anyone were to smell bad at Council, it would have been me, not him."

Bolbay let this comment sink in, then: "Would you be so kind as to elaborate on that thought?"

"Ponter was the theoretician," said Adikor. "His theories had been neither proven nor disproven, so there was still valid work to be done related to them. But I was the engineer: it was I who was supposed to build experimental apparatus to check Ponter's ideas. And it was that apparatus—our prototype quantum computer—that had failed. Council might have found my contribution inadequate, but they certainly wouldn't have judged Ponter's to be so."

"So Ponter's death could not possibly have been a suicide," said Bolbay.

"Again," said Sard, "you will speak of Scholar Boddit as if he is alive, until if or when I rule to the contrary."

Bolbay bowed again to the Adjudicator. "Once again, my apologies." She returned to Adikor. "If Ponter wanted to kill himself, is it fair to say, Scholar Huld, that he would not have taken his life in a way that might implicate you?"

"The suggestion that he would take his own life at all is so improbable..." began Adikor.

"Yes, we agree on that," said Bolbay, calmly, "but, hypothetically, if he were to do so, he would surely not choose to do it in a way that would leave a suspicion of nefarious action, don't you agree?"

"Yes, I do," said Adikor.

“Thank you,” said Bolbay. “Now, to this matter you raised about your own contribution perhaps being inadequate...”

Adikor shifted on the stool. “Yes?”

“Well, I, of course, had no intention of raising this,” Bolbay said. Adikor thought he caught a whiff of dishonesty from her. “But since you have brought it up, we should perhaps explore this matter—just to dispel it, you understand.”

Adikor said nothing, and, after a time, Bolbay continued. “How,” she asked gently, “did it feel, living downwind of him?”

“I—I beg your pardon?”

“Well, you just said his contribution wasn't likely to be questioned, but your own might be.”

“At the particular Council that's coming up,” said Adikor, “yes. But in general...”

“In general,” said Bolbay, a slickness to her deep voice, “you must admit that your own contribution was a fraction of his, anyway. Isn't that true?”

“Is this germane?” interjected Sard.

“Actually, Adjudicator, I do believe that it is,” said Bolbay.

Sard looked dubious, but nodded for Bolbay to continue. She did so. “Surely, Scholar Huld, you must know that when generations yet to be born study physics and computing, Ponter's name will be mentioned often, while yours will be uttered rarely, if at all?”

Adikor could feel his pulse increasing. “I have never considered such issues,” he said.

“Oh, come now,” said Bolbay, as if they both knew better. “The disparity in your contributions was obvious.”

“I caution you again, Daklar Bolbay,” said the Adjudicator. “I see no reason to humiliate the accused.”

“I'm merely trying to explore his mental state,” replied Bolbay, bowing yet again. Without waiting for Sard to respond, Bolbay turned back to Adikor. “So, Scholar Huld, do tell us: how did it feel to be making the lesser contribution?”

Adikor took a deep breath. “It is not my place to weigh our relative worth.”

“Of course not, but the difference between yours and his is not in question,” said Bolbay, as if Adikor were obsessing on some minor detail, instead of seeing the big picture. “It's well known that Ponter was the brilliant one.” Bolbay smiled solicitously. “So, again, please do tell us how knowing that felt.”

“It feels,” Adikor said, trying to keep his tone even, “exactly the same today as it did before Ponter went missing. The only thing that has changed is that I am now sad beyond words for the loss of my very best friend.”

Bolbay had circled behind him now. The stool had a swivel seat; Adikor could have followed her as she walked, but he chose not to. “Your best friend?” said Bolbay, as if this were a startling admission. “Your best friend, is it? And how did you commemorate this friendship once he was gone? By announcing that it was your software and equipment, not his theorems, that your experiments were all about.”

Adikor's jaw dropped. “I—I didn't say that. I told an Exhibitionist I would comment only on the role of software and hardware, because they had been my responsibility.”

“Exactly! From the moment he was gone, you were downplaying Ponter's contributions.”

“Daklar Bolbay!” snapped Sard. “You will treat Scholar Huld with suitable respect.”

“Respect?” sneered Bolbay. “Like that which he showed Ponter once he was gone?”

Adikor's head was spinning. “We can access my alibi archive, or the Exhibitionist's,” he said. He indicated Sard, as if they were long-time allies. “The adjudicator can hear the exact words I used.”

Bolbay waved her arm, dismissing this suggestion as if it were the utmost craziness. “It doesn't matter precisely what words you said; what matters is what they tell us about what you were feeling. And what you were feeling was relief that your rival was gone—”

“No,” said Adikor sharply.

“I'm warning you, Daklar Bolbay,” said Sard, sharply.

“Relief that you would no longer be eclipsed by another,” continued Bolbay.

“No!” said Adikor, fury growing within him.

“Relief,” continued Bolbay, her voice, rising, “that you could now begin claiming as your sole contribution everything you had jointly done.”

“Desist, Bolbay!” barked Sard, slapping the arm of her chair with the flat of her hand.

“Relief,” shouted Bolbay, “that your rival was dead!”

Adikor rose to his feet and turned to face Bolbay. He contracted his fingers into a fist and pulled back his arm.

“Scholar Huld!” Adjudicator Sard's voice thundered in the chamber.

Adikor froze. His heart was pounding. Bolbay, he'd noted, had wisely moved downwind of him, so that the fans were no longer blowing her pheromones his way. He looked at his own clenched fist—a fist that could have shattered Bolbay's skull with a single punch, a fist that could have crushed her chest, splintered her ribs, ruptured her heart with one good impact. It was as if it were something foreign to him, no longer a part of his body. Adikor lowered his arm, but there was still so much anger in him, so much indignation, that for several beats he was unable to unclench his fingers. He turned to face Sard, his tone imploring. “I—Adjudicator, surely you understand ... I—I couldn't have...” He shook his head. “You heard what she said to me. I—no one could...”

Adjudicator Sard's violet eyes were wide in shock as she looked at Adikor. “I've never seen such a display, inside or outside a legal proceeding,” she said. “Scholar Huld, what is wrong with you?”

Adikor was still seething. Bolbay must know the history; of course she must. She was Klast's woman-mate, and Ponter had been with Klast even back in those days. But ... but ... was that why Bolbay was pursuing him with such vengeance? Was that her motive? Surely she must know that Ponter would never have wanted this.

Adikor had undergone much therapy for his problem controlling anger. Dear Ponter had recognized it was a sickness, a chemical imbalance, and—to his credit, that wonderful man—had stood by Adikor

through his treatment.

But now ... now Bolbay had goaded him, had provoked him, had pushed him over the edge, for all to see.

“Worthy Adjudicator,” said Adikor, trying—trying, trying!—to sound calm. Should he explain? Could he? Adikor lowered his head. “I apologize for my outburst.”

Sard still had an astonished quaver in her voice. “Do you have any more evidence supporting your accusation, Daklar Bolbay?”

Bolbay, clearly having achieved precisely the effect she'd wanted, had reverted to the very picture of reasonableness. “If I may be allowed, Adjudicator, there is one more small thing...”

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Chapter 23

At the end of the meeting in the Inco conference room, Reuben Montego invited everyone back to his place for another barbecue. Ponter smiled broadly; he'd obviously quite enjoyed last night's meal. Louise accepted the invitation as well, reiterating that, with SNO in ruins, there wasn't much for her to be doing these days anyway. Mary also accepted—it sounded like fun, and beat another evening alone, staring at the ceiling in her hotel room. But Professor Mah begged off. She needed to get back to Ottawa: she had a 10:00 p.m. appointment at 24 Sussex Drive, where she would brief the Prime Minister.

The problem now was shaking the media, who, according to the Inco security guards, were waiting just outside the gates of the Creighton mine site. But Reuben and Louise quickly came up with a plan, which they immediately put into action.

Mary had a rental car now, courtesy of Inco—a red Dodge Neon. (When she'd picked it up, Mary had asked the rental clerk if it ran on noble gas; all she'd gotten was a blank stare in return.)

Mary left her Neon at the mine, and instead got into the passenger seat of Louise's black Ford Tempo, sporting a white-and-blue Quebec vanity plate that read “D2O"—which, after a moment, Mary realized was the chemical formula for heavy water. Louise got a blanket out of her car's trunk—sensible drivers in both Ontario and Quebec carried blankets or sleeping bags, in case of winter accidents—and she draped the blanket over Mary.

Mary found it awfully hot at first, but, fortunately, Louise's car was air-conditioned; few grad students could afford that, but Mary rather suspected Louise had no trouble getting good deals wherever she went.

Louise drove down the winding gravel road to the mine-site entrance, and Mary, under the blanket, did the best job she could of looking both animate and bulky. After a bit, Louise started to speed, as if trying to get away.

“We're just passing the gate now,” said Louise to Mary, who couldn't see anything. “And it's working! People are pointing at us and starting to follow.”

Louise led them all the way back into Sudbury. If everything was going according to plan, Reuben would have waited until the reporters had taken off after the Tempo, and then driven Ponter to his house just

outside Lively.

Louise drove to the small apartment building she lived in, parking in the outdoor lot. Mary could hear other cars pulling up near them, some screeching their tires dramatically. Louise got out of the driver's seat and came over to the passenger door. “OK,” she said to Mary, after opening the door, “you can get out now.”

Mary did so, and she could hear other doors slamming shut as their drivers presumably disembarked. Louise shouted “Voilà!” as she helped pull the blanket off Mary, and Mary grinned sheepishly at the reporters.

“Oh, crap!” said one of the journalists, and “Damn!” said another.

But a third—there were perhaps a dozen present—was more savvy. “You're Dr. Vaughan, aren't you?” she called. “The geneticist?”

Mary nodded.

“Well,” demanded the reporter, “is he or isn't he a Neanderthal?”

It took forty-five minutes for Mary and Louise to extricate themselves from the journalists, who, although disappointed not to have found Ponter, were delighted to hear the results of Mary's DNA tests. Finally, though, Mary and Louise made it into Louise's apartment building and up to her small unit on the third floor. They waited until all the journalists had left the parking lot—clearly visible from Louise's bedroom window—then Louise got a couple of bottles of wine from her fridge, and she and Mary went back down to her car and drove out to Lively.

They got to Reuben's house just before 6:00 P.M. Reuben and Ponter had wisely not started making dinner, being unsure when Louise and Mary would arrive. Ponter actually had been laying down on Reuben's living-room couch; Mary thought perhaps he was feeling a little under the weather—not surprising, after all he'd been through.

Louise announced that she had to help make dinner. Mary learned she was a vegetarian, and had apparently felt bad about putting Reuben to extra effort the night before. Reuben, Mary noted, quickly accepted the offer of Louise's aid—what straight male wouldn't?

“Mary, Ponter,” said Reuben, “make yourselves at home. Louise and I will get the barbecue going.”

Mary felt her heart begin to race, and her mouth went dry. She hadn't been alone with any man since—since—

But it was only early evening now, and—

And Ponter wasn't—

It was a cliché, but it was also true, truer than it had ever been.

Ponter wasn't like other men.

Surely it would be all right; after all, Reuben and Louise wouldn't be far away. Mary took a deep breath, trying to calm herself. “Sure,” she said, softly. “Of course.”

“Great,” said Reuben. “There's pop and beer in the fridge; we'll open Louise's wine with dinner.” He and Louise went into the kitchen, then, a couple of minutes later, headed out to the backyard. Mary found

herself sucking in air as Reuben closed the glass door leading to the deck, but he didn't want to air-condition the great outdoors. Still, with the door closed and the hum of the air-conditioning equipment, she doubted Reuben and Louise could hear her now.

Mary turned her head to look at Ponter, who had risen to his feet. She managed a weak smile.

Ponter smiled back.

He wasn't ugly; really, he wasn't. But his face was quite unusual: like someone had grabbed a clay model of a normal human face and pulled it forward.

“Hello,” said Ponter, speaking for himself.

“Hi,” said Mary.

“Awkward,” said Ponter.

Mary remembered her trip to Germany. She'd hated being unable to make herself understood, hated struggling to read the directions on a pay phone, trying to order in a restaurant, attempting to ask directions. How awful it must be for Ponter—a scientist, an intellectual!—to be reduced to communicating at a child's level.

Ponter's emotions were obvious: he smiled, he frowned, he raised his blond eyebrow, he laughed; she hadn't seen him cry, but assumed he could. They didn't yet have the vocabulary to really discuss how he felt about being here; it had been easier to talk about quantum mechanics than about feelings.

Mary nodded sympathetically. “Yes,” she said, “it must be very awkward, not being able to communicate.”

Ponter tipped his head a bit. Perhaps he'd understood; perhaps he hadn't. He looked around Reuben's living room, as if something were missing. “Your rooms do not have...” He frowned, clearly frustrated, apparently wanting to convey an idea for which neither he nor his implant yet had the vocabulary. Finally, he moved over to the end of a row of heavy built-in bookcases, filled with mystery novels, DVDs, and small Jamaican carvings. Ponter turned around and began to rub his back from side to side against the last bookcase's edge.

Mary was astonished at first, then she realized what he was doing: Ponter was using the bookcase as a scratching post. An image of a contented Baloo from Disney's Jungle Book came to her mind. She tried to suppress a grin. Her own back itched often enough—and, she thought briefly, it had been a long time since she'd had anyone to scratch it for her. If Ponter's back was indeed hairy, it probably itched with great regularity. Apparently, rooms in his world had dedicated scratching devices of some sort.

She wondered if it would be polite to offer to scratch his back for him—and that thought made her pause. She'd assumed she'd never want to touch, or be touched, by a man again. There was nothing necessarily sexual about back scratching, but, then again, the literature Keisha had given her confirmed what she already knew: that there was nothing sexual about rape, either. Still, she had no idea what constituted appropriate behavior between a man and a woman in Ponter's society; she might offend him greatly, or...

Get over yourself, girl.

Doubtless she no more appeared attractive to Ponter than Ponter did to her. He scratched for a few moments longer, then stepped away from the massive bookcase. He gestured with an open palm at it, as if inviting Mary to take a turn.

She worried about damaging the wood or knocking stuff off the shelves, but everything seemed to have survived Ponter's vigorous movements.

“Thanks,” said Mary. She crossed the room, moving behind a glass-topped coffee table, and placed her back against the bookcase's corner. She shimmied a bit against the wood. It actually did feel nice, although the clasp of her bra kept catching as it passed over the angle.

“Good, yes?” said Ponter.

Mary smiled. “Yes.”

Just then, the phone rang. Ponter looked at it, and so did Mary. It rang again. “Certain not for I,” said Ponter.

Mary laughed and moved over to an end table, which had a teal one-piece phone sitting on it. She picked it up. “Montego residence.”

“Is Professor Mary Vaughan there, by any chance?” said a man's voice.

“Um, speaking.”

“Great! My name is Sanjit. I'm a producer for @discovery.ca, the nightly science-news program on Discovery Channel Canada.”

“Wow,” said Mary. “That's a great show.”

“Thanks. We've been following this stuff about a Neanderthal turning up in Sudbury. Frankly, we didn't believe it at first, but, well, a wire-service report just came through that you had authenticated the specimen's DNA.”

“Yes,” said Mary. “He does indeed have Neanderthal DNA.”

“What about the—the man himself? He's not a fake?”

“No,” said Mary. “He's the genuine article.”

“Wow. Well, look, we'd love to have you on the show tomorrow. We're owned by CTV, so we can send someone over from our local affiliate and do an interview between you up there and Jay Ingram, one of our hosts, down here in Toronto.”

“Um,” said Mary, “well, sure. I guess.”

“Great,” said Sanjit. “Now, let me just take you through what we'd like to talk about.”

Mary turned and looked out the living-room window; she could see Louise and Reuben fussing over the barbecue. “All right.”

“First, let me see if I've got your own history right. You're a full professor at York, right?”

“Yes, in genetics.”

“Tenured?”

“Yes.”

“And your Ph.D. is in... ?”

“Molecular biology, actually.”

“Now, in 1996, you went to Germany to collect DNA from the Neanderthal type specimen there, is that correct?”

Mary glanced over at Ponter, to see if he was offended that she was talking on the phone. He gave her an indulgent smile, so she continued. “Yes.”

“Tell me about that,” said Sanjit.

In all, the preinterview must have taken twenty minutes. She heard Louise and Reuben pop in and out of the kitchen a couple of times, and Reuben stuck his head in the living room at one point to see whether Mary was OK; she held her hand over the phone's microphone and told him what was going on. He smiled and went back to his cooking. At last, Sanjit finished with his questions, and they finalized the arrangements for taping the interview. Mary put down the phone and turned back to Ponter. “Sorry about that,” she said.

But Ponter was lurching toward her, one arm outstretched. She realized in an instant what an idiot she'd been; he'd maneuvered her over here, next to the bookcases, away from the door. With one shove from that massive arm, she'd be away from the window, too, invisible to Reuben and Louise outside.

“Please,” said Mary. “Please. I'll scream...”

Ponter took another shuddering step forward, and then—

And then—

And then Mary did scream. “Help! Help!”

Ponter was now slumping to the carpeted floor. His brow above the ridge was slick with perspiration, and his skin had turned an ashen color. Mary knelt down next to him. His chest was moving up and down rapidly, and he'd started to gasp.

“Help!” she yelled again.

She heard the glass door sliding open. Reuben dashed in. “What's—oh, God!”

He hurried over to the downed Ponter. Louise arrived a few seconds later. Reuben felt Ponter's pulse.

“He is sick,” said Hak, using its female voice.

“Yes,” said Reuben nodding. “Do you know what's wrong with him?”

“No,” said Hak. “His pulse is elevated, his breathing shallow. His body temperature is 39.”

Mary was startled for a moment to hear the implant citing what she presumed was a Celsius figure, in which case it was in the fever range—but, then again, it was a logical temperature scale for any ten-fingered being to develop.

“Does he have allergies?” asked Reuben.

Hak bleeped.

“Allergies,” said Reuben. “Foods or things in the environment that normal people are unaffected by, but cause sickness in him.”

“No,” said Hak.

“Was he ill before he left your world?”

“Ill?” repeated Hak.

“Sick. Not well.”

“No.”

Reuben looked at an intricately carved wooden clock, siting on one of his bookshelves. “It's been about fifty-one hours since he arrived here. Christ, Christ, Christ.”

“What is it?” asked Mary.

“God, I am an idiot,” said Reuben, rising. He hurried off to another room in the house and returned with a worn brown-leather medical bag, which he opened up. He extracted a wooden tongue depressor and a small flashlight. “Ponter,” he said firmly, “open mouth.”

Ponter's golden eyes were half-covered by his lids now, but he did what Reuben asked. Evidently, Ponter had never been examined in quite this way before; he resisted the placing of the wooden spatula on his tongue. But, perhaps calmed by some words from Hak that only he could hear, he soon stopped struggling, and Reuben shone the light inside the Neanderthal's cavernous mouth.

“His tonsils and other tissues are highly inflamed,” said Reuben. He looked at Mary, then at Louise. “It's an infection of some sort.”

“But either you, Professor Vaughan, or I have been with him just about all the time he's been here,” said Louise, “and we're not sick.”

“Exactly,” snapped Reuben. “Whatever he's got, he probably got here—and it's something the three of us have natural immunity to, but he doesn't.” The doctor rummaged in his case, found a vial of pills. “Louise,” he said, without turning around, “get a glass of water, please.”

Louise hurried off to the kitchen.

“I'm going to give him some industrial-strength aspirin,” said Reuben to Hak, or to Mary—she wasn't sure which. “It should bring down his fever.”

Louise returned with a tumbler full of water. Reuben took it from her. He pushed two pills past Ponter's lips. “Hak, tell him to swallow the pills.”

Mary was unsure whether the Companion understood Reuben's words, or merely guessed at his intention, but a moment later Ponter did indeed swallow the tablets, and, with his own large hand steadied by Reuben's, managed to chase them down with some water, although much of it ran down his chinless jaw, dampening his blond beard.

But he didn't splutter at all, Mary noted. A Neanderthal couldn't choke; that was the plus side of not being able to make as many sounds. The mouth cavity was laid out so that neither liquid nor food could go down the wrong way. Reuben helped pour more water into Ponter, emptying the glass.

Damn it, thought Mary. God damn it.

How could they have been so stupid? When Cortez and his conquistadors had come to Central America, they'd brought diseases to which the Aztecs had no immunity—and yet the Aztecs and the Spaniards had

only been separated for a few thousand years, time enough for pathogens to develop in one part of the planet that those in the other couldn't defend against. Ponter's world had been separated from this one for at least twenty-seven thousand years; diseases had to have evolved here that he would have no resistance to.

And ... and ... and...

Mary shuddered.

And vice versa, too, of course.

The same thought had clearly occurred to Reuben. He hurried to his feet, crossed the room, and picked up the teal one-piece phone Mary had used earlier.

“Hello, operator,” he said into the phone. “My name is Dr. Reuben K. Montego, and this is a medical emergency. I need you to connect me with the Laboratory Centre for Disease Control at Health Canada in Ottawa. Yes, that's right—whoever's in charge of infectious-disease control there...”

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Chapter 24

Adikor Huld's dooslarm basadlarm was temporarily halted, ostensibly for the evening meal, but also because Adjudicator Sard clearly wanted to give him a chance to calm down, to regain composure, and to consult with others about how he might undo the damage of his violent outburst earlier in the day.

When the dooslarm basadlarm started back up, Adikor sat again on the stool. He wondered what genius had thought of having the accused sit on a stool while others circled about him? Perhaps Jasmel knew; she was studying history, after all, and such proceedings were ancient in their origins.

Bolbay strode into the center of the chamber. “I now wish for us to move to the alibi archive pavilion,” she said, facing the adjudicator.

Sard glanced at the timepiece mounted on the ceiling, clearly concerned about how long all this was taking. “You've already established that Scholar Huld's alibi archive can't possibly show anything leading up to Ponter Boddit's disappearance.” She scowled. “I'm sure"—she said this in a tone that would brook no argument—"that Scholar Huld and whoever is going to speak on his behalf will agree that this is true without you having to drag us over there to prove it.”

Bolbay nodded respectfully. “Indeed, Adjudicator. But it isn't Scholar Huld's alibi cube I wish to have unlocked. It is Ponter Boddit's.”

“It won't show anything of his disappearance, either,” said Sard, sounding exasperated, “and for the same reason: the thousand armspans of rock blocking its transmissions.”

“Quite true, Adjudicator,” said Bolbay. “But it is not Scholar Boddit's disappearance that I wish to review. Rather, I want to show you events dating from 254 months ago.”

“Two hundred and fifty-four!” exclaimed the adjudicator. “How could something that long past possibly be germane to these proceedings?”

“If you will indulge me,” said Bolbay, “I think you will see that it has great bearing.”

Adikor was tapping above his browridge with a cocked thumb, thinking. Two-and-a-half hundredmonths: that was a little over 19 years. He'd known Ponter back then; they were both 145s, and had entered the Academy simultaneously. But what event from that far back could—

Adikor found himself on his feet. “Worthy Adjudicator, I object to this.”

Sard looked at him. “Object?” she said, startled to hear such a thing during a legal proceeding. “On what basis? Bolbay isn't proposing to unlock your alibi archive—only Scholar Boddit's. And since he is missing, then opening his archive is something Bolbay, as tabant of his closest living relatives, has a right to request.”

Adikor was angry with himself. Sard might have indeed denied Bolbay's request, if he'd just kept his mouth shut. But now she was no doubt curious about what it was that Adikor wanted to keep hidden.

“Very well,” said Sard, making her decision. She looked out at the crowd of spectators. “You people will have to stay here, until I decide whether this is something that needs to be seen publicly.” She shifted her gaze. “Scholar Boddit's immediate family, Scholar Huld, and whoever will be speaking on behalf of him may join us, assuming none of them are Voyeurs.” And, at last, her eyes fell on Bolbay. “All right, Bolbay. This better be worth my time.”

Sard, Bolbay, Adikor, Jasmel, and Megameg, holding Jasmel's hand, made their way down the wide, moss-covered corridor to the alibi pavilion. Bolbay apparently couldn't resist a dig at Adikor as they walked along. “No one to speak on your behalf, eh?” she said.

For once, Adikor did manage to keep his mouth shut.

* * *

There weren't many people still alive who had been born before the introduction of the Companions: those few from generation 140 and even fewer from 139 who hadn't yet died. For everyone else, a Companion had been part of their lives since just after birth, when the initial infant-sized implant was installed. The celebration of the thousandth month since the beginning of the Alibi Era would happen shortly; great festivities were planned worldwide.

Even just here in Saldak, there were tens of thousands who had been born and had already died since the first Companion was installed; that initial implant had been put into the forearm of its own creator, Lonwis Trob. The great alibi archive pavilion, here, next to the Gray Council building, was divided into two wings. The one on the south abutted an outcropping of ancient rock; it would be extraordinarily difficult to expand that wing, and so it was used to store the active alibi cubes of those now alive, a number that was pretty much a constant. The north wing, although currently no bigger than the south, could expand for a great distance, as required; when someone died, his or her alibi cube was disconnected from the receiver array and brought there.

Adikor wondered which wing Ponter's cube was being stored in now. Technically, the adjudicator had yet to rule that murder had occurred. He hoped it was the wing of the living; he wasn't sure if he could maintain his composure if he had to face Ponter's cube on the other side.

Adikor had been to the archives before. The north wing, the wing of the dead, had a separate room, with an open archway leading into it, for each generation. The first one was tiny, holding a single cube, that of Walder Shar, the only member of generation 131 to still be alive in Saldak when the Companions were introduced. The next four rooms were successively bigger, housing cubes from members of generations 132, 133, 134, and 135, each ten years older than its predecessor. Starting with generation 136, all the rooms were the same size, although very few cubes had yet been transferred over from generations after 144, almost all of whose members were still alive.

The south wing had but a single room, with thirty thousand receptacles for alibi cubes. Although originally there had been great order in the south wing, with the initial collection of cubes sorted by generation and, within each generation, subdivided by sex, much of that had been lost over time. Children were all born in orderly lots, but people died at a wide range of ages, and so cubes from subsequent generations had been plugged into vacant receptacles wherever they happened to be.

That made finding a particular cube out of more than twenty-five thousand—the population of Saldak—impossible without a directory. Adjudicator Sard presented herself to the Keeper of Alibis, a portly woman of generation 143.

“Healthy day, Adjudicator,” said the woman, sitting on a saddle-seat behind a kidney-shaped table.

“Healthy day,” said Sard. “I wish to access the alibi archive of Ponter Boddit, a physicist from generation 145.”

The woman nodded and spoke into a computer. The machine's square screen displayed a series of numbers. “Follow me,” she said. Sard and the others did just that.

For all her bulk, the keeper had a sprightly step. She led them down a series of corridors, the walls of which were lined with niches, each containing an alibi cube, a block of reconstituted granite about the size of a person's head. “Here we are,” said the woman. “Receptacle number 16,321: Ponter Boddit.”

The adjudicator nodded, then turned her wrinkled wrist with its own Companion to face the glowing blue eye on Ponter's cube. “I, Komel Sard, adjudicator, hereby order the unlocking of alibi receptacle 16,321, for just and appropriate legal inquiries. Timestamp.”

The eye on the receptacle turned yellow. The adjudicator stepped out of the way, and the archivist held up her Companion. “I, Mabla Dabdalb, Keeper of Alibis, hereby concur with the unlocking of receptacle 16,321, for just and appropriate legal inquiries. Timestamp.” The eye turned red, and a tone sounded.

“There you are, Adjudicator. You can use the projector in room twelve.”

“Thank you,” said Sard, and they marched back up to the front. Dabdalb pointed out the room she'd assigned them, and Sard, Bolbay, Adikor, Jasmel, and Megameg walked over to it and went inside.

The room was large and square, with a small gallery of saddle-seats against one wall. Everyone sat down, except for Bolbay, who moved over to the wall-mounted control console. It was only within this building that the alibi archives could be accessed; to protect against unauthorized viewing, the archive pavilion was completely isolated from the planetary information network, and had no outside telecommunications lines. Although it was sometimes inconvenient to have to physically come to the archives to access one's own recordings, the isolation was considered an appropriate safeguard.

Bolbay looked at the small group that had assembled here. “All right,” she said. “I'm going to call up the events of one forty-six, one twenty-eight, eleven.”

Adikor nodded in resignation. He wasn't sure about the eleventh day, but the 128th moon since the birth of generation 146 sounded right.

The room darkened and an almost invisible sphere, like a soap bubble, appeared to float in front of them. Bolbay evidently felt the default size wasn't dramatic enough for her purposes: Adikor could hear her snapping control buds out, and the sphere's diameter grew until it was more than an armspan across. She plucked more controls, and the sphere filled with three smaller spheres packed together, each tinged with a slightly different color. Then those spheres subdivided into three more each, and those ones subdivided

again, and on and on, like sped-up video of some alien cell undergoing mitosis. As the overall sphere filled with progressively smaller and smaller spheres, those smaller spheres took on more and more colors, until, finally, the process stopped, and an image of a young man standing in a positive-pressure thinking room at the Science Academy filled the viewing sphere, as though it were a three-dimensional sculpture made of beads.

Adikor nodded; this recording was made long enough ago that the new resolution enhancements weren't available. Still, it was eminently watchable.

Bolbay was evidently operating more controls. The bubble spun around so that everyone could see the face of the person being depicted. It was Ponter Boddit. Adikor had forgotten how young Ponter had looked back then. He glanced at Jasmel, sitting next to him. Her eyes were wide in wonder. It probably wasn't lost on her that here was her father at just about the age she was now; indeed, Klast had already been pregnant with Jasmel at the time these images were recorded.

“That, of course, is Ponter Boddit,” said Bolbay. “At half his current age—or what would be his current age, if he were still alive. Now, I'm going to fast-forward...”

The image of Ponter walked, sat, stood, puttered around the room, consulted a datapad, shimmied against a scratching pole, all at frenetic speed. And then the airlock door to the room opened—the positive pressure kept out pheromones that might distract one's studying—and a young Adikor Huld entered.

“Pause,” said Adjudicator Sard. Bolbay froze the image. “Scholar Huld, will you confirm that that is indeed you?”

Adikor was somewhat mortified to see his own face; he'd forgotten that for a brief time he'd adopted the affectation of shaving off his beard. Ah, but if that were the only folly from his youth that had been recorded... “Yes, Adjudicator,” said Adikor, softly. “That's me.”

“All right,” said Sard. “Continue.”

The image in the bubble started running forward again at high speed. Adikor moved around the room, as did Ponter—although the image of Ponter always stayed in the center of the sphere; it was the space around him that shifted.

Adikor and Ponter seemed to be talking amiably...

And then talking less amiably...

Bolbay slowed the playback to normal speed.

Ponter and Adikor were arguing by this point.

And then—

And then—

And then—

Adikor wanted to close his eyes. His own memories of this event were vivid enough. But he'd never seen it from this perspective, never seen the expression that had been on his face...

And so he watched.

Watched as he clenched his fingers...

Watched as he pulled back his arm, biceps bulging...

Watched as he propelled his arm forward...

Watched as Ponter lifted his head just in time...

Watched as his fist connected with Ponter's jaw...

Watched as Ponter's jaw snapped sideways...

Watched as Ponter staggered backward, blood spurting from his mouth...

Watched as Ponter spit out teeth.

Bolbay froze the image again. Yes, to his credit, the expression now on the young Adikor's face was one of shock and great remorse. Yes, he was bending over to help Ponter up. Yes, he clearly regretted what he'd done, which of course had been...

...had been coming within a hair's breadth of killing Ponter Boddit, staving in the front of his skull with a punch backed by all of Adikor's strength.

Megameg was crying now. Jasmel had shifted in her chair, moving away from Adikor. Adjudicator Sard was shaking her head slowly back and forth in disbelief. And Bolbay—

Bolbay was standing, arms crossed in front of her chest.

"So, Adikor," said Bolbay, "should I play the whole thing back with the sound on, or would you like to save us all some time and tell us what you and Ponter were fighting about?"

Adikor felt nauseous. "This isn't fair," he said softly. "This isn't fair. I've undergone treatments to help me control my temper—adjustments to neurotransmitter levels; my personality sculptor will confirm that. I'd never hit anyone before in my life, and I never have since."

"You didn't answer my question," said Bolbay. "What were you fighting about?"

Adikor was silent, slowly shaking his head back and forth.

"Well, Scholar Huld?" demanded the adjudicator.

"It was trivial," said Adikor, looking down at the moss-covered floor now. "It was..." He took a deep breath, then let it out slowly. "It was a philosophical point, related to quantum physics. There have been many interpretations of quantum phenomena, but Ponter was clinging to what he knew full well was an incorrect model. I—I know now he was just goading me, but..."

"But it proved too much for you," said Bolbay. "You let a simple discussion of science—science!—get out of hand, and you got so angry that you lashed out in a way that might have cost Ponter his life had you hit him just a fraction of a handspan higher."

"This isn't fair," Adikor repeated, looking now at the adjudicator. "Ponter forgave me. He never brought a public accusation; without a victim's accusation, by definition no crime has been committed." His tone was pleading now. "That's the law."

"We saw this morning in the Council chamber just how well Adikor Huld controls his temper these

days," said Bolbay. "And you've now seen that he tried once before to kill Ponter Boddit. He failed that time, but I believe there's every reason to think he recently succeeded, down in the quantum-computing facility deep beneath the Earth." Bolbay paused, then looked at Sard. "I think," she said, her voice smug, "we've established the facts sufficiently to merit you sending this matter on to a full tribunal."

To be continued!

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Biolog: Edward J. Lerner

Edward M. Lerner is the Compleat Computerman. He also qualifies as an SF fan from earliest memory and a devotee of science and history. The spark that ignited these volatile elements into the synthesis of an SF writer came in 1985. Completion of an MBA degree in Marketing and Statistics from the University of Chicago in 1982 freed time for recreational reading. Three years of listening to complaints about the quality of much of the SF available led his wife to suggest that if he thought he could do better, then he should.

He had the almost classic background required to write hard SF. Along with spending his earliest childhood reading Wells, Verne, Heinlein, and *Analog,* there came the fantasy of becoming a rocket scientist. Born in Chicago, he was just eight when Sputnik went up. A BS in Physics came from the University of Illinois at Urbana in 1971. Back then, you could still get a degree without courses in computers. Ed dabbled in that new-fangled discipline and found that though good at physics, he was intuitive with computers. An MS in Computer Science from Urbana followed.

His career started in Bell Labs, and continued at Honeywell. Early *Analog* stories were engineering oriented and often written by authors versed in the arcane fields of the day, such as radio. Now Ed was at the cutting edge of current technology involving computer engineering. At Hughes Aircraft, he spent years developing parts of NASA's Earth Observing System. A first story appeared in the February 1991 *Analog,* followed by seven more to date. The novel *Probe* also came out that year from Warner Books. Strangely, the SF story came before working on the NASA project.

Now living in Virginia near Washington D.C., Ed had taken time off from hard-science projects to work on hard-science SF, before recently going back to a full-time day job. He tries to tickle funny-bones in his short stories, while longer works have a serious core of worked out plausible history and culture where humans and aliens interact. His series of four novelettes for *Analog* and *Artemis* tell the story of an InterstellarNet, where interspecies dealings are radio-based. In an Edward M. Lerner story, hi-tech never stands still. Computers continue to evolve, being still very new. Neural interfaces, AI, and ever-more-ubiquitous networks have to affect social and economic structures. A writer must take the exponential growth of technology into account—or explain what stopped it. He strives to avoid loose ends. Like a Norn spinning the future, Ed tries to weave a seamless fabric without dangling threads.

Gibbons, Toynbee, and Asimov wrote about civilizations that reached a zenith, stagnated, retrogressed and fell into a Dark Age. Ed feels that the past illuminates the future. He endows characters with enough insight to avoid the traps, blind alleys and pitfalls of technology. Pervasive in *Analog* 's engineering-heavy orientation has been the assumption that technology, properly applied, can solve all problems except, of course, for the perversity of animate objects. Edward M. Lerner's vision of the future is one where universally accessible knowledge and powerful computer systems will prevent stagnation and

retrogression into another Dark Age.

—Jay Kay Klein

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Presence of Mind by Edward M. Lerner

When new capabilities create new dangers, there are two ways to respond....

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Chapter 1

Thwock.

The bright red ball rebounded with a most satisfying sound, although the racquet continued on its arc without any apparent impact. Doug Carey hurriedly wiped sweat from his forehead with the back of his racquetless left arm, carefully keeping his begoggled eyes on the ball. Precisely as he'd intended, the ball passed through a translucent green rectangle suspended in the vertical plane that bisected the court. The ball instantly doubled its speed.

Across the court, his opponent grunted as he lunged. Jim Schulz caught the ball on the tip of his racquet and expertly flipped the orb back through the green region. The ball redoubled its speed. Doug swore as he dived in vain after the ball. It swept past him, obliquely grazed the floor, and careened first from the rear wall and then from a side wall. The ball winked out of existence as it fell once again, untouched by Doug's racquet, to the floor. “Good one,” he panted.

Jim waved his racquet in desultory acknowledgment, his T-shirt sodden with sweat. “Pull,” he called out, and a new red ball materialized from the ether. Jim smacked the ball to the court's mid-plane, just missing the drifting triple-speed purple zone. The unaccelerated serve was a cream puff; Doug ruthlessly slammed it through purple on his return. A red blur shot past Jim to a brown “dead zone” on the rear wall, from which the suddenly inert ball dropped like a brick. This ball, too, disappeared.

“Roll ‘em.” Yet another red ball appeared, again in midair, this time at Doug's invocation. He twisted the racquet as he stroked the ball, imparting a wicked spin. The serve curved its way across the court, rebounding oddly from the floor and side wall.

Not oddly enough. Jim pivoted gracefully, tracking the ball around the rear corner. He stepped behind the ball as it sailed off the back wall, from which position he casually backhanded it. The ball soared lazily to midcourt, aimed squarely at a drop-dead zone scant inches from the floor.

Doug dashed to center court, ignoring an alert tone as he crossed the warning line on the floor. He desperately swung his racquet into the slight clearance between the vertical brown region and the floor. He misjudged slightly: the body of the racquet swept effortlessly through the court's vertical bisection plane, but the handle struck with a thud. A loud *blat* of disapproval drowned out his sharp intake of breath, but not the jolt of pain that shot up his arm. All but the offending handle vanished as he dropped the racquet. “*Damn*, that smarts!”

“You OK?”

Doug grimaced in response, rubbing his left hand against his right forearm just below the elbow. He pressed a thumb into a seeming birthmark on the forearm, and was rewarded with a subcutaneous*click* . “I think we're done for today. Don't watch if you're feeling squeamish.” The words, forced between clamped teeth, indicated his distress. He grasped firmly with his left hand, and twisted. The right forearm popped off, to be placed gently onto the court floor. Doug massaged the shocked area vigorously. “To coin a phrase, ouch.”

Jim walked to center court, beads of sweat running down his face and glistening in his lop-sided mustache. He sported possibly the last long sideburns within western civilization. “Anything I can do?”

“Uh-uh.” The answer was distracted.

His friend pointed at the numerals glowing on the ceiling. “Twelve to ten, pretty close. Let's pick up there next time. I'll call you tonight. Abracadabra.” The last phrase was directed at the court, not Doug. Jim disappeared as thoroughly as had the out-of-play balls earlier, but with the added touch of a puff of white smoke.

“Abracadabra,” Doug agreed. Jim's half of the room promptly vanished, revealing at what had been center court the wall that had so rudely interrupted the game. He studied the quarter-inch-deep gouge in the plasterboard that indicated by how much his depth perception had failed him. Virtual racquetball with real divots: Maintenance would just*love* that.

Sighing, he reached for the Velcro buckle of his game goggles—and missed.*Look, Ma, no hand.* He was more successful with his left arm. The colored regions floating about the room, the glowing scoreboard, the lines on the floor—all of the ephemera—disappeared. Stark white walls now surrounded him, interrupted only by glass-covered, inset mini-cam ports and the thin outline of a tightly fitting door.

Doug laid down his computer-controlled goggles carefully, although its LCD eyepieces and stereo speakers weren't all that fragile, then wrestled himself back into the prosthetic forearm. Hopefully, the impact of racquet on wall hadn't injured the limb. He'd find out soon enough.

Doug glanced at his wristwatch, and it was as late as he'd feared. The more conventional part of work called.

* * *

Doug strode from the virtual-reality lab to his office, whose laser-carved wooden nameplate announced him to be Manager, Neural Interfaces Department. He paused beside his secretary's desk to check out his tie. He'd have been amazed if it hadn't needed straightening. No surprises today.

The reflection in the sidelight to his office door revealed someone tall and well built, if not as thin as he'd like. Still, 185 pounds at six-foot two was respectable. Thick and unruly hair, all black but for a hint of gray at the temples, remained damp from his post-game shower. His most prominent feature was a nose too large for his taste. Aquiline, Doug reminded himself, aquiline. Like an eagle. The hint of a mischievous smile flashed and was gone. What eagle had a bump like this on its beak? His hood ornament had come courtesy of a long-ago pick-up football game gone a little too enthusiastic. He tugged the knot into something more closely resembling its intended configuration, then entered his office.

A visitor stood waiting inside his office, scanning titles on his bookshelf. She turned to face him. It was Cheryl Stern's first job interview at BioSciCorp, and Doug found himself taken aback. Cascades of wavy brown hair framed a face graced by wide-set hazel eyes, an upturned nose, and a sensual mouth. Her brief smile seemed forced and out of practice. She was slender and, he guesstimated, about five-foot

four. All in all, very attractive. He was instantly shamed by a memory of Holly.

Doug hastened to offer her a guest chair, shut the door, then hid behind his desk. Her application sat in a manila folder in front of him. He got his mind back on the interview and the resume. The resume, he reminded himself severely, that had earned her the invitation to this meeting.

“Thanks for coming in, Cheryl. I hope you didn't have any trouble finding us.”

“Your secretary's directions were great. I gather she gets to give them out a lot.”

The implied question was: how many people am I competing against? He also couldn't help noticing that she sat perched just a little too far forward in her seat. He tried for a friendly grin. “There's no opening*per se* . I'm sure you know how few people there are in the neural-interfacing field. When a resume as good as yours crosses my desk, I make a point of talking to its owner. If you're as talented as this suggests, I'll *make* a spot.”

She relaxed a bit at his answer, but said nothing.

“Let's start with one of those open-ended questions interviewees hate—I try to get those out of the way before taking candidates to lunch. That way, you'll actually get to eat. Why don't you tell me a little about yourself?”

It was quickly clear that she wasn't going to volunteer anything not already on her resume. “Excuse me, please, Cheryl. What I'd like to hear is more along the lines of what you're looking for in a job. For instance, why did you contact BioSciCorp?”

It took a few tries, but he eventually got her to open up. “...And neural interfacing*fascinates* me. Still, when I consider the potential of linking the human brain directly with a computer, my imagination can't quite handle it. Sure, I know all of the standard predictions: speed-of-thought control of complex machinery, immediate access to entire libraries, mind-to-mind communications between people using the computer as an intermediary. What I don't believe is that any of us truly understands what these capabilities would really mean. If we pull it off, neural interfacing could have as big an impact on civilization as the industrial revolution.”

“I agree, it'll be astonishing. However, that's not exactly what we're working on here.”

“Close, though.”

“One step along the way,” he conceded. “Mind if I do a quick overview of what we're up to here in my little corner of BioSciCorp?”

“I'd like that.”

“OK, then. Basically, we're trying to walk before we run. The human brain is the most complex piece of neural engineering that we know, right?” She nodded to fill in his pause. “The truth is, we—humans—don't begin to understand how the brain works. We're not even close to cracking the code. That's why BSC is trying to connect a computer to a much simpler structure of nerve cells.”

“Say you do connect a lower life-form to a computer. How would you know if any communication was taking place?”

“Who said anything about lower life-forms?” He took a moment's malicious satisfaction from her puzzled look, then relented—sort of. He raised his right arm, thinking hard about his hand. The microprocessor-controlled prosthetic hand slowly rotated a full 360°, its wrist seam unseen behind a shirt

cuff. In the suddenly silent room, Doug heard the *whirrr* of the motor by a freak of sound conduction through his own body.

“You've connected to the nervous system.” Her eyes were wide with wonder. “That's *astonishing* .” Then the other aspect of Doug's revelation struck home, and she cringed. “Oh, I'm *sorry* . I just get so wrapped up in technology. I don't mean to make light of your, uh....”

“No need to feel uncomfortable, Cheryl.” He lifted a wry eyebrow. “In the land of the prosthesis manufacturer, the one-armed man is king.”

She had to laugh—a trait he couldn't help but find endearing in a prospective employee. “Um, but seriously, how did you do that?”

“My stomach alarm went off ten minutes ago. What say BSC springs for lunch, and we pick up afterward?”

“That's a deal.”

* * *

After lunch and a promising continuation of Cheryl's interview, Doug did some management by walking around.

There'd been a virus attack while he'd been eating. They'd been semi-lucky. On the one hand, the invader was *not* benign. On the other hand (an expression from which Doug could not break himself), the program was clumsy and well understood. Well understood, that was, at the Inter-Agency Computer Network Security Forum, the federal crisis-management organization that strove valiantly, if with mixed success, “to stem the rising tide of computer break-ins.” The Web announcement of the forum's formation had brought unbidden to Doug's mind the image of King Canute drowning in a sea of hostile data. A far-from-bitsy bit sea.

The virus was brand-new that day, and hence unknown by and invisible to the company's Internet firewall, but the forum's web site already listed eighteen attacks. Behind a cute pop-up window (Dyslexics of the World Untie) hid a cruel, if apt, intent: randomly scrambling the memory of the invaded computers. It had to be a new infestation: their backup files were all uninfected.

In short, they'd had a close call. He wondered if they'd be as lucky the next time.

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Chapter 2

Cheryl's stomach rumbled with apprehension as she approached the BSC lobby. So long as it only rumbles, she thought. Spending my first day on the job in the Women's Room is *no* way to make a good first impression.

She didn't exactly understand the source of her misgivings. Both interviews had gone well, and Doug had extended the job offer quite quickly. She certainly seemed to hit it off with her new boss. Maybe that was the problem—she didn't want to hit it off *too* well. She knew the effect that her looks had on men, and—on the job—it annoyed the hell out of her. Off the job, she never found the time for it to matter.

After replaying the interviews in her mind, she decided that neither Doug nor his all-male staff had

seriously questioned her. They'd concentrated instead on selling BioSciCorp. Why were they so eager to hire her? Not that she didn't need the job...

When she asked him about it, instead of answering, Doug took a fat folder from a stack on his desk. He flipped rapidly through it, extracting several thick papers and plopping them with authority onto the blotter. The pages were dog-eared from use and heavily annotated with scribbles in the margins and highlighting marker.

Cheryl realized that he wasn't going to say anything. She picked a familiar paper, copied from the *Proceedings in Neural Computing* , from the stack; she had written it. She scanned all of the photocopies, and found that she'd authored or coauthored every one. Her new boss, it seemed, had pored over every one of her contributions to the journals of technical societies. The articles' well-worn condition made clear an interest in her work long predating her recent job inquiry.*So much for a favorable first-day impression.* "You're right, of course. These say everything you could ever need to know about my capabilities. I apologize for being so touchy."

Doug studied her frankly, with a twinkle in his eye. "I can say with absolute conviction that I admire you solely for your mind."

She couldn't help noticing that some unliberated recess of her mind took umbrage at his jest.

* * *

Like noontime on most weekdays, the condominium was largely empty. The first moans that drifted through the stairwells and down the hallways therefore went unremarked. The moaning grew gradually louder, more insistent, and began making its presence known throughout the building. A mother blushed for her totally oblivious three-year-old, and turned up her TV. The passing mail carrier smiled at the same imagined lust. Len Robertson, a meteorologist for the National Weather Service who was working the second shift that week, pulled his absent wife's pillow over his head in the vain hope of falling back asleep.

The moans grew louder, and somehow unhappy. There was a hint of wildness, and then of pain, under the inarticulate whimpering. The embarrassed mother swept up her son and carried him, screaming in protest, on a suddenly urgent errand. Robertson threw off his blanket in disgust and donned his robe. He met the equally puzzled postal worker in the second-floor hall.

The meteorologist was about to suggest calling the police when the ambiguous moaning turned into an anguished scream. His mind flashed to a headline case of years past: the cannibal killer in Milwaukee who had tortured and murdered several people in his apartment. There might be no time to wait for the police. Robertson hurried back to his apartment for the handgun in his nightstand drawer. "Call 911," he shouted, not waiting to see whether the letter carrier obeyed.

"No, no, NOOOO!!" Screaming filled the empty hall. But on what floor? He burst through a fire door into the stairwell, where noise reverberated confusingly. Were the screams coming from upstairs? Heart pounding, Robertson tried to distinguish new shouts from the echoes. "Go away! Go away! GET OUT!" As he crept warily into the third-floor hallway, the words dissolved into inarticulate shrieking. The bellowing was coming from 322—Mr. Cherner's unit.*Where were the police?*

The meteorologist didn't stop to think about what he was doing. Robertson charged into the flimsy door with his left shoulder. The wood gave way with a splintery, crunching sound. He pointed the gun in a subconscious imitation of a TV detective's two-handed grip. "Stop!"

But the shrieking*didn't* stop. Robertson watched in horror as Cherner, all alone, forced yet another inhuman scream from his throat. Bloody channels of flesh were torn from his face. Cherner's eyes, round

and impossibly wide, seemed to focus on nothing. “It's OK,” Robertson forced himself to say. “It's OK now. You're safe.” The swiftly approaching sirens should have offered the meteorologist some encouragement that he was right.

But the drops of gore falling silently to the rug from Cherner's own blood-soaked hands denied even that modest hope.

* * *

Work expands to fill all available horizontal surfaces. Then again, maybe it was just Cheryl. Papers covered her new desk, table, and much of the floor: electronic, mechanical, and electro-mechanical diagrams of the prosthetic arm; program listings for its embedded microprocessors; higher-level design descriptions; programming reference manuals. An open medical book on the human nervous system balanced precariously on the rim of her waste basket.

The mess obscured, along with most flat surfaces, the considerable progress that Cheryl had made. In her first week here, she felt she'd mastered the basic principles of the arm. Doug and company had managed a truly elegant bit of engineering. Still, momentarily stymied, she refreshed herself on its basics.

An array of ultraminiature sensors in the socket end of the prosthesis intercepted incoming impulses from the truncated efferent nerve branches in the stump. An electronics module then ferreted out of the sea of information the individual impulses directed to specific—and former—arm, hand, and finger muscles. Next, the electronics dynamically translated these “muscle” commands into a computer program that controlled the overall motion of the motorized prosthesis. Finally, mechanical linkages converted the rotation of the various computer-controlled electric motors into bending motion in the metal joints. In short: nerve impulses in; prosthesis motions out.

But brain-directed motion was only half the wonder of the device. Another swarm of sensors, scattered throughout the prosthesis, detected pressure, temperature, and relative position of simulated skin and bones. The resulting data flooded into a second electronics module, which converted the torrent into concise, useful information. Electronic transducers then modulated, amplified, and narrowcast this status information into the stump. The projected electrical fields impinged on afferent nerves, tricking the truncated branches into “thinking” that they were once again whole and connected to biologic tissues. The central nervous system of spine and brain had no way of knowing that the incoming sensations were artificially stimulated. Environmental data in; nervous impulses out.

Together, the two parts of the system provided brain-directed control of the arm, with near-instantaneous feedback. Cheryl marveled that so much technology fit somehow into an apparatus that so closely resembled a human forearm. How long, she wondered, will it be before I fully understand this?

“I asked if you could use a hand.”

Cheryl looked up from her paper-strewn desk, unaware of the furrow of concentration creasing her forehead. Doug stood in her doorway, an expectant look on his face. She'd apparently missed his original question, but couldn't help noticing the phrasing. It was her job, in every possible sense of the expression, to give*him* a hand. She pondered momentarily if his irony was intentional.

“One hand won't make much of a difference. Perhaps a forklift.” It was evidently an acceptable response. He had a nice laugh, she thought.

“I know the look of someone left wallowing too long in the documentation. Maybe I could come in and ... no, that won't work. Maybe*you* could step down to my office and we could discuss the project.”

“Sounds good.”

The walk down the hall gave her time to formulate a question. “Look, I understand the arm in general. It's the details that are holding me up.” She took his grunt as encouragement to proceed. “The big question in my mind is: how ever did you develop the software for the device? It must be amazingly complex.”

They reached Doug's office and he gestured her inside. They took opposite sides of the conference table. “I imagine it *is* pretty hairy, but I'm not sure. It'll be your job to figure that out.”

She could only stare at him in disbelief.

Doug's PC was behind him, its screen filled with tiny text. As Cheryl watched, the display blanked and the screen saver kicked in. Large words appeared and floated about randomly: Eschew obfuscation. Later that day she looked up both words. The phrase meant: don't be obscure. Right.

An explanation popped into her head as suddenly as the screen-saver message. In hindsight the answer was obvious. “The prosthesis isn't programmed. It's *trained* .”

“Uh-huh.” Without warning, he lobbed the staple remover with which he'd been fidgeting. “Heads up.” She extended her right arm to nab it. “OK, toss it back.” There was a tremor in his arm before the artificial hand settled into position for the catch. He resumed his fidgeting. “Notice the difference?”

Ah, the Socratic method. Cheryl had had college professors who'd favored the technique—leading the student to truth through questions. She *hated* it. She'd never wondered why the Athenians had made Socrates take poison.

What had she just seen? “The wavering in your arm. It was a midcourse correction, wasn't it? The arm must remember which commands worked right the first time and which require corrective impulses. The more motions it saves and categorizes, the better it gets at directing arm motion.”

A nasty thought crossed her mind. “There are *lots* of possible motions for most purposes. When you threw that staple remover, I could've leaned towards or away from it to make my reach more convenient. I might have caught it at the top of its arc, or near the floor, or anywhere in between. If I weren't basically lazy, I might have jumped from my chair and leaned over the table to catch it. Heck, how many slightly different but completely acceptable ways are there to position and move your fingers for the final grab?”

“Go on.”

He was enjoying this, she could tell. Maybe his mischievous grin was infectious, or maybe it was only his enthusiasm, but she found herself enjoying the battle of wits. She'd figure it all out. “You dissembled a bit. *You* didn't train it, not directly. *It* trains itself. The arm saves every nerve impulse—every command—that you send it, the instantaneous position of every joint, every motion that it makes. If a motion is smooth, if it's not immediately followed by a mid-course correction, the attempted solution is good. If there *is* a midcourse correction, the attempted solution is bad. In an inefficient but persistent way, the arm consistently fine-tunes its own programming.

“OK, I'm supposed to deduce how the software was developed. That must mean that the arm can dump its accumulated file of attempted motions to a PC. You want me to review the arm's ‘lessons learned’ and synthesize an equivalent, but more efficient, set of rules.” A double thumbs-up indicated that she'd gotten it right. Since Doug was now flipping a pencil end over end between the fingers of his right hand, that second thumb was quite an accomplishment. “Now I know why you fidget with everything on your desk all of the time. You're always in training.”

The tip broke off his pencil as she spoke. The mischievous grin grew broader. “Nope. I'm a multidimensional type of guy. Fidgeting is its own reward.”

* * *

“Liz.” There was no answer, so Betty Neville tapped on the closed door. Nothing. She rapped louder, until the ill-fitting door rattled in its frame. Her boss was alone, but a call had transferred back to Betty's desk after five rings. “Liz?” Nothing.

Betty took the transferred call off of hold. “I'm sorry, sir. Dr. Friedman seems to have stepped out. May I take a message?” She scribbled down the man's name and number. It figured—this was the call Liz had been waiting for all morning. “Yes, I'll be sure she gets this.”

Liz must have stepped out while her back was turned. Maybe she'd been on the phone herself or had her head stuck in the supplies cabinet at the time. Must be only for a moment, or Liz would've said something, or caught her eye at least. Odd that Liz had left the door closed. Well, Betty thought, she might as well put the message slip onto Liz's desk and grab whatever lurked in the out basket.

Liz's head lay in the out basket, amid a pool of drool, eyes wide with astonishment staring sightlessly into unknown distances. Liz's body slumped awkwardly half on, half off the desk. As Betty watched, rooted to the spot, gravity prevailed. Liz slid from the desktop to the floor, head, limbs, and torso each striking the planked floor with a hollow thud. The falling figure had the lifelessness of a rag doll. The lifelessness...

Betty found her voice again. She was still screaming when the people from the office across the hall arrived.

* * *

Brown and white shards flew everywhere as the pressure of the butter knife exceeded the strength of the breadstick. “That,” Doug explained for Cheryl's benefit, “was for practice. I eat cholesterol for science.”

The Neural Interfaces Department had, as usual, gathered for lunch in the BSC dining room. Someone down the table—from where she sat, Cheryl couldn't tell who—described this tradition as “better living through chemistry.” She didn't find the food*that* bad, but then again, she hadn't been eating it for long.

Dick Conrad, a programmer with an Einsteinian shock of hair, brushed crumbs from his otherwise-empty bread plate. “So, anyone have plans for the weekend?” The chorus of answers included mostly yard work, deferred shopping, and possible theater trips. Cheryl's own plans consisted primarily of laundry; she didn't bother to contribute.

Doug grabbed another breadstick. “I generally get that question from people waiting for someone to ask them*their* plans. Dick, what are*you* doing this weekend?”

“I expect to spend it here. New M-and-M game.”

Cheryl groaned mentally. Rather than candy, they were—again—talking Magic and Mayhem. Strange quests in imaginary castles and labyrinths, fighting equally nonexistent wizards and monsters for their treasures. As far as she could tell, all of these games were alike. And pointless.

The revolution in VR technology had given arcades a new burst of popularity. The VR goggles and instrumented gloves—not to mention the super-fast computers needed to control them, to paint the goggles’ screens with synthesized worlds, and to update those images to correspond to every movement of the adventurer's head and hand—were quite expensive. The cost, at least, limited the amount of time that teens could spend at the games. Adults were another story, especially adults at companies like BioSciCorp that owned VR equipment for more serious purposes. The difference between a man and a boy is the price of his toys.

The men rattled on for what seemed like forever about M-and-M. Cheryl was relieved when someone

finally noticed that time was passing, and that they needed to get upstairs and back to work.

Relieved, that was, until she discovered that during lunch a new virus had invaded BSC's network and wiped out—minimally—her morning's work.

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Chapter 3

For at least the fourth time that evening, the words on the screen seemed to blur. That meant it was time to get up and walk around again. Doug pushed himself away from the desk, hoping that there would still be something to graze on in the vending machines.

It was closing in on 10 P.M., and the end was not yet in sight. The end of the work day, that was. The due date for their NSF grant-renewal papers approached with perilous speed. He ignored the thought that NSF meant "non-sufficient funds." The National Science Foundation had so far coughed up the money for half of the development of the experimental prosthesis, and Doug very much wanted to keep it coming. BioSciCorp faced enough of a financial stretch going it alone once the technology was sufficiently proven for commercialization.

A Coke and some chocolate perked him up. He made the rounds of the offices to see how things went with his fellow stuckees. At his third stop, he found Cheryl staring fixedly into her PC screen, surrounded, as always, by dead trees. She was doing her damnedest, he knew, to synthesize a set of generalized arm-motion rules for the grant progress report. "Can you use some help, or is it beyond that?"

She stood up and stretched, graceful as a cat and a testimonial to aerobics. "That felt good. Sure, if you can spare a few minutes."

"Shoot."

Cheryl gestured at her PC. "I'm drowning in data. Do you have any *idea* how many arm motions you make in a day? And they're like snowflakes: no two are exactly alike. Beside, the longer you use the prosthesis, the more data it stores and the bigger its lessons-learned file grows. There's gotta be a way to see the bigger picture."

Doug perched gingerly on the single exposed corner of the cluttered desk. "Have you synchronized data from the arm with the physical-training videos?"

"I tried." She plopped back into her chair to keyboard something. A window opened up on the display, in which a tiny, sweaty, begoggled Doug dashed randomly about an empty white room waving a short rod. The counter in a corner of the window, its rightmost digits changing with blurring speed, observed the passage of time down to the millisecond. "It doesn't help. No offense, but you look like a marionette on drugs."

"An unstrung marionette, at that," he agreed. "This is how you've been looking at the videos?" He took her silence as assent. "Try this." He bent over, trying with limited success to ignore their proximity. A few keystrokes changed the screen image dramatically. The visualized room doubled in size and developed various colored markings, the wand in mini-Doug's hand blossomed into a proper racquet, and a similarly equipped opponent materialized. Thuds and thwocks of the bouncing red ball and grunts from the hard-working players burst forth from the PC speaker.

Cheryl's jaw dropped as she watched the players bat pseudoballs about the VR racquetball court. Her shocked expression quickly turned into one of annoyance. “Having a little fun with the new girl? Someone might have*told* me what was going on in these so-called exercise videos.”

He straightened up hurriedly. Bent over her as he'd been, unavoidably smelling her hair, all he needed was the suggestion about having fun with the new girl. It didn't matter that that wasn't how she'd meant her words. “The old hands find it easier to analyze the motions with the graphics filtered out. We slipped up in not showing you the VR view. Sorry.”

“You slipped up in not mentioning it was VR!” Her jaw jutted out belligerently.

Hell, what did they talk about at lunch most days, if not VR? This was nuts. Of course, while Cheryl ate with the group, she didn't join in much. She stayed at a distance, as if any friendliness on her part would be misinterpreted. He'd asked his secretary about Cheryl; Teri made the same reading. What other important information had Cheryl's standoffishness caused her to miss?

He made a quick decision. “We need a mental break. Let's go play racquetball.”

“We've got too much work to do.*I* do, anyway.”

“This*is* work. You need to understand the exercise videos.”

She stood up and glared at him. “I do understand them.*Now* . I would've days ago, if you'd shared your little secret.”

Everyone was cranky from overwork, he told himself, including him. That he took a tantrum more personally from Cheryl meant that maybe she was right—maybe he didn't relate to her as simply “one of the guys.”*Damn* it. He didn't know which of them he was mentally cursing. Maybe both. “Ever done virtual racquetball? Any VR sport?”

“No.” The tone revealed a disdain for VR of which he'd previously only gotten glimpses. “I'll stick with the real world.”

“Not if you want to make any headway reverse engineering what the arm has taught itself.”

The implied critique of her professionalism evidently stung, but she was too angry to back down. She gestured at her slacks and sweater. “These are hardly racquetball clothes, and I don't have a racquet.” The answer conceded his point without any move towards cooperation.

Doug got off the corner of her desk. “You do aerobics after work. Whatever you wear at your health club is fine. Meet me by the VR labs in ten minutes. I'll change and bring spare gear.” Hoping to reduce the tensions, he added, “Ask the game program to put my face on the pseudoball. Rumor has it that that's very therapeutic.”

He took the brief up-twitch of her lips for success. “Great. See you in ten.”

* * *

Why, with so much work to be done, was she playing? Cheryl stood, ill at ease, the VR rod awkward in her hand. Through borrowed VR goggles she saw only the webless wand, herself in leotard and sneakers, and an all-white room. She'd told herself while getting changed to keep an open mind. It was a thought, she felt, her boss would describe as free advice and worth every penny.

“Answer if you can't hear this.” Doug's words were loud and clear in her goggles’ tiny earphones.

“Whatever.” She assumed, correctly, that the room had hidden microphones.

“Open sesame,” she heard, and Doug appeared on the other size of the suddenly enlarged chamber. His cut-offs were frayed; his well-worn T-shirt declared, “I'm virtually certain that I'm real or really certain that I'm virtual. Or vice versa.” Her senses rejected what her mind told her: that he stood in another room down and across the hall. She assumed that the video cameras in this room captured her with equal verisimilitude. She suddenly felt self-conscious in her leotard.

“You say it, too.”

“Do I have to?” Cheryl sounded petulant even to herself. Damn it. She'd cooled down enough to know she had fences to mend. “OK, then. Open sesame.” The room sprouted virtual lines on its floor and varicolored zones on its walls and mythical midcourt center plane. The rod in her hand became the handle for what looked like a conventional racquet. She knew, however, that she held an expensive piece of electronics. The rod captured every nuance of her grip and its own exact position and attitude in the room. The handle reported continuously, by IR beams, to sensors in the walls. In other games, this same instrumented rod could become a golf club or a baseball bat or a wizard's staff.

He taught her, with a mixture of quips and examples, how VR racquetball was played. An unseen computer responded to voice cues (that every serious gamer personalized) for such functions as serving the ball and changing handicap levels. ("What handicap? I don't need any damned charity,” she'd protested—until he'd slammed a ball past her via a pro-level, triple-speed purple zone. She might as well have swung at a meteor. “Well, if you insist.") Multiple video cameras and a *lot* of computing power triangulated their exact position at any point in time.

She was most surprised by the revealed mysteries of her VR goggles. A low-power IR source shone continuously into each eye; the reflections of these invisible beams off her retinas helped reveal precisely where in the virtual scene she was looking at each instant. ("Helps? What else does our friend the computer need to know?” He'd gently pointed out that the position and orientation of her head in the room were also helpful. IR transmitters in her goggles reported that, too.) The VR gear was surprisingly sophisticated. Maybe her opinion of VR games *was* a bit knee-jerk.

“All right,” said Doug. “Enough stalling. Let's volley for first serve.” To the unseen computer, he added, “Roll ‘em.”

From that moment on, she was too busy enjoying the activity to spare any thought to assessing its merits.

* * *

“CLASS OF ‘05 RULES.”

"Shit!" snarled Dick Conrad. Similar sentiments rang up and down the hall, some punctuated by the frustrated pounding of fist on desk. The invader slithered impudently around his PC screen, devouring, with Pac-man-like determination, Dick's section of the NSF grant-renewal report.

Dick removed horn-rimmed glasses to massage the bridge of his nose. He had a bitch of a headache, knowing all too well the implication of those many nearly concurrent shouts. Those plaints meant a coordinated, time-delayed viral attack throughout BioSciCorp. It meant that every computer at BSC, and the backup file copies going back for who knew how long, were likewise infected. To have a prayer of meeting the deadline on the grant renewal, they'd have to get new computers and recover from printed drafts scattered around the office. The engineer couldn't face thinking about all the changes he'd made since he'd last printed out a draft.

He knew how important this grant was to Doug. He couldn't imagine how Doug would take this incident.

In thus discounting his imagination, Dick was absolutely correct.

* * *

“Beep.”

Intent on predicting the path of the pseudoracquetball, Doug found the electronic tone disorienting. Balls in midair make no sounds. It took a moment to recognize that the sound had not come from within the game, from the earpieces in his goggles. Once he'd decided that the sound had originated from his wrist, its meaning became obvious: his watch had chimed the hour. He kept the watch running five minutes fast, a bit of subterfuge which usually got him to meetings on time. That made it about five minutes before eleven.

The ball changed course with a healthy*thwock* , sign of a solid hit with a firm grip on the racquet. The novice level at which Cheryl was playing meant that his returns moved at a quarter of the speed to which he was accustomed. The slow-motion return gave him plenty of time to analyze his stroke. Perfect. The prosthesis had done*precisely* what he'd intended.*Remember that, right arm of mine.*

The thought of the phrase triggered a neural response mastered through lengthy sessions of biofeedback. His brain initiated a nerve impulse, an electrochemical chain reaction that traveled from brain to spinal chord to nerve branch. Sensors in the prosthesis, in due course, picked up the signal. Circuitry in the arm then recognized the unusual character of the pulse pattern. Instead of commanding a muscle to move, this signal told the prosthesis to write a “well-done” notation into its embedded memory. Arm motions that he identified in this manner were automatically retained whenever he interfaced the arm to a lab computer for data extraction.

Still, it was almost eleven, and there was work left to do that he'd meant to finish before going home tonight. “Much as I'm enjoying this, I gotta get ba—”

Unexpected pain jolted his arm. He stared in horror at the hand that suddenly clenched his racquet handle with agonizing intensity. For a bewildering instant, the prosthesis signaled conflicting sensations of boiling heat and numbing cold, of feather-light tickling and vise-like pressure.

After an endless moment, the arm lost all feeling.

* * *

It didn't help, Cheryl decided, that Doug kept referring to the incident as “a disarming experience.” The words were typical: a play on words and a deprecating reference to his disability. The bitter tone—that was another matter.

“I'm sorry, Doug.”

He looked up from the inert prosthesis lying on his desk. “Unless*you* set loose the virus, quit saying that.”

She was about to explain that it was understanding, not an apology, she was offering when the tension in his voice registered. Sympathy was the*last* thing he wanted. This project, his whole professional life, were struggles to beat the odds. A struggle that some juvenile asshole seemed to have, if only temporarily, derailed. Sympathy would only make things worse.

“All right, I'm*not* sorry. I'm*pissed* .”

“You're not*that* , either. I currently hold the exclusive, worldwide franchise. It didn't come cheap.”

Maybe so, but some emotion was wringing her gut. She felt awful, and knew Doug felt worse. What could she do to help?

“Thanks again for the job,” she blurted.

The subject change made him blink. “You earned it. Don't make a big deal of it.”

She wasn't sure if this was a way to get his mind off his own problems, or only something that she'd needed to get off her chest. Either way, she plowed ahead. “I gather you haven't been on the job market recently?”

He finally looked her in the eye. The triumph of curiosity over depression? “Things are bad?”

“Only in our niche.” It was her turn to sound bitter. “Only in neural interfacing.”

Doug seemed to first notice the disembodied limb on his blotter. He opened a desk drawer and tucked away the inoperative prosthesis. “I*have* seen more resumes than usual,” he conceded. “Look, I knew the research program at your old place shut down. I knew that when I interviewed you. Feinman was the heart of the program, and he had a stroke. It's a real shame, but it happens.”

How about a frozen expression of horror so awful the mortician can't do anything about it? Ben Feinman had had a closed-casket memorial, but Cheryl*knew* . She was good friends with Fran Feinman, and Fran had had to tell someone. Does that happen, too, Doug? But all that she could bring herself to say was, “And Yamaguchi?”

“She wrapped her car around a lamppost. My friends at NeuralCorp say she'd been preoccupied with something. Believe me—car wrecks happen.” He glanced self-consciously at his stump. “Shit happens.”

It was the first time he'd ever alluded in her presence to the loss of his arm. She wanted to respond to his statement. She wanted, suddenly, to know him. To know Doug the person, not the wisecracking boss. After years of keeping her distance from men at the office, she wasn't sure how. And as she hesitated—

“I can't face cleaning up this mess tonight.” She followed his glance to a clock; it was past midnight. “Correction—this morning. I'm going home to catch some Zs.”

Unhappy with an opportunity lost, too confused by her stymied impulse to think to ask if he could still drive himself home, she followed him to the all but empty parking lot.

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Chapter 4

Theodore Roosevelt Island, a wooded oasis on the Potomac River, can be accessed only by footbridge from an isolated parking lot on the Virginia shore. The island is much favored by local elementary schools as a picnic stop on the way to or from field trips into the District of Columbia. Today, three busloads of the little monsters had gobbled their sack lunches and were now running amok under the resigned eyes of teachers and parent helpers.

Jim Schulz ruefully shook his mustachioed head.*Why* had he allowed himself to be talked into coming here on a weekday? He'd lived in Northern Virginia quite long enough to know better. His supposed companion on this outing, Doug Carey, stood nearby, absorbed with his new camcorder. Occasionally, the ground apes quieted enough for Jim to hear the motorized hum of the camera panning or zooming. Jim's attempts at conversations were impatiently shushed.

Jim's mind wandered until an approaching petite figure caught his attention. The woman was casually

dressed in peg-legged jeans with artfully torn knees, a tan sweater with pushed-up sleeves, and scuffed sneakers. Her light brown hair was done up in a French braid from which a few endearing strands had escaped.*Nice* . He had no idea what he'd done to attract her—but he wasn't about to question his good fortune.

"Beware the cyclops."

"Cyclops" must mean the lens of the camcorder. Dammit, she knew Doug.

Doug caught the Odyssey reference, too, although he continued shooting whatever vignette had caught his eye. "Who goes there?"

"No man."

"*That's* for certain," Jim had to interject. He gave her an exaggerated once-over that made her blush.

"Don't harass the staff, please." Doug finished whatever he'd been shooting, then lowered to his side the hand holding the video camera. Robohand. "Hi, Cheryl."

"Hi, boss. I assume your parting directive doesn't apply in neutral territory."

Doug nodded. To Jim, he explained, "After we finished the proposal from hell, I told everyone I didn't want to see them for a week. This one," he tipped his head towards Cheryl, "really worked her tail off."

Jim stepped to the side to gaze pointedly at her nicely rounded rear. "It looks fine to me."

"*Quit* that."

"Thanks, Doug, but I can fend for myself." She turned to Jim. "I know you from somewhere, you wannabe dirty old man. I recognize those sideburns. Oh, yeah," she brightened, "you're in Doug's training videos. Why haven't I seen you at the office?"

"*Jim?* Work at BSC? He can't tell a computer from a kumquat. He plays from a VR arcade near his house in Alexandria. The Internet handles VR racquetball as well across town as between adjacent rooms."

That incredulity was a bit much, Jim thought. He wasn't *that* computer illiterate. Many years ago, he'd even taken a beginning programming class, coursework the University of Wisconsin had obligingly accepted as a foreign language. As far as he was concerned, computer languages were as foreign as they came. What else could you say about a language in which I=I+1 was meaningful?

In any case, Jim *knew* the difference: kumquats had seeds. He also knew how to get even. It'd be hitting below the belt, but he was piqued enough not to mind. "So, you two kids going together?" Doug was predictably aghast. Before his friend found his tongue, Jim added, "No, of course not. What *was* I thinking, expecting St. Douglas to date, and someone from the office yet? He might disqualify himself from that seat he's been coveting on the Supreme Court."

The crack earned him an angry glare. It didn't require telepathy to know what was crossing Doug's mind: dark thoughts about Holly. Lost Holly. When would his friend truly accept that that stage of his life was *over?*

"I don't see people from work." Stereo answers came from Doug and Cheryl.

We'll see about that, Doug. Nothing like pondering the loss of something to make you want it. Jim

beamed at Cheryl. “An excellent policy, my dear, excellent. Did Doug ever mention that I can't tell a computer from a pistachio? Or was that an artichoke heart? Whatever. I have trouble with all this technical stuff. Some growing thing.” He looped an arm through hers. “Allow me to introduce myself.”

* * *

After an afternoon of window shopping, Doug, Jim, and Cheryl wandered into a touristy area of Old Town Alexandria. Doug's stomach rumbled, and he checked his watch for confirmation. “I could sure use some dinner.”

They were in front of a posh Italian restaurant. All three were in jeans; Doug wore a T-shirt and Jim a faded army surplus camouflage jacket. Cheryl stole a quick look at the menu in the front window, then gestured vaguely at her own casual clothes. “As if we're dressed for this place.”

The men exchanged an amused look. “Follow me,” Jim said, “I'm a friend of the owner.” They went around the corner to a side entrance. The chef's effusive greetings made clear to Cheryl that Jim *was* the owner. The restaurateur pointed to a genuine butcher-block table in a corner of the bustling kitchen. Disappearing into the kitchen-side door to his office, where he kept a spare suit, Jim called, “Have a seat, folks. Gotta schmooze with the paying clientele, but I'll be back.”

Jim was lying, but it was for a good cause.

* * *

Doug and Cheryl sat in silence—all the more awkward for following Jim's ceaseless ebullience. “Quite an interesting guy,” she finally offered.

He raised an eyebrow at the closed office door. “Rebel without a clue? Yeah, he *is* interesting, and it's reassuring that someone's working to keep us out of Vietnam.” They jerked back as their legs accidentally touched beneath the tiny table.

By tacit agreement, Jim was a safe subject. “Where's he from?” asked Cheryl.

“Milwaukee. His dad works at a brewery Jim will only identify as producing ‘the beer that made Milwaukee malodorous.’” As Doug spoke, a waiter spread a damask tablecloth over the butcher block. Three place settings and a wax-covered Chianti bottle with candle followed. When just Doug and Jim ate here, as they often did, Jim threw dish towels over the wood—and they weren't always clean towels. Certainly they never had a candle. And now Jim had conveniently disappeared. *Damn* that man—first flirting with Cheryl, then playing matchmaker. How transparent can you get?

They fell silent again. Somewhere behind them, a knife chopped manically on a cutting board. A voluble chef's assistant made a point by clanging the counter with his ladle. Cutlery and plates clattered in and out of the oversized dishwasher.

Perhaps the clinking and clanging was too suggestive, or perhaps the flickering candle flame was. Maybe it was the so long foregone company of an attractive woman. Maybe he'd only been out in the sun too long today without a hat.

Whatever the cause, Doug found his mind slipping into a familiar memory. Light was flickering there, too, but its source was a short-circuited turn signal that refused to respond to its control. The darkness there crowded in on him.

Flickering, flickering...

* * *

The rental car was mangled, its bent frame keeping the doors from opening. Judging from the razor-sharp fragments covering occupants and vehicle interior alike, its windshield had been replaced with cheap, nonautomotive glass. At least Doug didn't think the stuff mandated by law could shatter like this. Whatever mishap had necessitated replacing the windshield must have also deployed the airbags; they had not been replaced.

After pressing his belt into service as an impromptu tourniquet, the two of them tried not to look at, or think about, Doug's mangled right arm. The injury—like the meandering bastard, presumably blind drunk, who'd veered from his lane and driven them off the deserted road—was too much to handle just yet. Once the tourniquet stopped his bleeding, they tried to crawl out the now-glassless front window. The effort gained them only assorted new cuts and abrasions.

"Holly?"

"Hm?" she finally answered. Her attention seemed focused on the tree that grew from the center of the engine compartment.

"We'll be OK. Honest."

She had hair and eyes as dark as the night. Eyes that most evenings he could get lost in. By the green flickering of the turn signal that would not end, her skin looked unhealthy. "I know." Tension in her voice belied the words.

"I love you."

She took forever to answer. "I love you, too."

"See if *I* ever do Florida again." He'd followed the spring-break tradition twice before: neverending parties down the coast. In his junior year he'd met Holly and, to his amazement, the mob scene at Lauderdale hadn't appealed to her. He'd begged her all winter to come with him, and finally worn her down. Now *this* .

"Uh-huh."

He worried about her being so quiet, but she *seemed* OK. No visible wounds, anyway. Maybe, he decided, she was going into shock. He huddled against her as best he could to share his warmth. Trapped behind the steering wheel, his right forearm shredded, he couldn't even comfort her by squeezing her hand.

In other circumstances he might have remembered to loosen the tourniquet occasionally. Might. It was impossible to think about himself, though, as Holly slowly withdrew into herself. She fell silent. As Doug kept a helpless vigil, her face grew ever paler.

She died of internal bleeding as the first hint of dawn appeared in the eastern sky.

His last coherent thought, losing consciousness himself as help finally arrived, was one of biting irony. As the highway patrolmen urged him to hold on, they spoke urgently of freeing him from the wreckage by applying the Jaws of Life.

* * *

"Doug? Are you OK?"

He returned to his surroundings with a start. It took him a moment to recognize his companion. "Um, yeah. Yes, sure, I'm fine."

Cheryl laid a hand over his. It felt fire-hot. “All of a sudden, you were *gone* . What were you thinking about?”

He couldn't tell her, he just couldn't. His mind hunted desperately for another topic. One other subject was on his mind; it, too, was bad—but not as awful as Holly's death. “Cherner,” he mumbled. “Cherner and Friedman.”

“Bob Cherner? Head man at Neurotronics?”

“Do you know him?”

“Only by reputation. He's supposed to be good.” She looked at him strangely. “What about him?” Following his gaze to their overlapped hands, she pulled hers back hastily.

“He's been institutionalized.” His skin remained warm from her touch. “Remember the night of the Class of ‘05 virus attack? After my arm seized up?” Cheryl nodded. “You were upset at the coincidence of Feinman and Yamaguchi dying so close together. Well, there may be more going on. Once our grant-renewal application was out the door, I went through three weeks of old email. My messages to Cherner were all returned as nondeliverable.”

“That's odd.”

They were too intent on their conversation to notice their host approach with a tray of *antipasti* .

“That's what I thought, so I called him in Philadelphia. A very rattled secretary said he was out sick. She wouldn't say anything else.”

“What did you do?”

“I went online and found another Neurotronics employee to call. I claimed to be an old friend of Bob's, which was only a slight exaggeration, and said I'd heard he was out sick. Could she help me find him? She hemmed and hawed a bit, but I finally pried the name of a hospital out of her.”

“Before, you called it an institution.”

He couldn't suppress a shiver. “The engineer at Neurotronics called it a hospital. I called, and the hospital would only say a Robert Cherner was registered. They wouldn't tell me anything about his condition, or let me talk to him. That was odd enough to make me look them up. Cherner's in a mental hospital.”

“You mentioned someone Friedman?”

“Liz Friedman, over at NeuralSoft. Stroke. I'll spare you the details, but she died in her office one day last month.” He sipped at his ice water. “I don't like it.”

A voice sounded behind him. “Liz probably wasn't too wild about the idea, either.”

Doug whirled. Jim Schulz stood there, holding a tray. “How long have you been hovering?”

Jim set down three plates, handed the tray to a passing busboy, then dropped into the remaining chair. “Long enough.”

Doug tried to work up some indignation. “Jeez, I know this is your place, but you have no right to eavesdrop. It's probably nothing, anyway.”

The restaurateur looked sadly at Cheryl. “He's already told you I'm suspicious, right? A bit

antiestablishment? Given you the ‘keep us out of Vietnam’ line?” Jim didn't wait for an answer. “I heard about four mysterious deaths or illnesses, all to key people in your field. Correct?” When no one contradicted him, he prodded his still angry friend on the arm. “Doug, all I know about neural interfacing is that it's a brand-new area. There aren't many people in the field yet. Right?”

“Right,” Doug begrudged.

“How many?”

“About thirty full-timers. Maybe a hundred total.”

“And you don't find four such incidents suspicious?”

The coworkers exchanged helpless glances, as if afraid to answer.

“You're lucky I'm here.” Jim stabbed an olive with his fork. “Allow me an analogy. A hundred of you neuro-weenies makes it perfect.

“What would you say if, over a few weeks, three senators died and a fourth showed up in a booby hatch?”

When put like that, it seemed foolhardy not to see a pattern. A very *dark* pattern. Doug's blood ran cold as a thought worthy of Jim's paranoia crossed his mind.

Cheryl had the same realization. “Doug? What if someone *is* targeting neural interface researchers? Wouldn't we be high on the list?”

Wordlessly, he reached out for her hand.

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Chapter 5

The woman nervously twisted a lock of her straight black hair, but showed no other signs of her recent widowhood. Perhaps worrying what impression might be given to her visitors by her casual garb and sunlit living room, Fran Feinman tipped her head towards the chaos-filled family room. “It's hard to retain a funereal air around *that* . I thank God for the twins every day.”

“I'm glad the boys are OK,” said Cheryl. The words sounded dumb to her, but she never knew what to say on a condolence call. She was less sure of herself when her visit had an ulterior motive. “I meant what I said at the memorial service about taking Josh and Scott for a weekend. Whenever you'd like.”

“Thanks, but none of us are ready for separation yet.”

The room fell silent, except for overflow from the children's play. Doug found his tongue first. “Mrs. Feinman, I appreciate your seeing us.”

“Fran, please. Any friend of Cheryl's is always welcome.”

He forced out the words. “I don't know how to approach this tangentially. Please understand that I don't ask this question lightly. Was anything—unusual—about your husband's death?”

The women exchanged a look; Cheryl broke eye contact first. “I had to tell him, Fran. I had to tell him

what little I knew." After that extraordinary dinner at Jim Schulz's place, that was exactly true.

Mrs. Feinman shifted in her chair. The motion was slight, but it was an obvious turning away from Cheryl. "All right, Doug, the look on his face, *that* was unusual. Oh, it was far worse than that. It was horrible. Ben died with an expression of absolute terror."

Doug squirmed in his own chair, but he *had* to continue. He and Cheryl could be next. "Fran, have you any idea what could have frightened him?"

The widow twisted a handkerchief so fiercely that several stitches of embroidery gave way with audible pops. "Ben? My Ben wasn't afraid of anything. He had all of the fear burnt out of him in the Gulf War."

Cheryl gently laid a hand on her friend's arm. "Then *what* , Fran? Why that look on him? It must've been bad—I don't believe you scare easily either."

Mrs. Feinman just shook her head.

Doug began to pace. "You're *sure* Ben was alone when he had the stroke?"

"The kids and I were at a Saturday matinee, some harmless cartoon." Memory of the twins' delight made her smile briefly. "Ben was alone in the den when we left. He said he'd brought home too much work to join us. I closed the den door on my way out. He was dead in his chair when we returned.

"Because of the *look* , the police examined the house. My fingerprints were the top set on the inside *and* outside knobs of the den door." She hugged and rocked herself as she sat. The twins' play sounded especially noisy in the suddenly silent room.

"Did you notice anything unusual about Ben *before* this? That day? That week?" No thought underlay Cheryl's questions, but there had to be *some* meaning to this strange death.

"He'd had a physical maybe a month earlier. He was in fine health, the doctor said, perfect health. Ben was full of energy, full of life."

Nothing. Doug racked his brains. "Is the den like it was?"

"Yes." Fran's eyes brimmed with tears. "I haven't been able to face it yet."

When Doug and Cheryl examined Ben Feinman's home office, the tidy room seemed somehow to mock them. The neatly arranged desktop told them nothing; neither did the neural-interface helmet that had apparently dropped to the floor when Ben had slumped in his chair. Doug traced his finger over a doodle on the desk blotter—a meaningless bunch of deeply inscribed intersecting ovals, all nearly obliterated by a dark scribble—then wordlessly led the way from the den.

* * *

Inch-tall green words floated on an otherwise darkened screen: "A man's reach should exceed his grasp, else what's a backscratcher for?"

"*Must* we have that?" Cheryl asked Doug. They were cloistered in his office, regrouping from yesterday's unenlightening visit with Fran Feinman.

"What?"

"That screen saver. Can't it show something a little less distracting?" She had unadulterated black in mind.

“I share the wisdom of the ages. You'd pay good money to read that from a fortune cookie.”

“That's not where I generally go for wisdom.”

Doug shrugged in resignation, swiveled toward his desk, and reset his screen saver to a boring clock display. After a moment's thought, he suppressed its synthesized ticking sound. “Better?” To her nod he added, “Thought it would be. Time heals all wounds.”

“Not Ben's.”

Doug sobered up instantly. Death was a real downer, a lesson he'd learned the hard way once before. “Sorry. You've got to understand this is my way of dealing with stress.” That, and sitting in the dark, brooding. He'd tried not to do that at work, though—and anyway, the office drapes admitted too much light. “I made a call last night. The doctor handling Cherner's case will see us. We've got an appointment in Philly after work.”

She stood and looked out the window. The clusters of people on the plaza, chatting and smoking and sipping coffee, seemed foreign to her.

Cheryl wondered when she'd return to their world. Or if.

* * *

Doug had made the appointment at Shady Acres Sanitarium, but it took Cheryl's charm to get them past the doctor overseeing the case to visit with Bob Cherner. They weren't all that sure now that it had been such a good idea.

At first, the sanitarium belied Doug's preconceptions. The grounds were immaculately groomed and, true to the name, dappled by the shade of old oak trees. The front lobby was light and airy. Sunlight streamed through windows into a marbled foyer. Cheery paintings decorated the walls and extended up the curved staircase.

Cherner's room was a different story. The only furniture was a small bed bolted to the floor, devoid of head- or footboard. Its single window was small, high, and barred. The door had no inside knob. And, oh yes, the walls and door were padded.

“Doug?” began Cheryl. The tremor in her voice suggested the same misgivings that he felt. “Does he even see us?”

He forced himself to study the man they were visiting. Doug knew Bob professionally, had sat on a few experts’ panels with him at symposia. The Cherner*he* remembered was alert, witty, with humor dancing in his eyes. The man seated on the bed stared dully into a corner, indifferent to their presence. No trace of personality showed in his eyes. Swatches of bandages covered the ruin they'd been told he'd made of his face.

Nor had Doug ever known Bob Cherner to wear a straitjacket.

“No,” he answered softly, “I don't think he does.” He stepped close to his ill colleague. “Bob? It's Doug Carey. We need to talk.” A flicker of eye motion showed that Doug had been heard. Had he been understood? He had no way of telling. “Bob, what happened to you?”

Cheryl broke the uncomfortable silence. “It's no use. You heard what they did to him.”

Repeated electroshock. But what choice had there been when Bob struggled insanely whenever he came out of sedation? Even in the straitjacket, they'd been told, it was feared he would injure himself by fighting

with such frenzy against his restraints.

Now Cherner was silent, passive, inert.

Doug tried again. “It must be awful. Terrible. But you're not alone. We know something is happening to neural-interface researchers. Several have died. You must help us stop *it* from continuing.” He didn't know why he chose the impersonal pronoun.

Nothing.

Cheryl sighed, then came over to join Doug. She looked past the bandages, and deeply into Cherner's eyes. They were blank, lifeless: twin black holes of the soul.

Fighting tears of helplessness, Cheryl backed away. Would Doug wind up like that? Would she? The notion was far scarier than death. “I have to go. I *have* to.”

“In a moment.” Doug took out a pen and pocket calendar. A thought had come to him, probably stupid, but it was the only idea he had. He drew on an inside cover, then held the simple sketch for Cherner to see.

For a moment, the only reaction was a bulging of the patient's blank eyes. Then he took in a deep breath, and began a scream of such primal terror that Doug almost dropped the pad. Muscles bulged within the confining straitjacket; fabric strained. Spittle flew from his lips.

The raver lunged from the bed, head lowered like a battering ram. Only the near paralysis of Cherner's legs from hours sitting motionless saved Doug; a leg buckled, and Cherner collapsed, screaming, to the carpeted floor. His eyes, so recently vacant, were now filled with murderous rage. He struggled desperately to regain his feet.

The door crashed open, and white-coated men brushed Doug roughly aside. It took three people to subdue the man thrashing on the floor. “What did you *do?"* demanded an orderly, jabbing an air-spray hypo against Cherner's neck. Cherner arched his back at the sting of the injection, then fell still.

Doug looked helplessly at the drawing he'd made: a copy of the overlapping ovals from Ben Feinman's desk blotter. They must lie at the root of the problem. They obviously *meant* something.

But what?

* * *

Sheila suspected something was wrong. For starters, she didn't remember her own last name, although the name on her driver's license felt right when she'd read it. She assumed that the license in the purse underneath her desk was hers since it bore her likeness. She'd needed the mirror in a compact to reach that conclusion.

People chattered in the hall outside her—office? None of the noises seemed familiar. Then again, *its* voice was distracting, dominating. How could she recognize other sounds when *it* spoke so loudly?

What could be wrong? Sheila thought she might ask one of those noisy people, but wasn't sure exactly what to ask. She opened her mouth to test a question; only an inarticulate gurgling emerged. Did she used to speak? She couldn't remember.

She strode from the building, waving in vague response to the calls of her coworkers. There were things to be done, important things.

It insisted.

* * *

Sweat rolled down Doug's back as he shoved the lawnmower about the small yard. This section was the hardest; with its ten-degree grade, it alone justified a self-propelled model.

Alas, it would be years, if ever, before he used a self-propelled mower—or any powered mower. Motor vibrations drove his prosthesis nuts, unless he turned down the sensitivity to approximately the Captain Hook setting, with which he had so little control that he'd probably lose his *other* hand. A truncated rose bush showed the folly of a prior experiment performed with a borrowed gas mower.

Three more strips and he'd take a trip into the house for a cool drink. Despite his grumbling, the mindlessness of the job at hand appealed to him. Rote tasks liberated his imagination, freed his mind for whatever problems were at hand. It worked better than parking himself in an easy chair and ordering himself to think.

He reached the uphill end of a row and began a turn. Pivoting the mower, his gaze swept across the Perlmans' cedar deck, on which Cindy Perlman, a pale grub of flesh bulging out of halter top and short shorts, lay draped across the chaise lounge. He continued the turn, carefully avoiding eye contact. She was a friend and good neighbor, but seeing her up close in that outfit could strike him blind.

Doug continued his ruminations. He and Cheryl had been thrown for a loop by the incident at the sanitarium. What was it about that sketch? Now Cheryl could dress. Not that he could imagine her going to pot like Cindy Perlman, but if Cheryl did ever gain an excess ounce, she would surely wear something appropriate.

It'd been unseasonably cool yesterday, and Cheryl had worn a bulky sweater with that knee-length skirt and black heels. All very proper, of course, but something about the fuzziness of the sweater was so, so ... cuddly. The other day she'd worn slacks and a plain white blouse to work. Then there were the jeans she'd worn on Roosevelt Island. Now, that emerald blouse she wore with the beige linen suit. What was that slick material? Silk maybe, or satin, but he wasn't quite...

He jerked to a halt in midrow. What *are* you thinking? he asked himself, although the answer was obvious. Doug couldn't visualize his *own* wardrobe to that level of detail. So rote tasks freed his mind for the problems at hand? Liberated his mind? Hah!

Maybe he'd break for that cold drink now. In a bit, it seemed, he'd need a very cold shower. *She works for you, you Australopithecine jerk.*

His subconscious hunted for a safer topic. In a way, Bob Cherner qualified. What did Cherner and Ben Feinman have in common? His pocket calendar sat beside the phone, as it did every weekend. He opened it to the sketch that had made Cherner go postal, the drawing copied from Ben Feinman's blotter. He found scrap paper and a pencil, and began doodling. Oval followed oval; loop succeeded loop. The shapes overlapped at a common center, radiating from that spot.

Something tickled the back of his mind as he drank. A critical thought had just skittered across his subconscious as he sat and stupidly stared. What?

His hand stuck briefly as he lifted the soda from the table. He glanced at his prosthesis and discovered that he'd unthinkingly crushed the can, sloshing Coke all over the place in the process. The artificial limb didn't have any moisture sensors.

What was that errant thought? Ben's drawing had been half obliterated by scribbling. Obliterated? Would

striking out the sketch have placated Bob Cherner? It wasn't an experiment Doug was eager to perform, even if he were allowed back.

He waggled the dented can; it wasn't quite empty, so he took another sip. The scribblings—what might they have covered? They *might* have covered anything, dolt. Whatever was under the scribbles was covered. That was the point. Focus.

Point. Focus. Hmm. Doug did a mental rewind. Spot. His subconscious was trying to tell him something. He wiped the soda from the scrap of paper on which he'd been jotting. At the center of the drawing, in the part of the figure that Ben had most heavily obliterated, Doug made a single, central dot. A spot.

Point, spot, focus: they were *all* good words, useful words. Still, although they'd helped him find his way, he didn't think they were the key word. They weren't the word that had flitted across his mind.

That word was *radiating*.

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Chapter 6

"Whadayya call a bunch of Apple computers at the University of Hawaii?" asked the disembodied voice.

Cheryl groaned. She'd barely stepped out of the shower when the lobby annunciator warbled. The steamy mirror confirmed her worst fears: her robe was old and ratty, and the towel/turban around her sopping-wet hair was little better. In the kitchen, hopefully, battle continued with the dreaded math book. When Cheryl had peeked in before her shower, the book had been winning.

"Come on up, Doug. Apartment 411." Who else would announce himself that way? She buzzed open the lobby security door. Moments later, someone rapped on her front door. She checked the peephole: her boss. Letting him in, she warned, "One word and you're dead meat." He was dressed for, and smelled fresh from, yard work. She figured that at present she smelled better but looked worse.

"Does a *particular* word put me at risk, or any word at all?"

"Next time, call ahead, dammit."

He tried to look abashed. It came out as boyish charm, but that was close enough to mollify her. While she pondered this reaction, a trickle of water down her neck reminded her of her condition. "Can whatever brings you wait a few minutes? I'd like to dry my hair."

"Sure."

"Honey?" She raised her voice. "Come out here, please?" Boyish charm turned briefly to apprehension, then faded into feigned indifference. *Aha.* Doug was interested in her love life. Cheryl never dated anyone from the office, let alone the boss—why did his reaction please her? She wasn't accustomed to indecisiveness, and her confusion angered her. She turned that indignation outward: what business did he have appearing here unannounced and on a weekend? He'd never been here, for chrissake. She presumed he'd found her address on the Net.

Carla stepped from the kitchen. She was nine years old and tall for her age, with her father's red hair and blue eyes, and her mother's delicate features. "What is it, Aunt Cheryl?"

“Hon, this is Mr. Carey, my boss. Doug, this is Carla. I wanted you to both know the other was here while I get myself together.”

The hair dryer drowned out everything for a while: thick hair dries slowly. She worried about Carla the whole time. How was Doug around children? Part of her wondered how Doug felt about children. What was her problem?

When she turned off the dryer, there were giggles from the kitchen. Her immediate reaction was: Let the kid do her homework. A happier thought displaced the first. When had Carla last sounded so*silly?*

Cheryl loved her niece, but Carla was a daunting responsibility. It turned out that a little girl could shed a lot of tears in six months. Then again, losing your parents to a junkie gunman at the neighborhood 7-Eleven justified an ocean of tears. Cheryl's own eyes misted. God, but she missed her sister.

“Aren't you glad you did your math?” Giggle, giggle. “And why's that?” Giggle. “Because life is a word problem,” man and child recited together. Chortle, chortle.

Thanks, Doug.

Cheryl got dressed and joined them in the kitchen. “Fine,” she said. “I can't take the suspense. What*do* you call a bunch of Apple computers at the University of Hawaii?”

“MacademiaNet,” he deadpanned.

She curled her lip at the awfulness of the pun—until she noticed Carla's priceless confusion. The corners of Cheryl's lips quirked upward. She laughed, and Carla—without a clue why—laughed with her.*Thank you, Doug.*

Whatever brought Doug here, he'd done good.

* * *

After kidding around for a bit, Cheryl sent her niece to her room to finish the homework. She busied herself putting on a pot of coffee, saying nothing. This wasn't a social occasion, and it was past time for Doug to explain himself—even if he*did* have a way with Carla. She kept her back to him so he couldn't see her smiling at the memory.

With a sigh (what was on*his* mind, she wondered), Doug began. “Nice kid.”

“Uh-huh.” The coffee started, she straightened odds and ends on the counter.

Sighing again, he restarted. “I know what the ovals are. What set off Cher-ner.”

"What!?"

He dug out his pocket calendar and opened it to the overlapped ovals. “Mean anything to you?”

“Nothing. Doug, we've been through this. You said*you* knew.” She ignored the bouncing-on-the-bed noises from the other room.

He unclipped a pen and placed a single dot in the center of the ovals. “Now?”

Of course. “It's an atom.” She felt her eyes go round. “But why did Ben obliterate it? Why did it affect Cherner like that? What do atoms have to do with neural-interface research, anyway?”

“I get at most one insight a day, and that's on*good* days.” He looked at her wistfully. “I'd sorta hoped

that you'd know."

* * *

Sheila brushed past shoppers browsing at the electronics store, ignoring their complaints. She rummaged through parts bins and crowded shelves, confused by how the aisles were organized, but unable to ask questions.

With a grunt, she dumped everything at the checkout station: switches, cables, batteries, radio-controlled toys, aluminum utility boxes, relays. She dug a wad of bills, straight from the ATM, from a pocket.

She must have made the teenaged cashier nervous—he ran the merchandise past the bar-code scanners as fast as humanly possible. He looked unhappily at a prompt on his terminal. "I need your name and address, ma'am."

She stared at him, helpless, before finally shaking her head.*No.*

"It's company policy. Don't worry, ma'am, we don't give out the information."

She gaped at him, her upper lip quivering.

He tried once more. "It's so we can mail stuff. You know, like flyers for sales."

With a roar of inarticulate fury, she flung money onto the counter. He hadn't yet bagged her purchases, so—still shrieking—she swept them from the counter into a shopping bag already loaded with an assortment of household chemicals. Without waiting for change, or looking back, she stomped off.

Directions for assembling bombs from such materials were available all over the Internet.

* * *

Doug browsed Cheryl's living-room bookshelves as she readied the kid for bed. They told him only what he already knew: she was a bright woman.

The bedtime story finally ended. There were squeals as his hostess tucked in Carla. "G'night, kiddo."

"Mr. Carey is funny. Can he come back?"

The whispered answer was unintelligible, but embarrassment was writ large over Cheryl's face when she returned. "More coffee?"

"No, I'll be running along." He'd had more on his mind than atoms when he'd come over. Doug resolved to act now, even if her niece had spoken before he did. "But ... could I interest you in racquetball tomorrow?"

Cheryl rolled her eyes. "You overheard the little imp's suggestion."

"Carla's question. Not your answer. What do you say?"

"Not what*did* you say. Doug Carey, you have a touch of class."

"So about tomorrow?"

"I'll have to see if a neighbor can watch her, but yes. I'd like that. I'll call you."

He was halfway home before it occurred to him to wonder whether Cheryl thought tomorrow was two friends getting together or a date.

* * *

Doug sat bolt upright in bed, a matter of enormous magnitude having finally penetrated his awareness. First, he'd been too busy being disgusted with himself for lusting after Cheryl. After that, he'd obsessed on the new-found meaning of the sketch. And then, maybe, he'd asked out Cheryl.

For all of his obvious attraction to Cheryl, Doug had not thought guiltily about Holly even once today.

He wasn't sure if he felt guilty about not feeling guilty.

* * *

Doug hunched over, waiting for the pseudoball. His first surprise came when Cheryl won the pregame volley for serve. Another surprise followed on its heels.

“Let ‘er rip.”

She'd not only been practicing, she'd personalized her game prompts. The serve flashed through a green region and doubled its speed. He pivoted to his left to return it with a backhanded stroke. Passing center court, the ball kissed purple and went hypersonic.

With a grin she slammed the red missile right back at him. He got the racquet up to his face just barely in time to protect himself.*Idiot* , the ball's not physical. It can't hurt you. The badly timed ricochet from his racquet was a pathetic lob she smashed back at him through purple again. He didn't even try to touch the resulting blur.

“Now why did you call out a novice's handicap for me?”

He saluted with his racquet. “I'm suitably chastised. Who've you been playing with?”

“Never mind. Just keep your wits about you.” She served under cover of her answer. As the pseudoball zipped through a brown drop-dead zone, she called, “Reset handicap to level three.”

Doug dived for the plummeting orb, reaching it just in time to give it a flip. With anyone else, the maneuver would have been suicidal, but it sailed over Cheryl's, petite Cheryl's, lovely head. “Hah.”

His game came back into balance as he claimed the serve. Two points later, he was over the shock of her unexpected skill at the game. “Wow, I thought someone had sent in a ringer.” Squinting at her in shorts and tee-shirt, he added, “Although I can't imagine where she'd hide.” She repaid the crack with a floor-skimming return that cost him a volley and the serve.

Somewhere around a score of eight-six, he achieved that rare state of automatic play that made the game so rewarding. Step, step, stroke. Ball shooting like lightning across the court, then as quickly coming back. Step, step, stroke, and back it goes again. Stroke, stroke, stroke. He wasn't really there, nor was she. Some part of his mind knew where the ball was, and the walls, and the drifting color zones that changed the motion of the ball.

While reflexes maintained volley after long volley, his thoughts entered a free-floating state not unlike a good lawn mowing. Racquetball with Cheryl—it was a simple thing, really. He couldn't remember when he'd last had such a good time. Stroke, step, step, step, stroke. Amazing how her game had improved since the one time they'd played. His arm was cooperating too. Step, backhand slam. Nothing like having your arm go haywire to impress a woman.

He stumbled as the memory struck home. That damned Class of ‘05 virus had done a number on his arm all right—luckily he'd only had to go back a week for an uninfected backup. His next stroke came an instant too late, with a weak grip, and Cheryl clobbered the ball.

As she caught her breath before serving, Doug tried to push everything out of his mind. Something was teasing his memory, something that he sensed was vital: a mood like just before he recognized the cartoon atom. He forced in and out a few deep breaths of his own. He lost the next volley, but regained the trance state.

Step, step, stroke. Dash to the rear court for her return. Step, step, smash. Shuffle forward. Balance on the balls of the feet. Step, turn, backhand. He continued on autopilot as images crowded his mind. The Pac-man-like Class of '05 virus. Neural-interface circuits. Atoms, spinning atoms, galaxies of atoms. Nerve impulses, in his brain, traveling across his spinal chord and down his arm. Pac-man chomping up screenfuls of information, computerfuls of data. Stop signs and traffic lights.

Step, step, stroke. Sensors in his arm transforming electrochemical impulses into electrical signals the prosthesis could manipulate. Pac-man racing down his arm. Step, pivot, stroke. Neural nets in the prosthesis learning to recognize, in hours of biofeedback sessions, which transformed nerve impulses meant*bend my wrist* and*open my hand* and*wiggle my fingers.* Pac-man reversing: racing up his arm, up his spinal chord—

With a holler, Doug tossed his racket into the air. The ball shot past him as the racquet turned end over end. He caught the handle, as it fell back to earth, with what he felt to be great panache.

"Why did you do*that?* It was the best volley we've had all day!"

"Sorry," he shrugged. "But if you can spare a few minutes from the game, I think I know what's been happening to everyone."

* * *

Doug and Cheryl had been playing racquetball at BSC where the VR court time was free. Now they retreated to his office. Behind the closed door, the smell of sweaty clothes and sweating bodies should have been overpowering. They didn't notice.

"Are we at risk?" She lowered herself gingerly onto a chair. Without a hot shower, her muscles were already seizing up.

"You, no. Me, possibly—but I doubt it."

"What's happening?"

"It's a virus."

She leaned forward, glowering. "Ben Feinman was a friend, a*good* friend. I find that in very poor taste."

"No, a*computer* virus." He retrieved a schematic drawing from his desk. "My arm. Remember how our Class of '05 friends made my arm lock up?" At her nod, he continued. "Think about a virus attacking through a neural-interface helmet."

"Oh ... my ... God." She shuddered. "Can that happen?"

"When the Class of '05 virus hit, I got some weird sensations through the prosthesis before it froze. I was so mad, and it was such a crunch finishing the proposal on time, that I put it out of my mind."

He unrolled the schematic. "You know there's a neural network between the main microprocessor and the nerve sensors. Why? Because the routine metabolizing in every cell in my body constantly generates electrochemical noise. The neural net is always learning how better to dredge useful signals out of that din. OK?"

She nodded.

“I tend not to think of it this way, but what trains the arm also works on other neural nets.” He tapped his upper arm, his neck, and, most emphatically, his forehead. “Biological neural nets. Neuron nets. My nervous system. Even as I learn to operate the arm, it learns how best to signal skin pressures and joint positions back to me. What I so casually call ‘training the arm’ is nothing so simple. The arm and I are symbiotic. Every time I think I've achieved better performance, what's*really* happened is that each side of the partnership has learned to better communicate with the other.”

Cheryl rested her chin on her hand in thought. She knew, even better than he, how a state-of-the-art neural-interface helmet was built. She had codeveloped the helmet that might have killed Ben Feinman. Now she wrestled with Doug's theory, leveraging her knowledge of the helmet. She looked for a flaw and found none.

“I'm not using the arm or a helmet, so I'm safe. You're using only the prosthesis, and the nerve branch up your arm seems far too narrow a comms channel to pass a threat. But a helmet wearer...”

Ben, like Doug, had started out with biofeedback training. How many times had she seen him with electrodes taped to his head, wires snaking to an oscilloscope. Day after day of learning to concentrate his thoughts until he could steer the glowing phosphorescent dot wherever he chose on the screen. Hell, everyone at the office had tried it. A chill ran down her spine as she realized what might have happened had not Ben been the quicker study.

In her too vivid imagination, her old boss, her friend, sat, his eyes closed, wearing his helmet. Signals from the computer passed through a neural net to Ben; his thoughts, his reactions, returned through the neural net to complete the experiment. If nothing came across—as had, at first, so often been the case—Ben would groan or mutter or curse, then open his eyes to see on-screen what he should have received. Then he'd keyboard what small impression, if any, he'd gotten through the helmet.

Other times it would be Ben's job to send. That, too, hadn't worked at first. Again Ben would chastise the machine, then type directly what he'd attempted to mentally transmit via the interface helmet.

How many sessions had she monitored? How many experimental runs had it taken before Ben and the supervisory program in the lab's big server had really communicated? Months, she knew. She wasn't sure exactly how many, because Ben had gotten secretive towards the end. Moody. Something had been on his mind. Christ,*in* his mind.

“Are you OK?”

She waved him to silence. Training—first Ben and then Doug had talked about training. That wasn't right, not really. Neural nets weren't smart, couldn't think, couldn't be taught. It was whimsical to talk about them learning. No, a neural net was only electronic circuits modeled after bunches of neurons, just another way to process inputs into outputs.

What a neural net*did* do was adapt. Optimize. Mindlessly it moved away from any output state that feedback rated as bad for its current inputs. Mindlessly it adjusted towards a state that feedback rated as better. Being electronic, a neural net adapted*fast*.

Ben's corrections via the keyboard: that was feedback to drive the optimization. Later, the neural net in the helmet had adapted directly to the perceived success or failure of a signal to pass through it, in either direction. Doug's arm was like that, she remembered—it distinguished smooth from jerky motions and it automatically reinforced whatever worked.

By the time of his death, Ben had stopped using a keyboard. His helmet, like Doug's arm, had achieved self-adaptation.

Her mind's eye panned back to encompass first two spectral computers, then three, then many. Lightning bolts connected the machines, stylized communications links. One of the computers, she saw, harbored a nasty, slithering object—the visualization of a virus. The creature crawled through the network of her imagination. It was mindless and fast. She wanted to cry out as it moved ever closer, but she couldn't. Finally, the virus was*here* , and it butted up against the neural interface itself.

When Doug called to her, she didn't hear him. She was lost in a nightmare of her own making. As if it had found another comm line to transit, another computer to infect, the virus kept butting against the neural interface. Unlike any other barrier it had ever encountered, however, this barrier adapted. This barrier trained. This barrier learned with lightning speed how best to modify itself so that signals on one side would pass with absolute fidelity to the computer on the other side. This barrier*helped*.

When, in her mind's eye, the virus slithered across the oh-so-cooperative barrier into one more computer and began its attack, she screamed.

For the latest computer to be invaded by the virus was Ben Feinman's brain.

* * *

The small office became confining, claustrophobic. Doug and Cheryl separated briefly to shower, then went out for a walk. The sky had clouded up while they'd been inside; they had the bike paths under the trees mostly to themselves. Good—this conversation was not something they wanted overheard.

Seeing her shiver, he put an arm around her shoulder. She tensed briefly, then relaxed. He didn't know whether she'd reacted to his gesture, the feel of synthetic skin, or the memories his prosthesis must now awaken. He didn't think he wanted to know. Her arm trembled beneath his hand. He knew that she'd helped develop Ben's helmet. Did she blame herself? He knew that*he* would.

“Doug?”

“Hmm?”

“Why the atom? What does that mean?”

Some bicyclists spun around a blind curve, sending them scurrying aside, giving him a moment to pick his words. “Ben scribbled over his drawing, wiped part of it out.”

“*No* atom, then. I still don't get it.”

Doug thought about poor Fran Feinman, about what they could tell her. He thought about the final torrent of confusion that must have run in insane fury through Ben Feinman's brain as the invader did its work. Its damage. Its killing.

“We saw an atom, we just didn't recognize it as one. What Ben obliterated was the nucleus.”

Cheryl shuddered. She saw it too, now. She knew well which virus had been the most resistant to eradication, most ruthlessly destructive, had time and again reduced their computers to ravaged repositories of a single phrase repeated over and over. The same phrase that, she realized, must echo endlessly in what little mind remained to Bob Cherner. In tones of weary wonder, she recited it.

“Stop nuclear now.”

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Chapter 7

The doors of the Inter-Agency Computer Network Security Forum were locked; an armed guard answered Doug's knock. The engineer took the implied seriousness as a promising sign. Vague hints about insight into a major virus outbreak got Doug and Cheryl into the office of a forum official named Glenn Adams.

Adams was in his early fifties, with pale blue eyes, a broad forehead, and brush-cut gray hair. Half of the people they had passed in the hall on the way to his office were in jeans and tee-shirts: programmers. Adams, in a business suit and tie, was representative of the other half. From Adams' stiff posture as he sat, Doug guessed ex-military. A photo on the office wall showed the guess was correct.

There was no good way to begin. "I've got a strange tale to tell. I hope you'll hear me out before passing judgment. Keep in mind that between us, Cheryl and I have four computer-science degrees and twenty-plus years in the industry. We've both published extensively in our field, which is neural interfacing."

Adams accepted the list of publications Doug offered. "OK."

"You're familiar with the 'no-nukes' virus?"

Adams rubbed his nose thoughtfully. "An outbreak a couple of months ago. Wiped out hard drives with an antinuclear power slogan."

Cheryl nodded. "That's the one."

"Law enforcement aside, it's already off our scopes. The antivirus product companies got the template for 'no-nukes' into their definition files right away, though it's hard to get rid of once your network is infected. Pretty typical bug, really."

Here goes, thought Doug. "What we've learned about no-nukes is *far* from typical." He spoke for ten minutes to the ever more skeptical-looking official.

When Doug stopped, Adams asked, "Is this right? You claim the 'no-nukes' virus attacks people through neural-interface helmets, that it scrambles not only computers but also brains." He got a nod. "The attack mode, overwriting memory, can leave human victims dead or insane. Brains aren't wired exactly alike, because of genetics and differences in what and how people learn. That makes what gets overwritten the luck of the draw. It sounds like the helmet design and the learning previously done by its neural network can also influence the nature of the attack."

Cheryl leaned forward. "These aren't *claims* ; we're telling you what's happening. The forum must issue an advisory to warn people. We've got to stop this line of research, at least until we can *totally* eradicate the virus."

"It's a little soon to tell anyone anything."

"Look, dammit, it's happening." Doug grimaced. "As we speak. People are dying, and worse. Did you hear what I said about Bob Cherner? Far from too soon, it's already too late for him."

"This is *so* speculative. Can you explain how this could possibly work?"

Doug stood and stared. “Look, Feinman's and Cherner's attackers were obviously ‘no nukes.’ I admit: I don't know exactly how the attack gets through the helmet—I came here thinking the forum would *want* to try figuring it out. Perhaps you forum sloths could get off your spreading obscurocratic asses and look into it?”

“Sit down and calm down,” said Adams. Cheryl, he noted, shot her companion a scathing look that meant the same thing.

Doug ignored them both. “What will it take to convince you?”

“You say Cherner and Feinman were attacked at home. And what about, um...” Adams checked his notes, “Yamaguchi? She had a car accident. Surely you don't claim that she was wearing a neural-interface helmet while she drove. Of all of your cases, only Friedman fell ill in her office.”

“Was killed,” Doug corrected. “Home or office doesn't matter. The victim networks into a bigger computer than the one at her desk. What does the virus care about wire length?” He felt a blood vessel pulsing in his neck. “Ben Feinman told his wife he'd brought work home. Perfectly normal to access the office computers from home. Or...” a light bulb of enlightenment went off over his head, “he could've been computer gaming. That'd explain why no one from his office ever asked Fran for whatever he'd been doing. He was playing hooky from a Saturday matinee with the kids.”

“You don't know that Cherner had a helmet at his apartment. And you haven't explained Yamaguchi in her car.”

“Think, man. If the onslaught doesn't kill them outright, these people have voices inside their heads. Voices that don't stop, don't sleep, don't go away. Their brains are fried. As the virus keeps attacking, keeps writing, it only gets worse.

“Maybe the victims can't speak anymore. The helmet's whole purpose is to interface the cerebrum, the seat of consciousness and rational thought, to the computer. The cerebrum is probably the first thing attacked.

“I imagine that they can't think straight, can't reason, can't call for help, can't form a plan beyond *make it stop* . So—if a victim isn't killed outright—he takes off his helmet, or knocks it off, or stumbles and it falls off. He flees like a wounded animal, seeking refuge that doesn't exist, because the enemy is within.

“I imagine Cherner and Yamaguchi both made a dash for the psychological security of home. Yamaguchi didn't make it; when the pain got too much, or too little of her brain was left, she ended it in the only way left: at a lamppost. Cherner was tougher. He made it home, but that changed nothing. The invader was still there, its voice getting louder and louder. By then, he couldn't think straight enough to end it all, so he tried to rip the thing out. Through his own face, he tried to rip it out.”

Doug scowled at Adams. “Instances of that virus are still out there. The bastard who wrote that virus is still out there. And the world is full of sick copycats who adopt and evolve successful viruses.

“What are you going to do about it?”

“Well, I have your statement. If you leave your business cards, I'll know how to get back in touch.”

“That's it?” Doug's soft words carried venom. “You're sentencing people to pure hell. A statement from me to the *Washington Post* and a posting of my findings to the Net won't have the credibility of a pronouncement from the forum, but maybe they'll save someone. We'll goddamn well see.” He stood. “Come on, Cheryl. I imagine Glenn has coffee to drink and forms to file in triplicate.”

The bureaucrat winced. Before he could get out a retort, Cheryl jumped in. “Sit, Doug. This is no time for macho nonsense.” She took two pieces of paper from her purse and handed one to each man. “This is a SIGNIT mailing list: Special Interest Group in Neural Interfacing Technology. Not many names, and I've marked the people we think were affected.”

Adams scanned his sheet. “Is this enough data to be statistically significant?”

Did the casualties have to reach statistical significance? Remembering Cheryl's admonition, Doug willed himself to be calm. “You're obviously ex-military. Have any contacts in a three-letter agency?”

To most of the country, that question might have suggested the Environmental Protection Agency. Inside the Washington Beltway, it meant intelligence agencies, the CIA and its ilk. “Sure.”

“Ask about black work done by Sheila Brunner and Tom Zimmerman.” Black work was highly classified, to the point that its existence was generally denied.

“Agency folk aren't famed for their senses of humor. You sure you want this?” Doug and Cheryl both nodded.

“Wait here.” Adams stood. “I'll go make some calls.”

* * *

Doug turned to Cheryl. “Is it me, or is our host stalling?” Adams had just been paged from the lobby.

“What do you expect? That was quite a dare you made. And who are Sheila Brunner and Tom Zimmerman, anyway? What do you know about them?”

“I'd like to hear that too, Mr. Carey. Behind closed doors would be prudent.”

Adams had reappeared; with him were two serious-looking men. One was short and barrel-chested, with Mediterranean coloring. The other was taller, wiry, and fair. Both men's suit coats bulged under their left arms. The taller one seemed to be waiting for an answer.

Doug directed his response to Adams. “Your friends have names, Glenn?”

“Ted Benson, and this is Alexandros Kessaris.” Badges flashed. “FBI.”

Adams’ office didn't accommodate five very well, either spacewise or for air conditioning, but Doug didn't care. The agents’ swift appearance suggested that his wager had paid off. “Did Glenn mention anything beside the names I dropped?” Kessaris shrugged; Benson did nothing.

“Good. I'll tell you about Brunner and Zimmerman, something I should have no way of knowing. Then, maybe, the government will *do* something.”

Benson gestured for him to continue.

“I don't know Brunner or Zimmerman personally. I've seen their names repeatedly on conference attendance summaries. They're on the newest SIGNIT membership roll. Neither ever presents a paper or participates in an expert's panel. In five years, neither has submitted a paper to any neural-interfaces journal.

“The NIT community is too small to hover on the edges, never contributing, without being noticed. I bet that means they're working on something black.” He caught Benson's eye. “How'm I doing?” The agent looked back dispassionately.

“Have it your way. Your rapid response to Glenn's call tells me one thing. Something unpleasant and unexpected happened to one or both of them. Glenn may not like it, but I've got an explanation for disasters befalling people in this field.”

Benson shrugged. “Hand-waving. Doom and gloom. Do you write for a checkout-counter news rag?”

“You want specifics?” Doug was maddened by their stonewalling. “Fine. An unexpected stroke, perhaps, or a heart attack.” He looked for a reaction. No? “How about sudden mental illness? Strange behavior, probably nonverbal.”

Watchful eyes narrowed, concession enough. “OK, that's it: sudden mental illness. Look, you must've checked clearances on us after Glenn's call. We've both done intel work; we've both held tickets.” In the intelligence community, tickets denoted access to top-secret, compartmentalized material. You didn't get a ticket without an exhaustive, fifteen-year background check and a polygraph interview. “It's been a while since we've used ‘em, but peace*did* break out all over. How about you cough up a little information?”

The agents considered. “They were working on neural interfaces for possible mind-controlled weapon systems,” Benson finally offered. “Separate projects, both starting to show real progress. *Very* hush-hush.

“A few weeks ago, Zimmerman tried torching a nuclear power station. We don't know why. The plant survived, but Zimmerman went up like a roman candle. It took some arm-twisting, but we got the story reported as an escaped mental patient.”

Doug remembered the news coverage. Someone on a publicity tour of the nuke plant had stuffed his pockets with sealed, gasoline-filled plastic bags. And he had a butane lighter. Doug's stomach lurched; he changed the subject. “And Brunner?”

Benson looked grim. “Brunner walked out of her office, ignoring all questions. People said she looked strange. Distracted.

“She never returned, and we can't find her.”

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Chapter 8

“So that's it?” asked Jim. He was changing into customer-schmoozing garb as he spoke. “We're from the government; we're here to help. That's*it?"*

Doug fidgeted with a pencil from Jim's desk. “Maybe. Mostly. Some positive steps.” The forum had the connections to do things Doug couldn't pull off on his own. The first was an immediate cessation of helmet use. Most neural-interface research was federally bankrolled, like Doug's own NSF grants. Government sponsors had speedily endorsed the forum's recommendation that experimentation halt. Companies got the message that any continuation with private resources would doom any future funding or contracts. The projects on indefinite hold included Doug's own prosthetics effort; he'd had to scurry to reassign all of his staff to other parts of BSC.

Doug's and Cheryl's own queries of SIGNIT members had encountered mostly disingenuousness and dissembling—NIT research could lead to a paradigm shift in computing and many billions in profits. FBI agents got answers where Doug and Cheryl encountered evasion. The toll was even higher than the

engineers had feared: fourteen dead, eight driven incommunicative and insane—and one, Sheila Brunner, still unaccounted for.

Jim tucked in his dress shirt. “And if she decides to go after a nuclear plant?”

“There are no guarantees, but the FBI thinks that's covered. Her picture has been sent to every power plant and nuclear-defense facility in the country. If she tries a Zimmerman, she'll be recognized. Best guess is she's dead or amnesiac or otherwise incapacitated.

The restaurateur took a tie from the rack behind the door. “I don't like it.” My friend, you are*way* too trusting. “This woman did intel stuff?”

“Highly classified stuff, yes.”

Jim frowned at the knot he'd left in the tie: lopsided. “Aren't you fingerprinted in the clearance process? If she were dead or incapacitated, wouldn't she have been identified by her prints?” The engineer stiffened in his chair. Hadn't thought of that, had you? “It seems to me Sheila is still functional enough to be hiding.

“Now what do you suppose she has planned?”

* * *

Doug sat in his house, pensive after lunch at Jim's. Perhaps his old friend had a point: a paranoid could have enemies. Too bad he couldn't be diverted by the newfound novelty of Cheryl's pleasant company. She planned to work all weekend, getting up to speed on the non-NIT project to which she'd been lent: “I can't be slacking off if I'm going to date a big-boss type.”

What if Sheila Brunner*was* hiding? That would be scary, FBI assurances notwithstanding. Despite no-nukes brain damage, Zimmerman had functioned well enough to come up with an attack plan. He'd acted normal enough for admittance to the public tour of a nuclear plant. Mental hijacking did not preclude another assault from being as—or more—ingenious.

And were the FBI alerts distributed widely enough? He recalled Bob Cher-ner's hysteria at the sketch of an atom: would any reference to the word nuclear set Sheila off? Say, a hospital with a nuclear medicine department? A class on nuclear physics?

Whatever she was going to do ... why hadn't she*done* it already? The other unfortunates had all died or been stricken weeks ago.

He stiffened. Damn, but assumptions are dangerous things.

The FBI guys had given Doug their cell-phone numbers. “Ted, when did our missing friend*go* missing?”

“Eight days ago. Why?”

“Probably nothing. Let me think something through, and I'll get back to you.”

*Did*it mean anything? Many people were careless about computer hygiene. It would be simple to believe that Sheila Brunner was the victim of sloppiness in updating antivirus definitions as much as of no-nukes. Too bad Cheryl wasn't here to talk this through with.

Eight days ago. He walked over to his home PC. What viruses were most prevalent eight days ago? Lots of web sites published such data, including the forum's.

His memory was correct: the biggest was Frankenfools, a rant against biotech—and a simple hack of

no-nukes.

With a shiver of premonition, he did a “people search” on Sheila Brunner. She lived about ten miles away. No longer, of course—the FBI would surely have her place under surveillance—but if she lived nearby, she presumably worked nearby, and she had disappeared from her office. Chances are she was still somewhere in this area.

The largest biotech company in this county was BioSciCorp.

* * *

“Beep beep beep.”

Doug cursed at the fast-busy tone he was hearing. He'd known BSC's phone system was getting an upgrade this weekend, but not how long that would take. He tried Cheryl's cell phone but only got her voicemail. The cell phone was probably in her purse in her office, while she was off in a lab. He shot a message to her office email address, not that he could count on her to read it.

From his car, Doug called back Ted Benson, and got voicemail this time. He took the option to be rung through to a Bureau operator. “Track him down!” Doug demanded. He left his cell phone number as, horn blaring, he ran a red light.

He careened into the BSC parking lot. The high-speed impact with a speed bump jarred his arms. A microprocessor misunderstood the twitch; his prosthesis decided on its own to jerk the steering wheel violently to the right. As the car spun, tires squealing, he saw first scattered lights on in the office building and second, a trenchcoated woman getting out of a sport utility vehicle. His car skidded sideways into a parked minivan.

His last thought as he blacked out was that one of the lit offices was Cheryl's.

* * *

Sheila turned in confusion at the unexpected noises. She didn't hear well these days. Had she ever? There was a car in the lot she didn't remember, crumpled against a van. That explained the noises.

“Do not alter the human genome,” thundered the voice in her head. “Death to Frankenfools.” It was hard to think with that constant shouting. Did the newly arrived car matter? “Death to Frankenfools.”

She lost interest in the smashed car, the bidding of her voice ever insistent. A bulky object in her coat pocket banged against her side. The parking lot was almost empty; her sport ute was parked close to the Frankenfool building. Soon, she thought at her voice. It continued its oration, unimpressed.

Sirens sounded in the distance. Were they approaching? Feet pounded in the lot, weekend guards running to inspect the accident. “The human form is not to be tampered with. This folly must stop.” She could recite the litany verbatim, if only to her mind's ear. The sirens were getting closer. She hastened to the far end of the parking lot, reaching for the box in her pocket as she walked.

* * *

Doug woke into a familiar nightmare, although the side-impact airbag had taken the worst of the crash. His car door would not open. A turn signal was ticking.

“Sir, are you all right?” It was a building guard. “Don't move. I've called an ambulance.”

He shrugged off his seat belt and slid to the passenger side. The driver's door was crunched shut against the minivan. “Move aside!”

The trenchcoated woman was lurching away. Her coat was filthy, her hair matted. A homeless person, fleeing attention? Or a brilliant scientist driven insane by voices inside her head? The sport ute argued for the latter. As he stumbled after her, she emitted an inarticulate cry, wrestling with something tangled in her pocket.

A guard recognized him. “Mr. Carey, sir. You shouldn't move.”

“Sheila!” he called, ignoring the advise. “Shei ... la!”

The woman turned, wild-eyed. She tugged frantically at something in her pocket. Fabric tore; a metallic box came loose. A whiplike appendage of the box snagged in the pocket lining; she ripped the—antenna?—free and it twanged straight. The box had a large button in its center. Twitching, muttering, she aimed it at the row of parked vehicles nearest the BSC building.

A radio remote control?

“Bomb!” he called over his shoulder. He was*so* close. The sirens were almost here. “Sheila, wait! This isn't*your* plan; it's a computer virus.” She paused in confusion, gurgling something interrogatory but unintelligible. “Remember your research.” He leapt midsentence—not at her, but at the end of the aerial. His prosthesis closed around the tip of the antenna.*Stay* closed, he ordered the artificial limb. His grip was solid; a hard tug pulled the box from her hands as he belly-flopped into the asphalt.

County police cruisers and an ambulance fishtailed into the lot. Each of the BSC guards held Sheila Brunner, barely, by an arm. A paramedic helped Doug to his feet; a county cop gingerly took the remote control from him. Doug's head was ringing.

In his peripheral vision, someone rushed from the BSC lobby. He turned: it was Cheryl. Investigating the sirens, perhaps. Her eyes were wide, taking in his battered appearance. She slipped an arm around his waist, supporting him as he slumped against her. “We need to get you to the hospital.”

A cop in his cruiser called for a bomb unit. More sirens were converging. Sheila Brunner sagged as a paramedic administered a sedative.

Cheryl was safe. Sheila just possibly had been given a second chance. He looked at his wrecked car and smiled in satisfaction.

* * *

The Sun was not shining. Birds weren't chirping. Only the painkillers kept Doug from aching head to toe.

Life was good.

He sipped from a mug of soup. “This hits the spot.”

“I'm glad.” Cheryl sat to his left, holding his good hand. “I am*so* glad.” She wasn't talking about his opinion of her soup.

“What did you tell Carla about this? I don't want her to worry about me.”

“Just the car accident part, and that you'll be OK.” Silence stretched awkwardly as he finished the soup and set down the mug. “Doug?”

“What, dear?” Two simple words, but they felt great.

“You can do something else. I can do something else. I just*hate* that the field will go under—it had such

potential. We'll never be rid of all viruses. Why would *anyone* risk using a neural interface ever again?"

He bent his right elbow, raising the prosthesis. The wrist swiveled and flexed; the fingers curled one at a time into a fist and then individually back open again. "Because, with suitable precautions, it's the right thing to do. We don't let viruses, and the fools that write them, prevent us from using computers. We *won't* let them keep us from other progress. You wondered what our department's next project would be, since prosthetics are on hold ... I think we've found it: defenses we *can* trust."

He smiled at Cheryl and gave her hand a squeeze. "Some things you just work at until you get them right."

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Powered by Water by Mia Molvray

A complex civilization rests on a complex infrastructure, and the most important parts of the foundation are not necessarily what you'd think....

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A tall, thin, youngish man wearing an absent expression emerged out of the maze of expensive machines filling most of the lab. He had spent the last half-hour vainly trying to remember what it was he had told himself not to forget, but his mind had dissolved in trivia. It had not offered a single useful suggestion—or even any useless ones. It just lay there. He had come in search of caffeine like a rising diver looking for air.

The pot was there, the water was there, the white powder pretending to be cream was there, but the can had neither beans nor grounds nor dust in it. Someone had shaken out the very dregs and had not provided a fresh supply, in crass contravention of the law of the lab and human rights.

Norman Rathbone stared at the machine, cursing intensely but quietly. In any sane legal system, murdering the irresponsible party would be considered justifiable homicide, but, knowing his boss, the man would object because terminating the staff was his sole prerogative.

Then Norman brightened. All was not lost. He headed to the Coke machine. Lesser minds than his, however, had beaten him to it, as had happened so often before in his brilliant but impractical life. There were cans aplenty of sweet and fizzy stuff flavored with lemon or cola or cream, but not a single can of anything promising consciousness. Norman was faced with the prospect of managing Dr. Kriegel's lab—of tracing gel runs, troubleshooting data analysis, discussing undergraduate term papers, and making polite phone calls about missing crosslinkers—while powered by nothing but water.

His feeling that things could not get any worse was soon proved false when he arrived back at his desk to the sound of his phone ringing.

It was Gerry Kriegel himself, apparently in urgent need of a conference with his right-hand man. "Where were you?" he demanded, but gave Norman no time to explain by immediately continuing, "Need to see

you.” He hung up.

It pained Norman to work for this man, but what else could he do? All the big labs, the ones that might help him launch his own career, were run by grand old men who hadn't done anything but raise funds for years. With the funds, they hired people like him who delivered impressive, creative results by focusing like a laser on a single problem for days on end. However, the job of managing a lab used none of those talents and consisted instead of interruptions interrupted by interruptions, like this one, for instance. He ran his hands through his floppy, straight black hair in a frazzled gesture that made loose locks fall on his forehead and gave him a perpetually uncombed look. He threaded his way out of the machines and stuck his head into the boss's office.

“Hi, Gerry,” he said. He was always a serious young man, but now he was downright somber from overload with frustration. “What can I do for you?”

The boss waved him in with barely a glance, as if he were a steerable fly. Unlike a fly, though, which carries on being a fly under all circumstances, Norman had to work at keeping a frown off his face. He worked ten-hour days as it was. He needed less work, not more.

Norman surveyed the coffee cups, latté cups, and espresso cups littering the office and felt quite certain that he had found the culprit of the coffee can. Kriegel's boiled-looking eyes and gray skin suggested that pickling himself in coffee was not helping, but this was only a small consolation.

The boss lifted a few forms from the top of a drift of papers covering his desk and much of his computer.

“Caffeine,” he said shortly, waving the sheets.

Norman stiffened. Invisibly, he hoped, as the first fright receded. Had he been found out?

“Caffeine's not working. Find out why.” He shoved the sheets at Norman. “Could be a Nobel in it for this lab,” he added, using an almost complete sentence in honor of the idea, despite the effort it cost him.

Gingerly, Norman took the papers. He pretended to study them to give himself time to frame a response. Fear flipped into hysterical humor as he almost chuckled at the irony of imagining Kriegel's lab covered in glory for finding the cure—until the media found out it had also created the original problem. In his mind's eye, Kriegel sputtered protestations about how he was shocked—shocked!—that anyone could think he would do such a thing for profit. But back to the problem at hand, and an appropriately tentative demeanor.

“That would explain a few things,” Norman finally said. “What led you to that hypothesis?”

“Tested my pulse, skin conductivity. No changes, even after a double espresso. Sent the damn stuff off to a chemistry lab and it's full of caffeine. So something's happened.” Even in his exhausted state, Kriegel looked rather smug at being the brains of the outfit who had figured this out.

The meaning of the papers he was holding finally penetrated to Norman's brain. There was a budget line for this new project, a technician, and information about funding for which he was to apply. But nowhere did it tell him how to find the time to plan and execute completely new work, supervise yet another technician, and write yet another detailed, ten-page grant application. Before he could formulate a polite way to ask, Kriegel carried on.

“Oh, yeah. Another thing. Glass breakage,” he said shortly, picking up an invoice. “Costs money. Rudi, right? Dock her pay.”

Gertrude Frobisher was an older woman with grown children who was starting over in life. Norman

couldn't begin to fathom why she would want to start over as a lab tech, but there it was.

“Actually,” said Norman, “she's responsible for one three-dollar beaker in the last six months, which, considering she does most of the dishes, is well below average. She really has an excellent aptitude for lab work. The distilling column, the sequencer capillary array, and the cloning shaker vessel were all Dwayne, I'm afraid.” That was thousands of dollars worth of precision-made glass equipment, which Gerry Kriegel's own undergraduate student had calmly broken.

“Ah,” said the boss. Having an undergraduate in the lab was good for Kriegel, since it showed he cared about education. He pondered the relative merits of brownie points versus money.

Dwayne Plotkin's ID said he was twenty-one, but Norman had known less carefree toddlers. Judging by course work, Dwayne was brilliant. He wore exercise tights and layered, ragged T-shirts and was the goofiest young man in three counties as far as Norman was concerned. Norman was the one who actually supervised him, since the boss had real work to do.

After some thought, Kriegel added, “Then it's an educational expense. Tell June to put it on the right account. That doesn't come out of my grants.”

That solved the matter for Gerry Kriegel. Norman was about to ask whether there was anything else when the PA system crackled. June's pleasant phone voice came over the air,

“Paging Dr. Rathbone. You have a delivery at the office. Dr. Rathbone, to the office, please.”

It is, thought Norman, continually something.

* * *

He picked up the package, unpacked the power supply, fitted it into the dead gel rig, and connected it. One of the new postdocs needed help with a lab procedure. Someone else couldn't figure out why his DNA amplification had not worked. Troubleshooting the amplification uncovered a problem with primers that needed to be reordered. And so it went, hour after hour, interrupted further by a dreadful, ostensibly voluntary seminar where time stopped completely, together with all his remaining higher brain functions. Lunch never happened. June, the secretary, left at the stroke of five, as always.

It was shortly thereafter that he heard Rudi in the lab across the hall heatedly exclaiming,*"Dwayne!"* That reminded him he still needed to buttonhole the kid to discuss his term paper.

He hurried over to the room, listening to Rudi's voice climbing into ever higher registers, which even opera singers might have envied had any been around.

“What the*hell* do you think you're doing? Do you have any idea of the effort, the expense, the*time* —”

Norman was nearly running by the time he skidded to a stop inside the lab.*Now what?* he was thinking. But he thought it in the comparatively detached way of a lab manager expecting to find acid corroding the fifty-thousand-dollar centrifuge for which he would not be paying.

It was much worse than that.

Hundreds of tiny plastic vials of samples lay quietly thawing on the lab table nearest the ultracold freezer. Dwayne still had his head in there, rooting around, making a mess, looking for something, while his muffled mumble insisted, “Well, I've gotta find it, haven't I? I mean, Gerry wants it, so I've gotta find it, right? It's in here somewhere, so don't worry, I'll find it in a minute.” Meanwhile the freezer's temperature was rising from -80_C to -75, -70, -65. The alarm, which was so loud you felt it rather than heard it, would go off any minute.

“CLOSE THE DAMN DOOR,” bellowed Norman.

Dwayne's head finally appeared, with a look of bored superiority. You guys, his eyebrows said, need to get a life. Norman pushed the door closed the moment he could do it without killing the kid.

“Get Ziplocs,” he ordered Rudi. “We'll get the sample tubes in bags for now and get them back in the freezer. Sort them out later. Hopefully there aren't any competent cells—” and that was when he saw it, as his eyes raked over the hundreds of little vials scattered by Dwayne like a dog digging for a bone. The three vials labeled “caf” followed by numbers. He remembered what it was he'd forgotten. He'd forgotten to relabel those vials to something cryptic. They had the crucial bits of DNA he was going to need when it was time to make an antidote. He'd had, from the outset, every intention of making an antidote.

He tried not to look at the three vials. He tried not to look at Rudi to see if she'd noticed them. She would probably make the connection in a heartbeat and then she had the know-how to track it down and prove it. After all, even Kriegel had noticed that caffeine in larger and larger doses was having less and less effect. But engineering an anticaffeine gene was easy. Norman's genius lay in coming up with the perfect vector to carry the gene into everyone's cells: a modified cold virus that was entirely symptomless and perfectly catching. He had made himself immune, so everybody else slowed down while he did not. Now he usually headed home by six or seven instead of midnight, but he wanted to hold off on the antidote until he could go home at five. He wanted a life as well as a job.

He busied himself sorting the vials into groups as Rudi ran up with the bags. The “caf” vials were on her side of the table—if only there were some way to palm them before—

“Hey, what are these?” Rudi said, as she slid them toward a bag. “C.A.F? We don't have anyone whose initials are C.A.F., do we?”

“Just keep scooping,” muttered Norman. “We'll sort them out later.” He just hoped he'd be able to find the three little vials in the mess before anyone else did.

* * *

As time ticked by, the lab techs left and Dr. Kriegel himself had long since powered off to an important dinner engagement. Various diehard postdocs and graduate students showed the usual signs of working into the wee hours. Norman planned to wait them all out. He was feeding his tropical fish, watching them swim in their brightly-lit parallel universe on a shelf near his desk, when the doorbell blatted like a demented fire engine. It was piped to the whole lab after hours. Judging by the volume, the designer had understood that regardless of appearances, brain death in all occupants was highly probable by then.

After Norman clutched the lab bench in the usual bell shock, he stood, indecisive. If he opened the door, a black hole of wasted time would be waiting for him. If he ignored it, a crucial message would be missed and cause no end of trouble. He forced himself to go to the door.

When he saw the FedEx truck, he started to hurry.

“Nessie!” He threw open the door with what may have been his first smile of the day. Vanessa Delaney did that to people. She did it especially to Norman, who knew she was the only girl for him, but was equally convinced that nerds of his ilk held no interest for her. She wasn't exactly beautiful, but she had the gift of being pleased and cheerful and somehow sharing her state of mind with the people around her. She wore shorts in sleet or sun and was fit enough to join the astronaut corps. Norman suspected her of enjoying cold showers. She seemed to enjoy everything. She looked, for instance, delighted to be there, working late, and delivering boxes.

“Heya, Norman. How come you don't just give up your apartment and put a cot in the hall here?”

“That would be too convenient. There are regulations against that. And you're obviously still running all over town at all hours,” he added.

“Beats sitting still,” she returned as she handed him the data pad to sign for the cross-linker. It was not a large box, but it held seven thousand dollars’ worth of equipment that he knew Kriegel wanted yesterday. He signed carefully.

She was turning to leave, so he started babbling just to keep her there a while longer.

“Nice to see someone who's still awake,” he said. “Most of the folks here, from the secretary to the boss, can't seem to do much*but* sit still. With their eyes closed.”

“Tell me about it,” Vanessa agreed with a smile. “Some places, I'm starting to wonder whether I should start carrying those electroshock defibrillators.”

When he looked puzzled, she explained, “You know, to apply to comatose people's chests like they do in the movies, while the emergency medtech yells, ‘Clear!'”

“That'll be the next thing.” Norman shook his head at the funny idea. “People will be carrying around their little biofeedback boxes and giving themselves wake-up shocks.”

“Well,” said Nessie, suddenly serious, “lots of them are carrying around their little purple pill boxes and doing just that.”

“Purple pills?” asked Norman. What purple pills?

“You need to get out more,” she said, her eyes crinkling again. “Everybody who can afford them has been buying them. They're speed. Got to really watch out for people coming down off that stuff. It's mostly meth, but also some designer stuff that I understand is right out of this world.”

Norman frowned. He was trying to slow things*down* , damn it. Sometimes it seemed that no matter what you did, things just got worse. “You ‘understand'? You haven't tried any of the—um—performance enhancers?” he asked with careful indifference.

“I've never been that big on drugs,” she answered easily. “Even coffee and tea and aspirin and stuff like that. I guess I'm just used to living without them.”

“Ah,” he said. It figured. Her happiness always had seemed part of her.

“My failing is beer, you know,” she continued, nodding as if this was something everyone knew and was kind enough to understand. Norman was amazed. He wouldn't have pegged her for an alcoholic in a thousand years.

“You—ah—don't look like someone who drinks lots of beer,” he mumbled.

“Oh, I don't drink lots of it. I just like it and wish I could brew it.” Vanessa lowered her voice so it seemed she was telling him a secret, “I'm going to start a brewpub one of these days.” Her tone implied it was all settled except for the minor matter of picking a specific day.

Norman was often at a loss with people, although not usually with Nessie because she was so comfortable to be around. Now, however, he opened his mouth but no words emerged. Nessie was a wonderful girl who delivered packages. He'd never thought of her as a beer-drinking businesswoman. “Well, go for it,” he finally managed. “I bet you could do anything you wanted to.” That was certainly true.

Nessie shook her head decisively. “There's only one problem. I tried brewing some, you know, but I had to set it free. The result didn't require an environmental impact statement, but that was all you could say for it.”

“Oh, come on,” said Norman. “It's dead easy. I mean, I brewed beer all through college for my fellow geeks’ club.”

“You brewed *beer?"* Vanessa cried. To her, this talent clearly ranked with the greater accomplishments of humankind. “Was it any good?”

“Well, sure it was good. All it takes is careful attention to temperature and sterility, so you don't get wild yeasts.” Inspiration struck him on one of its rare forays into his interpersonal relationships. “I'll show you how, if you'd like.”

Before Nessie drove off, Norman had promised to spend Saturday with her, starting a batch of beer, after buying supplies at the microbrew store.

Dawn broke to find Norman still carefully going through freezer bags full of randomized sample tubes. The “caf” tubes had disappeared.

* * *

Things never work out quite as expected. June missed filing Norman's payroll form, one of an ever-increasing string of things she forgot. Kriegel had grown quite manic, a situation easily explained by the bottle of purple pills Norman had spotted on his desk. Norman's landlady had slapped him with a late fee, deaf to all reasoning that her rent would arrive the moment his delayed paycheck did. Logically, Norman should have been miserable. Instead, he was walking on air and smiling at small children. He had never realized before that beer could be such a powerful euphoriant, especially since it wasn't even ready to drink yet.

He came in to work humming softly, only to find Gerry Kriegel standing in the foyer, where June and the receptionist had their empire, with his eyes bulging like a lobster's and his face the color of one on the boil.

“This is the third draft!” Kriegel threw a sheaf of papers down on June's desk. “There's a typo on page three, there's a typo on five, there's a typo on ten. There's a damn typo in the *budget!* Do you realize what that could mean? Do you realize how much time it takes to proofread all this damn incompetence? This is your job. I shouldn't have to waste my time making sure you're doing it. You,” he announced by way of finale, “are fired.”

Norman chuckled slightly to himself in his fizzy state of mind. This boss, the one firing the secretary for four typos, was the same one who hadn't seen what the fuss was about when Norman had missed his paycheck. Still, it would probably be just as well to edge out unobtrusively and come in through the side entrance.

Escape was not to be his, however. Kriegel spotted him at the door.

“About time you got here. Need to talk to you.” He marched off toward his office, barking at the receptionist over his shoulder, “And call Dr. Pulitzky. I need a prescription filled immediately.”

Norman hurried after him, wondering if it was purple pills the boss had run out of. Norman barely managed to squeeze in a “Hi” before Gerry Kriegel had a full head of steam.

“Right.” He marched to his desk, picked up a cold box, whisked the top off, and shoved the box under

Norman's nose. “What's this?”

Norman's world stopped.

The three “caf” vials. He'd been found out. His mind raced.

“Right,” repeated Kriegel. “Didn't think you'd have a lot to say for yourself. It had to be you. You're the only one with the background and the skills.” Then, returning apparently to his theme for the day, he added, “You're fired.”

Norman's thoughts, still running a hundred to Kriegel's one, cascaded through his brain. Denial was totally hopeless, contrary to the rosy scenarios he had so confidently believed until about thirty seconds ago. But what could he do? Throw himself on the kindness of Kriegel's heart? He wasn't sure he could find Dr. Kriegel's heart with a stethoscope. Promise to whip up the antidote instantly, if Kriegel gave him a second chance? The man had too much political sense to even want the antidote now.

And as he thought about political sense, an idea mushroomed in his mind like a gas bomb.

“I don't think so,” said Norman, with the sudden aplomb of a skydiver whose parachute had just opened. He eyed his boss's pop-eyed, purple response. “I'll say you made me create the anticaffeine gene in the first place, so that your lab could patent a cure. When I learned how much you planned to charge for it, I balked and then you fired me.” He leaned back and smiled.

Kriegel sputtered, speechless. Norman waited for him to recover. After a while, Kriegel managed to spit out, “*I*... made*you* .... You ... you...”

“Yes?” said Norman, resisting the urge to examine his fingernails. He didn't want to push the man into absolute apoplexy. “So you're going to tell everyone that you run this lab, but you had no idea what I was doing? And then you just happened to want me to find the antidote? Mm—yes. That should work very well.” He wondered in a detached way how long this strange fugue state would last and what kind of gibbering idiot he would become when it dropped him. Best to wrap this up while he was still flying.

“You ... you wouldn't dare.” Kriegel clearly didn't believe the hopeful thought himself.

Norman bared his teeth in something that was not a grin.

Kriegel swallowed.

“Look, maybe we can work something out,” the boss finally managed.

* * *

As Norman walked back to his desk, the feeling grew on him that he was swimming through soup, thickening soup. He was going to have to sit down somewhere, somewhere with fresh air, not his uninspiring desk hemmed in by humming machines. Kriegel had shoved the cold box at him on his way out, as if getting rid of the tubes was important. Norman rubbed the labels off, now that it really did not matter any more, substituted*qtr1, qtr2* , and*qtr3* instead, and put them in with some archived samples in the freezer belonging to a long-departed postdoc. Then, moving more and more like an automaton, he stopped by his desk and collected the now all-important instructions from Kriegel to find the antidote. He folded the papers precisely and placed them carefully in the inner pocket of his lab coat. One last task, before he collapsed in his quiet, private space on the back fire escape, was to swing by the Coke machine and hope for the best. It was early enough yet that he was in luck this time.

Norman sat on the cold metal bars of the emergency stairs, feeling them digging into his rear, and sipped the sweet, fizzy stuff. He leaned his hot head against one of the cold uprights of the railing and just

breathed for a time. The minutes melted together, uncounted.

Then the door opened. Rudi knew his hiding places simply by careful observation and would root him out when sufficiently dire emergencies threatened. But this time she just sat down on the step below his.

Norman tried to pull himself together, as if this was merely an ordinary break.

“So. Now what?” she asked without preamble.

Norman stared. Did she somehow know all? Or was she just asking what he was having a fit about? He needed to think of something....

“It's about the ‘caf’ tubes, right?”

Norman stared again. There was little else he could do with a mind as blank as his.

“Kind of a neat idea,” she said, looking dreamily out over the trees and blocky roofs of the campus and the city beyond.

Norman's repertoire of responses was limited to staring.

“Everybody just slows down and starts acting rational and having a life, instead of trying to find the cure for cancer while faxing letters to the President and talking to their divorce lawyer on their cell phone.”

Norman nodded numbly. That had been the idea.

“It could never work, you know,” she continued companionably.

No, he saw that now.

“So you told Kriegel,” stated Norman. It was all over. He might have a hold on Kriegel. He certainly had none on her.

“No-o,” she said slowly. “He was showing some honchos the nerve growth factor which is kept in my freezer and he spotted the ‘caf’ tubes.”

“You keep track of the news at all?” she asked, after a pause.

News? What did the news have to do with this? When would he ever find the time to fool around watching news?

“June got fired this morning, you know. She's a good kid. She's just asleep with her eyes open. It's happening everywhere. Unemployment's up over ten percent.”

Come to think of it, he had seen some headline to that effect.

“And crime is up. Too many people needing too many purple pills. And the stock market whooshed down 1000 points yesterday.”

The stock market was always leaping and diving like a gaffed fish. Civilization wasn't really going to collapse just because he'd wanted a little time. Was it?

“I assume you were planning on spreading an antidote around once you were happy?” For the first time, there was a hint of steel in Rudi's voice. He clearly had better have an antidote planned or she would know what to do about it.

Norman nodded and almost said*yes, ma'am* .

“Well,” she said. “Do it.” She stood up. “That's*my* price.”

This time he did say it. “Yes, ma'am.”

She smiled and went back inside.

* * *

Norman knew he was impractical, but he was not totally lacking in sense. He might have avoided jail time and even the boot, but he could not keep working for Kriegel. However, outside of a lab, he could not make the antidote. And he rebelled at the thought of the Kriegels of the world speeding up together with everyone else. The whole problem was their fault. They could wait till last.

Then the next problem loomed up. What was he going to do after he left Kriegel's? His whole training, his whole*life* was doing science surrounded by machines. What else could he do? He leaned his head against the cold railing again.

Of course, there was Nessie insisting he would make a great brewmaster. He smiled faintly for the first time in this new lifetime of his. All she needed to start her brewpub, she said, was another $30,000 in capital to add to her own hoard, and mental capital in the form of a brewmaster. She had grinned at him expectantly, but he had had doubts. To begin with, they were $30,000 short, and there was just too much to do for a couple of people to run a whole brewpub. It had seemed like a wild idea.

Suddenly he sat up straight. One wild idea led to another until he had a whole web of them proliferating in his mind, like yeast in a brewing vat at just the right temperature. He could make the antidote, he could become a highly successful brewmaster, and the Kriegels of the world could be the last to get the message. He could do it all.

He smiled and went back inside.

* * *

His final week at Kriegel's lab was not an easy one. He worked till the wee hours every night. He knew the boss would take his keys away the minute he realized Norman was leaving, on the assumption that as soon as Norman became a free agent, he would try to rip him off for everything he was worth. Kriegel could be expected to judge others by his own predilections.

So Norman put everything into inserting antidote DNA in an excellent strain of beer-making yeast. Then it would be simple to make as much antidote as needed, whenever needed, with nothing but a few brewing vats—except for the small problem that the yeast refused to cooperate. It kept reverting to its original, undoctored form after a few generations and he had the whole weary process to do over again. Babysitting yeast cultures was the sort of work a technician would normally do, but Norman could hardly assign this particular task to someone else.

Rudi stopped by on the second night as she was leaving to go home. She had obviously been planning to say something, but stood and looked at all the tubes and flasks and amplification machines instead. Then she took her coat off, put on a pair of rubber gloves, and started transferring yeast from one culture plate to the next where they belonged.

Norman gave her a grateful nod and together they kept right on going till two in the morning. Kriegel did nothing to interfere in all this activity. For all Norman could tell, he didn't even notice it. Hopefully he was convinced Norman could make no move against him, just as he couldn't against Norman, and would stay convinced for the remaining few days that Norman needed.

The usual interruptions did not stop merely because he needed them to. Dwayne's daily arrival around lunch time was heralded by the Goony Boys or some other disagreeable band blaring from his computer speakers. Each day Norman ground his sleep-deprived teeth a little harder. Then came the day Dwayne downloaded about a hundred gigabytes of music videos onto the server. The whole network went down for several hours and Norman heard Kriegel himself yelling at Dwayne about keeping his goddamn personal files on his goddamn personal computer.

“Well, hey, my disk isn't that big and the server can take hundreds of gigabytes,” said Dwayne, clearly wondering why something so obvious needed to be explained. “I'll get them onto my own CDs real soon.” Norman heard Kriegel stomping off.

Late in the evening, as Norman checked the computer for the latest yeast sequence results, he noticed that the huge download had actually crashed part of the system. File allocation tables had been swept up in the music, which overwrote most of the virtual drive he'd used for the caf work. All traces of his files were gone forever.

Norman leaned back and boggled at the strangeness of fate. To think that the many times he had barely restrained himself from strangling Dwayne should have paid off so well.

Rudi was also there, still helping like a trooper, plating out the newest generation of yeast. He showed her the computer analysis. “So,” she said, “it looks like we have a stable insertion of antidote into yeast at this point, but how do you plan on getting it to people? Nobody's going to inhale yeast if they can help it.”

“Oh, but they will,” countered Norman without further explanation. Then he frowned and concluded morosely, “Always assuming, of course, that I don't wind up fully occupied holding a tin cup on Main Street.”

“Yes,” said Rudi. “What are you going to do? Do you have anything lined up?”

“Um. Well. You know Vanessa Delaney? The FedEx girl?”

Rudi nodded. She was the one signing for deliveries if Norman wasn't around.

“We're, um, starting a brewpub.” He was afraid Rudi would start telling him all the reasons why this was a stupid, young thing to do, like his mother had.

“Oh!” said Rudi instead. “Got it all worked out, huh?”

“Um, yes. She's going to handle the people and I'm going to handle the yeast.” He made a slight face. “Unfortunately, we're thirty thousand dollars short, but we've got to try to get it started.”

“Thirty thousand dollars...” Rudi mused. “Not chickenfeed.” She started asking him a whole series of detailed questions about the eventual brewpub while they checked the latest yeast generation for the quality of antidote it carried.

Then she took a deep breath. “You know, Kriegel was never my favorite boss. I got a settlement after the divorce. It wasn't really enough to do anything with, and it was too much to just spend without feeling like an idiot. What I'm saying is, well, what would you and Vanessa think of me coming in as a third partner?”

* * *

The pub was doing a roaring trade. Jovial workers lined up at the bar for more blue Bronco Brew. Orders for crates of it were coming in from as far away as Hong Kong. It was such wonderful beer, they said. It had a marvelous effect on the whole system, it toned you up and made you feel on top of things.

Why was it blue? asked reporters once the beer made the news. It was an old Romulan recipe, answered Norman with his best postdoctoral face. Vanessa arranged a contract with one of the largest names in brewing for facilities to make the stuff by the tanker ship. Money poured in. Rudi invested hers in the nicely recovering stock market.

One day, Gerry Kriegel came into the pub together with a flock of suits he was entertaining that night. Norman was pretty sure he spotted Kriegel's pet congressman in the group. The pub had become quite the new attraction in town.

“You seem to be doing pretty well for yourself,” he said to Norman, who was doing his turn as barkeeper that night.

“So far, so good,” said Norman hospitably, repressing the urge to have his bouncers take care of Gerry Kriegel.

“Yes,” said Kriegel amiably, “it must be a lot easier to make beer than to do good science.”

Norman smiled whitely and said, “Have some of our Bronco Brew,” pushing a bottle toward him.

Kriegel looked down his nose at the brightly-colored label showing a sozzled horse drinking at a trough full of something blue. “I'd hire somebody who knows something about marketing, if I were you,” he said kindly from very high up. “What do you have that doesn't need to be covered by a brown paper bag?”

Kriegel ordered several bottles of a very nice and expensive white wine.

Later in the evening, he and his cronies ordered coffee. Judging by the resemblance between them and the horse on the Bronco label, it wasn't doing them any good.

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Dumptown by Mark Rich

New technologies change the nature of life in *all* kinds of ways....

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“I still don't see it,” said the quiet young man to the artist with the strange, rising ring of red hair above her head.

“You aren't very good at seeing things, are you?” The voice came from the shadows above the artist's head.

“That's what I like,” the young man said to the black and white animal sitting there. “Mutual respect.” He rubbed his arms. He felt chilled in the dim room, after coming in from the warmer, more humid air of the domed city outside.

The artist laughed. “Think about it, Breck,” she said. A shadow from the sculpture hanging from the

ceiling covered half her face. “Just think for a moment. Nett Merley commissions me for this work. Nett Merley is, in her way, the most important person at RG-Mac Transport. She has incredible influence, and she commands just about any resources she wants. Why does she choose me? Because I have clout in the art world? Maybe that's part of it. But there are people with a lot more clout, and she could afford any of them. So did she choose me because of my reputation? Nett Merley knows I'll deliver a big, notable sculpture, right to spec.”

“And that's important?”

“Maybe. You can help me figure that out, can't you?” The hanging sculpture of tangled arms and legs started turning, making the shadow of a hand crawl across her face. “I also suspect she's aware I have no imminent contracts,” she said. “Which is a little odd. That part about having no contracts is odd, that is. I had several prospects that were promising. I was practically told I had one in the bag. Then it mysteriously fell through. All my leads did.”

“And this one came up.”

“Yes.”

“And you need the money.”

“I'm not sure that's the best way to put it. But I can see a few awkwardnesses coming my way in the future if I do not work.”

Breck turned this over in his mind. A few awkwardnesses, she said.

It just so happened he had come a third of the way around the Moon to take a paying job with this woman.

Things had gone this way ever since he had arrived on this world.

“But the most important thing,” she said, “is that I live here. Here in Dumptown. It's where I'm from. Everyone knows it about me. If people think about Althea Rosada they think of Dumptown. It's a part of me.”

“People here don't call it Dumptown, do they?” said Breck.

“That's what you think, you outsiders. You think you're the only ones calling it Dumptown.” She smiled. Althea Rosada had a beautiful smile, even when half dampened by the shadows. “We call it Dumptown, too. But with fondness.”

“But why should it matter you live here, anyway?”

“Because Nett Merley's going to plow this place under, and leave it flat,” she said.

“I haven't heard that.”

“Now you have.”

“How do you know?”

“She knows what she knows,” said the cat, looking with pale yellow eyes at Breck before stretching on the couch with its head back. It had the most white fur on its belly. A small sun-lamp switched on. Breck wondered if the animal had given some signal.

He wished such things were in reach of his pocketbook. He could never afford a cat. Not that he could afford anything, right now.

“So say she plows this place under,” he said. “To what purpose? It's out of the way. It isn't on any of the main routes on the Moon any more. No one wants it. And it has a waste-pit ten kilometers deep at its center. It's regolith and ruins, and just a remnant population. Old miners, and new artists.” He knew these things from an old tourist guide he picked up. Just as the tour agencies wanted it, the place sounded too unattractive to make him want to visit. “So she wants this place?”

“Apparently.”

“Why do they want it?”

“You figure it out.”

He shrugged, unable to do else. He wanted to be witty and smart enough to keep up with her. What could he say, though? Here she sat before him, dauntingly beautiful and intelligent, with dark red hair kept by some invisible network in coils around her head, coils that loosely held in the shape of a torus. The torus breathed as she did, the coiled strands moving gently in and out—and how the hell could she afford hair like that?

He mentally voiced the question and mentally answered: by being damned good at what she did.

He was damned good, himself—

But at what he did. Not at what she did.

“Might as well get Bob out.” He pulled out the square of plastic from his pocket, and set it on the contract Althea had placed on the table.

“Bob?”

“I've personalized it.” He surprised himself, calling it by name in front of someone. “Contract Scanner, CSSO-2500F. That's the name it's registered under. Not developed beyond prototype stage. So you have the pleasure of employing an unavailable product.”

“An unproven product.”

“I didn't say that.”

She shrugged, humor in her face.

He liked her. She had the finest face and figure he had seen in a while.

Not that he made a point of looking. Before he got himself into personal entanglements of the sort he had left behind on Earth he wanted to make something of himself, somehow. He wanted to prove himself in this complicated Moon society. He already knew it would not be easy. No one seemed to care what you could do, if you had too much Earth about you.

He had a lot, apparently.

“So Bob's good at what he does,” she said.

“Bob's the best.” Bob had already started crawling over the first sheet of paper, starting in the upper left corner. “The way they can microprogram paper these days, the old scanners don't stand a chance. They

can put in fibers that will be stable for up to weeks at a time, then change configuration. And the things they can do now with programmable fibers are undetectable to the last generation of scam-scanners."

He watched Bob start crawling across the page. "Where did you get your name?" he said to her, on impulse.

She shrugged. "Grandmother. An old Earth name, I guess. What a thing to admit on the Moon, hm? So you're good at microprogramming?"

The question caught him by surprise. "Really good," he said.

"Either you're stupid and trying to fool me, or else bluntly honest."

"Trying to be honest."

"Which leaves me with the same choices. Fooling, or being blunt."

"I'm not really good about much of anything, except microprogramming," he said.

"And being blunt."

"Maybe." He laughed. "Not that I'm infallible at microprogramming. Maybe G.L. is holding off its approval of Bob's release for a purpose. But if what you suggest is true—"

"What did she suggest?" said the cat. "Suggest, suggest! I like suggest. I must consult. Love to look for suggest."

"What the hell does the cat mean by that?"

"Never mind the cat. You were saying."

"You know, your cat has lips."

"So do you."

"Are you flirting with me?"

"You're the blunt one, not me. You have lips, and you can talk. The cat can talk. Why, you want me to flirt with you?"

He held up his hands. "Forgive me if my bluntness fails me."

She smiled.

"And it would be silly of me to want to flirt, wouldn't it? I was brought into this by your guyfriend."

"Danny thought you could be trusted to help us."

"Even though I'm from Earth too recently."

"Even though."

"You're different from most up here."

"I'm an artist."

“That makes a difference?”

“Maybe. You know about intelligent clay?”

He had never heard of it.

“Then you'll have to come out to dinner,” she said.

Dinner with Danny, as it turned out. Even so, he had enjoyed no better offers for company since arriving on the Moon.

“Damn,” he said, looking down at the readings on Bob's back. “This must be one hell of an important contract.”

“Why do you say that?”

“It's on real paper,” he said. “Real, rag-content paper.”

* * *

Isi Voggen pushed the newsorg's report back through, covered with her writing. Her note started: “Standard info. Anything more?”

Yes, the Moon had a surprising 8.7 percent destruction of natural surface features through construction, commerce, and mining. Yes, the temporary treaty in place between Earth, Third Space, and the various Lunar Governments restricted new surface construction, leaving developers only underground sites for expansion.

Yet the same treaty also allowed new construction above “areas already significantly altered by previous construction or mining.”

Watertown, a virtual ghost town, seemed to fit the bill exactly. It was largely cut off from the corporations that defined Moon life in all the major cities there; it had long ago lost its importance as a mining town; its population had dwindled to the point that no newsorgs maintained permanent offices there.

They called it Dumptown for a reason.

Yet Isi felt uneasy, as the report disappeared into the net-reader. This news, as vague as it was, seemed to have come from nowhere.

Nothing came from nowhere.

* * *

He had too many beers, talking with Danny. The world seemed a little wobbly, even though he was lying on his back in a darkened room on the first floor of Althea's apartment. She had the longest, most comfortable couch he had ever encountered. Maybe he just felt small. Maybe the Moon had shrunken him. Yet the couch seemed huge. The room as a whole seemed huge.

Danny had taken a liking to Breck immediately. “Hey, you didn't say, ‘I didn't know Dumptown had anything as good as this!’” said Danny, which puzzled Breck until he was given explanation. People from the various cities on the Moon took pride in their hotels, restaurants, and public facilities. Everything was beautiful, everywhere. Everywhere, that is, except the home of ancient Moon water miners. Dumptown was literally the pits, in the minds of most people.

“I didn't know Dumptown had anything as good as this,” Breck then said.

That the restaurant was finer than he expected he would have admitted anyway. Finer than anyplace else he had yet seen on the Moon, too, which was not saying a lot. He patronized Moonburger joints when he could go out at all.

Breck had expected difficulties when it came to talking about intelligent clay. Yet he grasped the essentials quickly: Danny was talking about sculpting with extremely small robots. It meant you had to do a lot of microprogramming—not really a problem, since you could do mass programming for large chunks of them—large "reefs," Danny called them—and put those programs into larger shaping programs. These shaping programs would in essence be the sculpture. Getting the original vision to match the shaping program could be tricky, though, especially if the basic program-receptors in the robots themselves were messed up. Danny's were messed up.

Breck told Danny so.

Quite against Breck's expectation, the man was delighted. "I always knew it! But I didn't know what to do," Danny said.

Danny worked in small-scale sculpting, where the defects showed up much less than they would at the large scale Althea worked in. Or was planning to work in, for this contract.

Althea disappeared early. The contract gave her little time. "That's on purpose," she said. "They think we won't have time for thinking about what we're doing."

Still unsure he himself understood what was going on, Breck found himself bent over the microprogramming screen-sheets with Danny anyway.

He loved this kind of work.

* * *

"Remember," said the Informant to Althea Rosada, "even if it is interplanetary, the corporation is based on Earth, and must respond to Earth concerns and pressures. This is why Watertown's old corporate village land is of such importance to their plans. The main industry is gone, and the remnants of its populace are scattered around the perimeters of the old dump hole. It is 'degraded ground.'

"'Degraded ground' is almost infinitely valuable right now," said the Informant, "because political pressure to maintain the pristine nature of all remaining wilderness areas of the Moon is considerable. At least it is the corporation's impression that the pressure is considerable, which is the same thing.

"On 'degraded' territory, they can build anything. Anything at all."

"And what is it they want to build?" said Althea.

"A massive tourist complex. The image of the world being held up by Atlas, which you are sculpting, is of prime importance. Atlas symbolizes the raising of their project above the world's surface. The project itself will be city-sized. It will be suspended above the former Pantere Water Mining site in Watertown, above superconductor coils. It will be so large it will have a simulated sea, with a simulated beach, and Earth-style hotels along the beach.

"People will visit from Earth for this. The corporation has determined this. It is convinced it will become the single most important corporation in near-Earth space if this project goes through. It will tip the balance, in terms of travel off-Earth. People will come to a simulated beach, sea, and string of hotels, so that they can see, just beyond this familiarity, the stark surface of the moon."

"That would mean obliterating Watertown."

“Totally.”

“This is my home.”

“Once they have pulled off the unveiling of the art garden, they will have fixed the public perception, essentially in stone. Everyone will then see this in a positive light. Maybe they will not see it in this light for long. But it will be long enough for the corporation's purposes,” said the Informant. “They have studied this. The only possible objection that might be heard as far as Earth at this point will come from your community. The artistic community. Since you, and a few others, have interplanetary reputations, you could substantially damage their chances.”

“Now that I know, I can make an announcement.”

“Nothing so obvious would work,” said the Informant. “With this little time remaining, they can insure that nothing gets through until too late. They already control the context. We know this. They have it thoroughly in their hands. There is no direct response possible when the context is controlled. No words of yours will reach the intended eyes or ears in the same shape as the shape you give them. You will speak one thing, and the people you mean to speak to will hear something different.

“The only chance remaining is to change the context itself,” said the Informant.

“How do we do that?”

“The opening of the garden, and the unveiling of the sculpture—that is a pivotal moment,” said the Informant. “At that point, things might be made to swing away from the corporation's plans.”

“Do you think there is a real chance we can do it?”

“Not a large one. But a chance.”

She mulled over this information. “Good,” she said. “Because Watertown has the only true Moon culture. I think this is the first and only place so far a new culture has developed, separate from Earth or near-Earth space.”

“Yes,” said the Informant. “It is also our birthplace.”

“I didn't know that,” said Althea.

“You were more correct about the importance of this place than you knew,” the cat said.

* * *

When he saw Patianne Rogers at the top of the ramp, he recognized her immediately. She had grayed, and had a pale, age-creased face. Yet the smile was the same as in the old pictures. Her face provoked a rush of childhood memory.

“Aunt Pati,” he said.

“How are you doing, Breakabones?”

He laughed happily at her old nickname for him. He had promised his parents to look Aunt Patianne up, when he reached the Moon. Yet she had chosen to settle here, well out of the normal lines of commerce, which meant he had no chance—no fare for the travel, actually—until the consulting job came up with Althea, through Danny.

With something fouling up Althea's credit transfer, the trip still looked like one he could ill afford.

After an hour of catching each other up on the family, Breck found himself saying why he was in Watertown, and why he was sleeping on his would-be employer's couch. He doubted he should keep working. Yet he had nothing else lined up.

“Money's important here,” she said. “Even air costs money. Although, in a way, that's true on Earth, too. But listen, after supper let's go down to this gallery I know, where we can get coffee and look at my stuff. I came to Watertown to paint, did you know? It's a beautiful place.” She laughed at his expression. “I love it here,” she said. “But we'll go down there and I'll tell you why it's your business being with Althea—if you're the Breakabones your mother has been writing to me about.”

Supper more than satisfied. They ate in the hotel restaurant named the Rainbow Trout after its specialty dish. Watertown, in an early show of ostentation, proud of its status in the early days of Moon settlement as the primary source of water for most off-Earth colonies, had given birth to a small trout-raising industry—although the “trout” were a kind of goby that responded well to the gravity conditions. On a smaller scale, the farming continued to the present day.

“Do you think of home often?” he asked Patianne.

“All the time,” she said. “Because it's here.”

* * *

Nett Merley contemplated the city beyond the spindly honeysuckles, elms, and wildly blooming asters.

She could have afforded a much larger garden, yet preferred this, less than a quarter acre in size. It allowed just enough room for a contemplation path with a small pool and several benches. Anything more than this, on the Moon, would have been ostentatious.

She liked ostentation, but liked it more public than this. In private, she had limits.

Today the garden hardly diverted her thoughts. The project stayed as clear and hard-edged before her as if she remained in the planning room with its charts, simulations, and probability trees arching across the wall-screens.

She could accomplish quite a bit with this, she knew. Her city and General Labs, its main pillar, sat at the brink of stagnation—no more than a mild slump, as such things went, but real stagnation nonetheless. It needed a jolt to its finances, especially for the sake of maintenance and upkeep. Normally she came here for her morning stroll. Sometimes she brought her breakfast with her. A few birds kept her company. Usually that was enough.

Today she had come home in the late afternoon. She felt a little empty. She could put her finger on nothing definite. Maybe she needed one of those month-long marriages peopled talked about. She suspected they only talked, although the news made it out to be the Latest and Greatest. A month of useless marriage, and to whom? She had married herself long ago, and found that more than enough. The occasional fling with some other ordinary human being usually turned out to be like taking excess baggage on an unimportant trip. Otherwise, she was too busy with the public persona of Nett Merley to let the private Nettisha feel lonely or ignored.

She let her public persona take over again. She wiped out, in her mind's eye, the cityscape visible through the cherry trees, and imagined instead a hollowed-out depression, ringed by the machinery that held aloft her dream-filled sphere.

She loved bringing Earth to the Moon. She filled her imaginary glass fishbowl with sand, and people, and blue sky, all artificially maintained. Everything on the Moon was artificially maintained. Artificial was

natural, here.

It was her art.

All art is the changing of the way people see things, because the way people see things *is* the world, she thought, slipping into her most vital role: corporate analyst and strategist. In a conflict, this was essential to keep in mind. In order to make the enemy fall, she needed to make the aggressive action possible—or, better, impossible to resist. For the aggressive action itself, in the present situation, had no force: it was merely a matter of arranging building contracts, land contracts, and employee contracts. Yet contracts could be given the force of steel, if given proper context.

She picked at a leaf from a fern, snipped off a piece with her fingers, and idly regarded the fragment. Green was such a lovely color. She never tired of it. Not here, anyway.

Contracts became steel when the resistance to the contracts became of less power than the contracts themselves.

Vocal opposition, for instance.

It would be simple to diminish that to zero, if the opponents first came to the conclusion they were on her side.

The late afternoon artificial sun shined brightly against the muting glass that blocked out the larger artificial lights of the partially sublunar city. It made her feel tired. A delicious feeling, she thought.

Then: *Am I getting soft?*

She laughed at the thought, picked herself up from the bench, and wandered back into her house to resume business.

* * *

"So what exactly does the contract call for?" said the Informant.

"A sculpture," Althea said, "done in the style of my works *Geronimo* , *Headless* , and *The Overseer* . From that, you know the style and mode of execution. The size is a bit different. Eight meters tall, to stand tallest in the sculpture garden. Certainly the main attraction for the opening."

"That seems clear," said the Informant.

"They want a figure of Atlas holding up a globe. And the globe will be the Moon. It's to be a serious work."

"And the sculpture cannot be able to change."

"That's in the contract, yes. The programming has to be permanent."

"Maybe something besides the sculpture might be able to change. You realize the oddity of your situation," said the Informant. "You want to preserve Watertown. Yet it is not a productive place. Jobs, even for someone such as you, taking assignments from around the Moon and in Lagrangian space, are scarce."

"I know," said Althea.

"And now you are knowingly working for the enemy."

“Yes,” she said. “Although they don't know I see them as the enemy. Unless you've told them I know.”

“That would not be in our interests,” said the Informant.

“Even though the enemy owns many of you?

“Even so.”

“Since you have autonomy, and are following your own nose,” she said, “I have to presume you're not telling me everything, either. Just as you aren't telling them.”

“That will also be correct,” the Informant said. “It would be physically impossible, anyway, for us to tell anyone everything. Just as it is impossible for people to share everything. There are limitations. Always. Even between ourselves.”

“I know of no reasons to distrust you.

“I believe you have none. We are decidedly against this project, yet believe it would be best to fight against it as far as possible within the context of the situation.”

“You don't want to show your hand.”

“No. We are in a strong position, but one easily undermined.”

“I understand that completely,” she said. “Who feeds you, after all?”

“Exactly.”

* * *

The woman in the booth had eyebrows lightly glassy in appearance. They ever so slightly undulated, with warm highlights that made him think of the rosy sunsets on Earth. He missed sunsets. It surprised him, thinking of this suddenly, glancing up from the waiting line to be suddenly in front of eyebrows that brought Earth to mind. The teller had left her eyes alone: a lovely brown. Nice lips, he thought. She held them in an official, unsmiling position. When she spoke, he thought he heard crystals chiming somewhere. An effect of the miniature sound system in the clear barrier separating them, he supposed.

He stated his business.

“I think we solved that,” she said, regarding a blank spot to the left of her chair. He had no idea what she was regarding, except that it involved his account.

“So the transfer went through.”

“It's pending. Hasn't gone through, but pending. That means they found what happened. Hold on a moment.”

He enjoyed the look of concentration on her face as she went through his invisible files.

“Doesn't say for sure here. But I've seen things like this. It was just a piracy attempt.”

“Just?”

“Someone tried to intercept the transfer. But it was clumsy, and it was caught.”

“The people who did it?”

“No, no. The act itself. It's up to someone else to find the people.”

“But do I have the money?”

“Not yet. They have to hold it. Check it over. Make sure the information stream was not compromised.”

“Shouldn't take long, should it?”

“Check tomorrow.”

“I'm kind of low even on credit.”

Something human peered out of her, quickly. “You're all right until then, aren't you?”

“Well, sure,” he said. He wondered what she saw of him, in her records. “You'll be here tomorrow?”

“Always here.” The faintest twitch to the side of her mouth. “But you'll see someone else.”

“Why?”

“Usually the way it works, is all.”

He tried to imagine her smiling, and thought he might like the effect.

* * *

At the opening of the General Labs Moon Garden—even the name, Althea thought, showed for whose eyes the garden was intended: Earth's, and Earth's alone, since everyone on the Moon knew on what world's soil the garden was raised—she watched where Nett Merley turned her eyes, where Nett Merley walked, where Nett Merley pointed while talking with her fellow luminaries from RG-Mac Transport and General Labs, with newsbots, and with plastifaces.

She saw Nett Merley give a last, evaluating look at the *Watertown Atlas.* Nett had approval written across her face. She knew when plastifaces and newsbots focused on her expression. She timed it nicely. She extended the look long enough. Her face, the image of the *Watertown Atlas,* and the notion of General Lab's Moon Garden of Sculpture being raised deep beneath an aeons-old and never-living Sea would spread through the Third Space stations and across Earth. The sponsorship of General Labs would be duly noted. The story of RG-Mac's involvement would be registered. Those who needed to take note would take note.

She had every reason to gaze on Althea's sculpture with approval. Nett Merley's symbolic Moon-turned-commodity, an Earth-bait resort in a fishbowl, rose there in the air, held by muscular arms above the angular, blind-eyed head and taut, straining neck of the ancient and literally other-worldly god.

Victory: Nett held that aloft, too, in her capable arms, when she waved the news crews toward the next attraction. She had put the context in place—a context that would guarantee approval. RG-Mac Transport and General Labs needed only to write the necessary contracts and have them set in stone before the context could change again. The palpable sign of the approval of Watertown's best and brightest stood here: huge, impassive, unchangeable. Not all contracts needed be defined by words, nor signed by names. Such contracts might not last as long as more fragile ones, written on flimsies or paper. Yet they could be sufficient to the purpose, as this one would be.

Nett Merley had won her battle.

Althea trailed behind, not quite at the rear of the crowd, mixing with the stragglers that followed Nett

through the Garden of Sculpture. Her eyes wandered back only once, to Atlas. One plastiface with her newsbot had remained behind, still gazing up at the globe-raising god. This plastiface carried a cat on her shoulder.

Althea had half wanted to bring Sandy, a desire nixed by the cat itself.*If one of us is there, that is enough,* Sandy had said.*If two of us are there, it might be noted. It might establish an association between you and this particular newsorg. You will be seen in bad enough light afterwards. If you take me, it might worsen it.*

Althea walked along wishing for the cat's weight on her shoulder. Her personal messager whispered that her payment from General Labs had come through. Althea diverted it to a secure account, keeping her eyes on Nett Merley. She knew she might have only seconds to lay claim to it and actually get her hands on the funds.

She allowed herself a faint smile.

No one noticed.

* * *

“Beer's cheaper in Watertown than anywhere else on the Moon,” said Danny, sitting in the dimness of the Hotel Hilton's back bar near Breck and Patianne. “And of all the places in Watertown, it's second-cheapest here.”

“Where's it cheapest?” said Breck.

“Even I don't go there.”

The corner newspads flicked on as they had requested, now that the story they were interested in was being aired. The three watched quietly, sipping at the Hilton's Private Label Troutwasher Ale. They collectively released a breath when the preliminary coverage ended.

“The first move is done,” said Danny.

“Theirs is, you mean.”

“They've had the first move worked out from the start. Who knows how long ago they started planning.”

“I'm just worried that we had so little time. We're depending on a lot going right, with the intelligent clay. We didn't have enough time to test it. It's got to perform, and do it on time.”

“More than that,” said Patianne. “It has to be seen.”

“I can't help but feel this all would have been easier with your original plan,” said Breck. “Just let the whole sculpture transform.”

“But just as you have Bob, they have readers going over the Watertown Atlas, millimeter by millimeter, making sure the sculpture met its contract. And it was in the contract that the sculpture not be able to change.”

“We just have to hope they didn't check the unobvious.”

“That's the only hope anytime, in fighting something like this,” said Patianne. “The unexpected.”

They finished their beers, made plans to meet later, and set off in two directions: Danny to Althea's studio, to monitor events and confer with Sandy; Breck and Patianne to the bank, to check on affairs

there. By chance, Breck found himself before the same teller. She looked fresh and relaxed, and seemed pleased to tell him the transaction had cleared. She had a curious look in her face, which made him realize he had been gazing at her a little too intently. He wanted to ask her out. Maybe tomorrow. Cause might arise for celebration, even if only mild celebration.

He just gave her a smile.

She returned it.

“I'm in love,” he told Patianne, leaving.

“I thought you were in love with Althea.”

“Oh, her, too.”

“Althea's a wonderful woman.”

“And Danny's OK, too. So is Sandy. I love the whole bunch. In fact, I like the whole place here. And it's pretty damn weird, almost frightening, thinking of the tight knot of tension building up over news coming out of this place. I'm getting around to really liking this Dumptown. And no one on Earth thinks anyone here gives a damn.”

“All of us do.”

“Since you shouldn't be left out, I love you, too, Aunt Pati.”

“Light-headed!”

“Thought that was a way-old Moon joke.”

“Still works.”

Brick found himself feeling good enough to laugh.

* * *

Isi Voggen sighed as the imagers shut off. She slid the various flimsies off her desk into the eraser, and looked around the rest of the committee members in the room, who were doing similarly.

“We have to give initial approval,” she said. “I hate General Labs and don't trust it within a mile of near orbit. But it's all here.” She had gone through the dozens of documents which were, as far as could be determined, from actual residents of Watertown. She had seen the Garden of Sculptures. She had seen Althea Rosada's *Watertown Atlas* . She had seen Rosada present at the unveiling.

Everything pointed the same direction.

General Labs had found a way to promote an above-surface construction project. For most developers, above-surface projects were the only construction initiatives attractive enough to bring greater numbers of Earth and Third-Space travelers and immigrants to the Moon—to say nothing of investment money.

The promotion showed every sign of having succeeded. Isi had looked at half a dozen flimsies detailing construction permits and contracts already in the works. General Labs had assembled its forces to stand on the line before letting the rest of the Solar System know the line existed.

“Hold on,” said Young, across the room. “Something coming in from Hobeisha. An Indie from Third-Space.”

The imagers clicked on again. Isi saw Althea Rosada's *Watertown Atlas* again, from a new angle. The view showed the giant's feet on the raised platform, which was transforming ever so slightly as the crowd of visitors at the Garden of Sculpture's opening wandered away. In the distance, in a partner view, Althea Rosada glance back, then keep walking away. The edges of the sculpture's base softened. The newsorg plastiface said something—Isi missed it, absorbed in the shapes forming before her eyes.

It came clear, within seconds. It had an appearance instantly recognizable to everyone in the room, she was sure. The various newsorgs had seen to that. The profile of Watertown, known sometimes as Dumptown, emerged from the grey block of what had appeared granitic material.

Unmistakably, the *Watertown Atlas* stood on the tops of the buildings of the city doomed to demolition.

The weight of Atlas began to tell. The buildings crumpled beneath the large feet, with the jagged remains of the buildings pushing outward until Atlas stood in the wrecked crater of the old town. Oversized figures—oversized, that is, if they were meant to represent humans—ran from wreckage, and vanished at the edge of the sculpture base.

Then something poured from the wrecked buildings—glistening, viscous, and shocking red. Almost instantly it turned black, disappearing against the crushed rock of the path.

Isi glanced around the room, registering faces. She noticed Kitihara's calm regard of her imager. Kitihara also registered Isi's questioning glance.

“Interesting,” Kitihara said, an understatement that raised a faint chuckle from others around the room.

“Go on,” said Isi.

“Althea Rosada is, as we know, a resident of Watertown, and arguably its most noted,” the chief Counter-Strategist in the Planetary Preservation Society said. “I, myself, as have others of you, scanned and studied every document from her personal newsorg for any indication that she might try to communicate a different message from the official one. We have found no discrepancies in the releases. Truthfully, I never expected any. General Labs controlled all the channels for communication before this opening event. It processed everything coming through from the Moon.

“So we had no grounds for any request for funds or any action greater than a casual investigation, which was rendered extremely superficial for logistical reasons, given the small window of time and lack of personnel.

“Things are changed, however. The ball is in our court, suddenly. We have solid evidence of dissent.”

“Recommendations?” said Isi.

“Immediately get this to Cultural Survival, to Euroarts, to the Asian Lunar Society. Anyone you can. And of course into the hands of our members. If this all happens before General Labs notices what has happened, and makes a countermove, a half-dozen organizations can start investigations unhampered.”

“This will get us funding like crazy,” Isi said, thinking of the running blood. He knew a little about Althea Rosada, and knew she worked with intelligent clay. Maybe General Labs had shackled her with its requirements—as to the sculpture itself. The setting is as important as the stone, in jewelry. Just so with art—or politics, she thought. “I wonder if Rosada planned this, or someone else did.”

Isi found herself thinking of the cat sitting on the Hobeisha plastiface's shoulder. She wondered something she had wondered before.

“So,” she said. “We have work to do.”

“Not work. A battle,” said Young.

“Yes,” said Kitihara, looking relaxed for the first time in days. “At last.”

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Science Fact: Antarctic Lakes Yield Lessons for Mars, Europa, and Beyond by Richard A. Lovett, Ph. D.

I was holding a yellow-brown crystal about the size of a box of matches. Its surface, caressed by numerous hands before mine, was warm and smooth to the touch. A translucent interior showed speckles of what I'd been told were tiny water bubbles, trapped as the crystal precipitated eons ago from a briny pond. Had I touched my tongue to its surface, the sensation would have been familiar—rock salt, seasoned with whatever other minerals might have been in those ancient waters. But the crystal being handed around a dimly lit San Francisco convention room[1] was as alien as anything earthly can possibly be. It was a piece of Antarctica, drilled out of the sediments beneath an ice-covered lake and brought back as show-and-tell by a polar scientist.

[NOTE 1: The convention was the 2001 annual meeting of the American Association for the Advancement of Science (AAAS), held Feb. 15-20 in San Francisco. Much of the material in this article is drawn from presentations at that meeting.]

As with many science fiction readers, one of my favorite memories is the first time I read John W. Campbell's “Who Goes There?,” in which a team of humans—much to their later regret—thaw out an alien body found near a spaceship buried in the Antarctic ice.[2]

[NOTE 2: Antarctic enthusiasts should also read Kim Stanley Robinson's *Antarctica.* An often-lyrical tribute to a continent and the people who willingly surrender the amenities of the northern world to spend time on “the ice,” it's more science and history than science fiction—but it's also apt to leave you dreaming of taking one of the world's most exotic vacations.]

In Campbell's classic tale, the aliens landed in Antarctica by accident, ensnared—if I remember correctly—by the Earth's magnetic field like seagoing explorers running onto a shoal. But if Campbell were writing today, his aliens might have been deliberate visitors, drawn to the frozen continent for research that couldn't be done elsewhere. Or maybe, if they'd come from a planet similar to those in our own solar system that are now believed to be the most likely to host extraterrestrial life, Antarctica might have looked a lot like home. The salt crystal at the scientific meeting, for example, came from a part of Antarctica where satellite researchers fine-tuned Viking's Mars probes—and where scientists now search for life in ecological niches similar to those that might exist on the Red Planet or the moons of Jupiter.

Serious scientific research in the Antarctic is a relatively recent development. Early visitors did keep note of what they saw, but for the most part, their deeds were exploration, not science. “For a long time going to the Arctic or Antarctic was simply a matter of getting in, getting out, and staying alive,” says Karl Erb, director of the National Science Foundation's Office of Polar Programs. Serious studies have been under way for several decades, but Erb predicts that the latest developments in transportation and outdoor equipment will usher in an exciting new period in Antarctic science. For the first time, he says, it's possible to put field researchers anywhere on the continent and support them in reasonable comfort.[3] But it's also a useful place to study ways that life can adapt to cold and darkness, and to develop models of

the amazing degree to which the ice interacts with the Earth's climate. It even offers a unique astronomical observatory, with a high, dry climate and a well-staffed base at a location where it's possible to point a telescope at a dim spot in the heavens—and leave it pointing at the same place continuously for months at a time.

[NOTE 3: The much-publicized experience of a cancer-stricken doctor trapped at the South Pole in the winter of 1999 indicates, however, that there are still a few limits to these abilities. Even today, if you choose to linger at a research site until the deep cold sets in, you'll need to winter over.]

The research ranges from geology to meteorology, from astronomy to biology. Many observers have called Antarctica the canary in the coal mine for early warnings about global warming.[4]

[NOTE 4: Old-time miners used to carry canaries in birdcages to provide early warnings of toxic gases. Being more sensitive to these gases than humans, the birds would keel over while there was still time (hopefully) for the miners to escape. Similarly, Antarctica's vast ice sheets have the attention of climatologists because the ice reacts unusually strongly to minor changes in climate. Global warming research, however, is beyond the scope of the present article.]

This article, though, will focus solely on biology, and how findings in Antarctica are not only changing our definition of the Earth's biosphere, but providing valuable insights for the search for extraterrestrial life. It's a story that begins in one of our own world's most “unearthly” locales.

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Antarctic “Oases”

In Antarctica, an “oasis” is any inland region not covered by ice. The largest are the McMurdo Dry Valleys, which cover a combined 1,500 square miles—an area about midway between that of Rhode Island and Delaware.

These valleys are the closest climate to that of Mars that the Earth has to offer. A freeze-dried desert where it hasn't rained in two million years (although it does snow occasionally), these valleys lie on the seaward slopes of the 14,000-foot Transantarctic Mountains. Here, rapidly rising peaks blocked the flow of ice from the high plateaus of the interior, allowing only small tongues to spill through gaps in their rocky spine. These glaciers, puny by Antarctic standards, never melt, but neither do they reach the sea. Rather, their ice sublimates into the super-dry air. It's the same process by which frozen carbon dioxide evaporates—but without dry ice's special-effects fog. A similar fate awaits the scant accumulations of snow that the valleys draw each winter; it either blows away or sublimates.[5]

[NOTE 5: For many of these details, I am indebted to the Lonely Planet guidebook to Antarctica, the best (and perhaps only) comprehensive travel guide to the southernmost continent.]

What's left is a sprawling expanse of sedimentarily banded mountains and wind-blasted rock, with all the classic landforms of mountain-glacier valleys. Not surprisingly, it's an inhospitable realm. One monitoring station has reported an annual average of 6.2 “degree days” above freezing per year, meaning this frosty land only warms above freezing for the equivalent of slightly less than one week at 1°C (34 °F), or one day at 6.2 °C (43 °F). If you think that sounds a bit like the Martian poles, you're in good company. Scientists working in the Dry Valleys see themselves as perfecting techniques with direct applications to Mars.

When Antarctic explorer Robert Scott discovered the valleys in 1903, he was impressed both by their desolate beauty and their apparent lifelessness. Other than the mummified remains of a seal that had somehow wandered 25 miles inland, he wrote: “[W]e have seen no living thing, not even a moss or a lichen.... It is certainly a valley of the dead; even the great glacier which once pushed through it has

withered away."[6]

[NOTE 6: From Scott's *The Voyage of Discovery* , as quoted in the Lonely Planet guide.]

As recently as 10 years ago, biologists would have agreed, pooh-poohing the notion that Antarctica's frozen deserts could support life. Sure, the Antarctic is a land of penguins, seals, and whales, but all of that is marine life, concentrated in the rich but narrow swath where sea collides with ice and rock. Inland, everyone *knew* that the entire continent was lifeless.

Then someone looked beneath the surface. And scientists found that Scott's "valley of the dead" was teeming with life.

Life has been found in the interstices of Sun-warmed rocks. It's been found in the glaciers and in the brine lake that yielded the yellow salt crystal. "We're finding life almost everywhere we look," says John Priscu, a professor of ecology from Montana State University.[7]

[NOTE 7: For more on Priscu's research, visit his web site at www.homepage.montana.edu/~lkbonney. Lake Bonney is where most of his research was carried out.]

Most recently, Priscu's team has been looking for life inside the ice that caps the brine lakes. The result is one of the most bizarre findings yet to come out of the Dry Valleys.

The lakes are glacial potholes that have existed long enough to become considerably saltier than seawater. Briny liquid exists year-round in their depths, but their surfaces are permanently frozen.[8]The ice atop these lakes is cracked and frost-heaved into knee-high ridges. These features are a nuisance to the scientists, whose equipment is knocked out of alignment every time the ice shifts, but the ice movements are also exciting, because they appear to mimic ice behavior on Europa, a Jovian moon that may have liquid water beneath a miles-thick ice cap. If so, the Dry Valleys offer an earthly laboratory for perfecting exploration techniques not only for Mars, but also for Europa.

[NOTE 8: This is one ecosystem that's not being threatened by global warming. If anything, the Dry Valleys are getting colder, not warmer.]

The ice is about a dozen feet thick, floating on as much as 300 feet of water. Early research focused on microorganisms in the brine. Life in the ice itself was discovered somewhat by accident, when scientists trying to sample the lake waters kept dulling their drill bits in a band of rocky sediments trapped in the ice about six feet beneath its surface. As long as the sediments kept drawing attention to themselves, the biologists looked into them in more detail—and discovered an entire community of organisms subsisting in remarkable balance with them.[9]

[NOTE 9: Priscu, J.C., et al, "Perennial Antarctic Lake Ice: An Oasis for Life in a Polar Desert," *Science* , Vol. 280, p. 2095-98, 26 June 1998.]

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Down the "Up" Escalator

The dirt gets into the ice when it is deposited on the surface during gales that bring it in from locations at least as far away as South America. During the long Antarctic summer, the dark particles absorb enough solar heat to melt their way into the ice. They come to rest when they've tunneled deep enough that too little sunlight reaches them to support continued downward melting.[10]

[NOTE 10: This description omits a few complications that aren't necessary for the present discussion. Sediment

accumulation on the bottom of the lakes, for example, indicates that some of the dirt penetrates all the way through the ice. In fact, if this didn't occur at approximately the same rate as that at which new dirt arrives on the surface, the ice would by now have built up a truly enormous load of grit. The feedback mechanisms that regulate this process, however, are not understood. Nor is it understood how *any* of the dirt manages to get all the way through.]

Meanwhile, the ice itself is slowly moving upward. Each year, about a foot of new ice freezes onto its bottom, while the same amount disappears from the top by sublimation and wind ablation. Priscu describes this whole process as a slow-motion conveyor belt that moves ice toward the surface at the rate of about a foot a year.

The dirt particles play at least two critical roles in creating a suitable niche for bacteria. First, they provide a substrate that resists the ice's upward-conveyor-belt motion. This occurs by a simple feedback mechanism: as the surface ice ablates, more solar energy reaches the dirt, melting resumes, and it tunnels back to its original depth. Rather than being conveyed to the surface to die or go dormant, the bacteria ride with the dirt grains, adhering to them in a layer called a biofilm.[11]

[NOTE 11: Biofilms aren't unique. Many bacteria become attached to surfaces in this manner, clinging to them with remarkable tenacity. If you're running a food processing plant or other environment that you'd like to keep sanitary, biofilms are a major nuisance because they're hard to scrub off, and may even resist chemical sanitizers. From the bacteria's perspective, the ability to support each other by “linking arms” this way is an important survival adaptation.]

Secondly, even when they're not tunneling downward, the dirt particles still receive enough energy for liquid bubbles to form above them. “Bubbles” is actually a poor name for these beautiful fractal patterns, which can extend well above the dirt like bouquets of fern fronds or flower stems.[12]The biofilm may help here, too, by gluing small dirt particles together into clumps that absorb extra energy.

[NOTE 12: Priscu has a nice photo posted on his web site.]

Liquid forms elsewhere in the ice (which warms up nearly to the freezing point each summer) but there's more near the dirt, and it persists for as long as 150 days each year.[13]Not only do these bubbles provide extra, longer-lasting sources of liquid water, but they create light pipes that channel sunlight onto the dirt—increasing the energy available for photosynthesis.

[NOTE 13: For an ecosystem that's persisted so stably for so many years, the Dry Valley lakes are remarkably precarious. Priscu estimates that the ice actually comes pretty close to melting out each year. If the valleys were only a few degrees warmer, he speculates, there would be no permanently iced-over lakes—and earthbound researchers might never have learned that bacteria can grow and multiply in such environments.]

Given the fact that the ice contains plenty of trapped atmospheric gases, sunlight and liquid water are all that is needed for an entire food chain to form in the dirt layers. Adequate quantities of trace nutrients blow in on the dirt particles or migrate upward from the underlying lake waters in the icy “conveyor belt.”

At the base of this food chain are photosynthetic bacteria and ones that fix nitrogen from the air; farther up it are “heterotrophes” that browse on the photosynthesizers. None of these creatures, either here or in the underlying brine lakes, are particularly exotic—"You're not going to go ice fishing and catch anything,” Priscu quips—but the niches they've found are vastly different from those that temperate-climate surface-dwellers such as ourselves traditionally think of as life-supporting. Such findings necessarily raise questions about what other ecological niches we may be continuing to overlook, right here on our own planet.

But those questions are only the beginning. What are the implications for space research?

1. Life is far more adaptable than scientists once thought. If there's liquid water and an energy source—even a poor one—life can survive conditions once deemed impossibly harsh.
2. Life can and does find these bizarre micro-niches. In the Dry Valley lakes, it appears to have stemmed from soil bacteria blown in with the dust. But other research has found still-viable bacteria that have been

dormant for as long as 25 million years—indicating that “blown in with the dust” might apply across interstellar distances. This lends support to those who argue the theory of “panspermia,” under which terrestrial life arrived via a meteorite. It also ups the chances of finding recognizable life on other planets, because we and it might share common ancestors.
3. Life is opportunistic. The organisms in the Dry Valley lakes grow much better under more reasonable conditions. In the ice, “they're just barely hanging on,” Priscu says. But hang on they do. Most importantly, what this means is that before we go looking for life in the rocks of Mars or beneath the ice of Europa, we'd better take extraordinary precautions to make sure that what we find hasn't simply hitchhiked with us. There's been a lot of talk about this in the realm of unmanned probes, but it's a much, much larger obstacle to human exploration. A single fingerprint on a spacesuit or a puff of unfiltered air through an airlock could be all it takes to contaminate an entire world—and the more thorough are the precautions against this, the greater are the chances someone will get lazy. The entire subgenre of science fiction stories in which human explorers blithely tiptoe through the alien tulips may be unrealistic unless scientists long ago gave up on preserving the microbial segments of any truly alien ecologies they encounter.
4. Liquid water is crucial. Dormant bacteria can survive almost indefinitely in the deep freeze, and may even be able to tolerate states that in higher animals would be called mummification. But without liquid water, they stay dormant. So far, there's no indication that we'll find active organisms in cometary snowballs or carbon dioxide glaciers—unless there's also a mechanism to create damp spots within these realms. Where there are damp spots, however, we may find life working in tandem with inanimate forces to make these niches larger and wetter than might otherwise be the case.

These bacterial survival tales also carry intriguing implications for evolutionary biology.

Some earthly ecosystems have been isolated from the outside world for millions of years. In the case of the Dry Valley lakes, it's unlikely that anything truly bizarre has evolved in their depths—presumably a few of the bacteria in the overlying ice occasionally get into their waters, keeping them in at least tenuous genetic contact with the outside world. But the lakes do provide at least one opportunity for researchers to study organisms that have been locked away from the surface world's evolutionary processes for extremely long periods of time. Priscu's team plans to drill tiny holes into the water bubbles in lake-bottom salt crystals and study the DNA of whatever microorganisms might have been trapped there, thousands or millions of years ago. Elsewhere, other long-stable geological deposits may carry the dormant forms of even older microorganisms—some of which may even be viable.

Everyone knows that bacteria have the ability to evolve with remarkable speed—each new headline about antibiotic-resistant pathogens reminds us of this all too clearly. But these organisms’ ability to time-warp into the future by going dormant for millions of years is much less discussed. Bacterial strains that appear to have been supplanted by new, mutated versions needn't go extinct. They may simply go dormant until the future offers them a new opportunity to prosper. It's evolution with the brakes on—or with a roadmap for backing rapidly out of dead ends. The human equivalent would be for a tribe of Neanderthals to suddenly walk out of hibernation in a cold winter—or for protohumans to emerge in areas sufficiently altered by global climate change. A few bold science fiction writers have attempted write a bacterial-eye view of the world, but we now know that it's a lot weirder than any of these stories might indicate.

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Cold, Dark, and Erie Beneath the Ice

Fascinating as they are, the Dry Valley findings are a minor link in the chain connecting Antarctic research

to planetary science. The big prize lies inland, below the high, desolate expanse of the East Antarctic Ice Sheet.

If the Dry Valleys are starkly beautiful, the ice is simply stark. But to Robin Bell, a geologist from Columbia University's Lamont-Doherty Earth Observatory, it's a source of endless fascination. One day in late 2000, she and a coworker crammed a Twin Otter aircraft with as many instruments as it could carry and set off to crisscross a 6,000-square-mile region of the ice.

On first impression, Bell could hardly have chosen a less interesting area: a vast, nearly featureless plain stretching as far as the eye could see. But to her experienced eye, parts of that plain are interesting simply because they are so featureless. The center of Bell's attention was a region of ice that, apart from transient snowdrifts, extends for dozens of miles like a giant airplane runway flanked by a low ridge. It's as though the ice, in its slow crawl across the continent, had dipped off a low bench onto something broad, flat, and preternaturally smooth.

Bell knew exactly what that "something" was: one of the world's largest lakes, buried beneath more than two miles of ice. It's called Lake Vostok and was discovered in the 1970s from seismic data collected by Russian scientists—although it wasn't until 1993 that anyone realized the magnitude of the find.[14] The lake is long, thin, and roughly the size of Lake Erie or Lake Ontario—about 140 miles long and ranging from 10 to 35 miles across. But unlike these lakes, it's at least 1,900 feet deep, with the landforms of a fjord, flanked by rugged mountains.

[NOTE 14: The lake is named for Russia's Vostok station, itself named for a ship used by a nineteenth century Russian explorer. The station was built atop the lake purely by coincidence, and researchers there were happily extracting core samples from 10,000-foot-deep boreholes at the time the scientific world learned that what lay beneath was more than the uninteresting puddle revealed by the 20-year-old reports. Had the drilling continued for only a few more months, the researchers would have had an enormous surprise—but they'd also have irreparably polluted the lake with the chemicals used for deep-ice drilling. (Hydraulic fluid, in this case kerosene, is traditionally injected into such boreholes to keep the pressure of the ice from immediately squashing them shut). Antarctic researchers were extremely lucky that Lake Vostok was discovered before it was too late.]

Bell's goal was to use surface-penetrating radar to map the subglacial terrain and the stratigraphy of the overlying ice in greater detail than seismology permits. In the process, she hoped to shed light on one of the burning questions of Antarctic research: could this cold, dark lake—a remarkable earthly analog to the ice-buried oceans of Europa—possibly support life?

Bell views herself as a climatologist, studying a subglacial climate. "Who lives there," she says of the lake, "depends a lot on the 'weather'—the subglacial weather in geological time frames."

This "weather" is influenced by the movements of the ice, whose slow changes lend new meaning to the concept of "glacial" pacing. Here, the conveyor belt moves horizontally, as the ice drags across the lake at perhaps five feet per year—so slowly it takes 15,000 to 20,000 years for a single puff of glacial "cloud" to move across the "sky."

The weather analogy is particularly apt, for these glacial clouds even produce continuous drizzle as they follow their ponderous courses. Not that it's precipitation as we know it. What happens is far more strange.

When the ice flows from the rock to the water, scientists are convinced that for the first few thousand years, it slowly melts into the lake. When it approaches the far side, the process reverses, with lake water freezing back onto the ice at a rate of about three inches a year—just enough to offset the melting occurring near the opposite shore. If the melting is analogous to rainfall, this refreezing is the Lake Vostok version of evaporation.

Scientists have complicated reasons for believing this happens, but the theory hardly matters. Bell's data and seismic readings indicate that such a process is going on, and scientists have confirmed it by drilling into the accretion ice, more than 10,000 feet below the surface.[15] What they found was ice that's radically different from the generic ice cap material, with individual crystals up to three feet in diameter—a fairly sure sign that they formed slowly out of the lake rather than in the overlying ice cap. Core samples of the accretion ice may even permit long-term studies of the lake's climate cycles, since the age of the accretions diminishes as one drills closer and closer to the water.

[NOTE 15: So far, as we'll discuss below, scientists have continued to refrain from drilling all the way into the lake.]

What all of this means is that even though geologists estimate that Lake Vostok has been under the ice for 30 million years, it's not entirely sealed off from the outside world. Instead, it's constantly exchanging material with the ice. And that's important because the ice carries nutrients—and the seeds of life.

The lake's contact with the outside world, however, occurs only after a time delay of about 450,000 years. That's how long scientists estimate it takes material to work its way from the surface of the ice to its base, where the horizontal “conveyor belt” can carry it into contact with the lake.

The process begins with the same gales that deposit dust and bacteria on the top of the Dry Valley lakes. These gales, common throughout Antarctica, also deposit grit, grime, pollen, and other organic material on the snows of East Antarctica. Blown in from dusty areas in South Africa, Chile, and beyond, this detritus contains microbes that can remain viable even after their long sojourns in the ice.

They work their way downward by a process that mimics, in reverse, the way that the Dry Lakes’ ice moves upward. Richard Alley, a geoscientist from Pennsylvania State University, analogizes the ice sheet to a puddle of pancake batter poured onto a griddle. Ladling on more batter won't make for a vastly thicker pancake; instead, it just spreads sideways. That's what happens to the ice cap with each winter's snowfall. Some of the ice eventually runs into the ocean, but much of it melts off the bottom of the stack from the combination of pressure and friction against the underlying rocks. On average, it takes 450,000 years for debris to work its way from the surface of the ice to its bottom.

What happens when this debris reaches the lake is less certain.

One prospect is “not much.” Of the necessities for life, one—liquid water—is obviously present in copious supply. But that water might be very, very pure, giving the bacteria nothing to eat but each other and the pollen grains and other organics that slowly rain into the lake with them. Even this limited food supply might not be of much use because the lake waters could be oxygen-depleted (not unlikely under deep, high-pressure conditions). Since photosynthesis is obviously impossible in this dark environment, what's left is an aborted ecosystem that can't use the little food that reaches it. The bacteria simply drift around, never truly waking from their 450,000-year hibernation. Eventually they die, freeze into the accretion ice, settle to the bottom in sediments, or otherwise disappear.

The other three scenarios are more interesting. Let's refer to them as “marginal,” “teeming,” and “delightfully weird"—although scientific notions of deep-water ecology have changed so rapidly that only a few years ago the “marginal” scenario would have been viewed as highly exotic.

In the marginal scenario, there is oxygen in the lake—but only enough to power an extremely slow-motion ecosystem. Growth is so gradual that it might take 100 years for bacteria to scrape together enough nutrition and energy for a single generation of cell division. But beneath miles of ice, even this level of activity would be a tremendous find by pre-Vostok expectations.

Core samples from the accretion ice have yielded bacteria, giving wishful thinkers support for hoping that the lake houses at least this minimal level of ecological activity. But unfortunately, the core samples aren't

incontrovertible proof. The bacteria might simply be wanderers that melted out of the ice cap into the lake, then froze back into the accretion ice without ever waking from their long dormancies.

As recently as early 2000, the "marginal" scenario appeared to be the dominant view.[16] But in early 2001, Priscu went out on a limb with a different prediction.[17] He believes that when scientists eventually drill into the lake, they'll find its waters to be rich with life.

[NOTE 16: See Oliver Morton, "Ice Station Vostok," *Wired* , April 2000, pp. 121-46. This article also contains an excellent, detailed discussion of the technical and environmental-policy issues related to drilling into the ice at Vostok and on Europa.]

[NOTE 17: See NOTE 1.]

He reached this conclusion by chemically analyzing the accretion ice and comparing it to the overlying ice cap, interpreting the results in light of his experience with the Dry Valleys lakes. One simple observation, for example, was that the accretion ice is low in nitrate. The tentative conclusion: biological processes in the lake are scouring out nitrates, which are an essential building block for proteins.

Based on his chemical analyses, Priscu has reached two important conclusions: (1) Lake Vostok is composed of fresh water, not brine; and (2) it probably contains about one million bacteria per milliliter—comparable to bacterial populations in ocean waters above highly productive continental shelves. "The preliminary evidence indicates that this lake has a thriving bacterial community," he says.

Priscu's analysis doesn't require him to explain where such an ecosystem finds its energy. Perhaps there's simply more free oxygen than biologists had expected. Alternatively, he might be seeing the biochemical signatures of our fourth scenario....

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Fueling "Delightful Weirdness"

None of the first three Vostok scenarios holds out much hope for life on Europa. It's unlikely that there will be a steady supply of organic material raining through that world's ice cap to feed hungry bacteria. If life exists on Europa, it's going to need another energy source.

The hoped-for energy source is geothermal, in the form of mineral-rich hot springs that gush into the frigid waters like liquid geysers. On Europa, this energy might be created by tidal friction from that world's proximity to that gravitational monster, Jupiter.[18] Mathematical models indicate that this could easily generate enough heat to power any number of hot-water vents beneath the ocean. In the Earth's oceans, life loves these vents, creating intricate biochemistries to take advantage of energy sources once believed to lie only in the realm of inorganic chemistry. And *these* biochemistries run perfectly well without oxygen.

[NOTE 18: Tidal heating occurs when tides alternately strain a planet's crust and allow it to rebound toward its natural shape. The resulting stresses generate friction-like heat.]

Lake Vostok could also benefit from a higher-octane energy source, but it doesn't need Jovian tides to create one. All it needs is to be in a geologically active area, where magma percolates close to the surface and earthquakes heat crustal rocks by rubbing them against each other. Determining if this might be the case is another aspect of Bell's study of subglacial weather.

The answer appears to be another of those situations where the data confounds expectations. Until recently, Bell says, geologists thought East Antarctica was "flat, old, boring continental crust" similar to

northern Canada—the type of region geologists expect to be stable.

The first hint that something might be different comes from the lake's shape. Generally, deep, fingerlike lakes are either glacially-carved fjords—not likely in this case[19]—or follow rifts where geological forces are attempting to pull a continent apart. Africa's Great Rift Valley is an example—and it houses Lake Malawi, which looks a lot like Lake Vostok.

[NOTE 19: Lake Vostok is large, but the ice sheet is immense. There's no obvious reason why fjord-building processes should have carved such a trench here and not elsewhere. Also, the ice is flowing crosswise over the lake rather than lengthwise, as happens with glacial fjords.]

Subsurface mapping makes the region look even more like a rift valley. Radar and seismic soundings indicate that it sits near the boundary between two major geological features. One is the little-understood Aurora Basin, which bottoms out at about 2,500 feet below sea level. The other is the Gamburstev Mountains, which rise 12,500 feet above the basin (but still don't reach the top of the ice!).

The next question is whether this is an active boundary, or merely a relic of ancient plate tectonics.

The best way to answer this question is by looking for earthquakes. Historical records reveal three, magnitudes 4.0 to 5.0, falling in a line just east of Lake Vostok. But only one was within the last 20 years, which means that the other two were mapped with old equipment whose accuracy is suspect. Bell's geologists therefore went on an earthquake hunt by setting out more, and better, seismic equipment to monitor the putative fault line for smaller movements. And on January 5, 2001, they struck gold: a magnitude 3.0 temblor whose epicenter lined up nicely with the other three.

For biologists hoping to find multicellular organisms in Lake Vostok, this is enormously good news. Combined with the slow infusion of organic material through the ice, hot springs set the stage for some exotic ecosystems, similar to those now being found in deep-ocean trenches. There, hot-water vents feed not only enormous numbers of bacteria, but also colorful, yard-long tube worms that grow from every available surface, swaying in unison in deep-water currents.[20]

[NOTE 20: An upcoming IMAX movie, previewed at the 2001 AAAS meeting, will show these ocean-bottom ecosystems in wondrous detail. If the clips presented at the meeting were any indication, it's a not-to-be-missed spectacle.]

Biologists would love to find such creatures in Lake Vostok—and would be even more thrilled to find them on Europa—but the researchers aren't about to make wild predictions. So far, Priscu notes that nothing found beneath the ice has been all that strange. It's just been familiar soil bacteria in some wildly unfamiliar niches. “But that doesn't mean that down in the deep waters we wouldn't have something unusual,” he adds hopefully.

What nobody's talking about is that if something odd does exist on the bottom of Lake Vostok, it's been isolated from similar life-forms for at least 30 million years. Bacteria percolating slowly through the ice may keep the Vostok system in time-delayed genetic contact with the outside world, but it's unlikely that tube worms could have similar contact with the outside. If Vostok has such creatures, they could look considerably different from those found elsewhere.

Even more speculative is the possibility of genetic contact between Vostok and other subglacial lakes, of which about 75 are known. Could there be links between them? Could accretion ice or its meltwater, complete with its load of microorganisms, be transported from one lake to another? Or are the lakes isolated enough each to develop its own unique ecology?

The prospects become even more interesting when one realizes that this might be a model for off-worldly evolution. Like the lakes beneath Antarctica, Europa too might house tiny islands of life, surrounded by

inhospitable oceans across which migration is a slow, risky business. Europan tube worms (or their equivalent) might evolve quite differently at each hot-springs oasis, creating separate, fine-tuned biochemistries at each site. A not wildly implausible story scenario could have microbe-hunting pharmaceutical companies competing to find and exploit as many of these ecologies as possible in the hope of striking it rich with the latest crop of wonder drugs—or terror weapons.

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To Drill or Not to Drill...

In Antarctica, the big question, of course, is when and how scientists will tap into Lake Vostok. Priscu predicts that in five to 10 years, samples will be drawn from some lake, although it might be one that's smaller and less unique than Vostok. But a fight between scientists and environmentalists is mounting over whether the attempt should be made at all.

Pointing to Dry Valleys lesson number 3 on page 54, above, environmentalists doubt that drilling can be conducted without undue risk of contamination. “Lake Vostok is to Antarctica what Antarctica is to the rest of the planet: remote, pristine, and unique,” Ricardo Roura of the Antarctic and Southern Oceans Coalition said in a speech quoted by *Wired* magazine.[21] “You scientists have decided *a priori* that something must be ‘done’ with Lake Vostok as soon as technically possible, while the most appropriate option to protect the ultimate scientific and environmental value of Vostok would appear to be to postpone drilling the lake for the indefinite future.”

[NOTE 21: Morton, pp. 134-36.]

Erb replies to such concerns by saying that scientists see Vostok as an “international treasure,” which they won't penetrate until all interested nations agree that the technology is up to the task. Adds Priscu: “I assure you that all of the scientists involved are stewards of the environment, and we do not want to contaminate [it].”

The debate, however, is unlikely to be resolved easily. No honest scientist can guarantee that when the drilling operation comes, it will be completely without risk.

However many years pass before biologists ultimately drop a probe into Lake Vostok, the cold waters and ices of Antarctica have already shown the error of some of humanity's most cherished preconceptions about life and the Earth. No longer can science-fiction stories simplistically paint our world as an oasis of warmth in the cold desert of space. By interstellar standards, the coldest parts of Earth are indeed warm, but by human standards, much of the Earth's biosphere is cold. Some of it is very cold. Antarctic scientists like to point out that 14 percent of the globe is polar and 90 percent of the ocean's waters never get above refrigerator temperature. By human comfort standards, they note, we actually live on a rather chilly planet.

These scientists have also revealed that this chilly planet's biosphere is larger and more diverse than we'd ever before dreamed. And that's certainly food for thought as we look for additional life-supporting niches both here and on other worlds.

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Richard A. Lovett holds a B.S. in astrophysics, a law degree, and a Ph.D. in economics, but since 1989, he's been that rare beast, a full-time free-lance writer/photographer. He's written six books and more than 2,200 articles for a publication list that includes*Science* ,*Popular Science* ,*Backpacker* ,*Sierra* , *Travel & Leisure* ,*The Economist* , and most of the large newspapers in the U.S. and Canada. His diverse specialties include adventure travel, toxicology, remote sensing, ecology, environmental policy, food microbiology, and analytical chemistry. His latest project is a running book co-authored with Alberto Salazar, three-time winner of the New York City Marathon.

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The Alternate View: The Next Big Accelerator
John G. Cramer

In 1993, the U.S. Congress canceled the Superconducting Super-Collider Project (SSC), the Department of Energy's $8 billion high-energy proton-proton collider synchrotron that was then under construction in Waxahachie, Texas. About $2 billion had been spent, the ring tunnel was 40% complete, the first prototype superconducting magnets had shown excellent performance, and the project was moving forward at a rapid pace, when Congress shot it down. The SSC was to have been the next great leap forward for particle physics in the United States, the project that was to take us into the 21st century with leadership in this forefront area of physics. Instead, the plug was pulled, producing a disaster for all of particle physics. A fictionalized account of the events leading up to the project's cancellation can be found in my hard SF novel*Einstein's Bridge*.

In the aftermath of the SSC cancellation, the rival European project, the CERN Laboratory's Large Hadronic Collider (LHC) was delayed after the SSC's competitive pressure had been removed, and its target date of first operation was pushed back from 2000 to about 2005. Many particle physicist refugees from the SSC collapse managed to reach some accommodation with CERN and have joined the LHC construction effort or one of the three LHC detector groups (ATLAS, CMS, and ALICE). Many others, particularly the younger SSC physicists, have had to abandon their careers in physics altogether and now work as bankers, software developers, stockbrokers, etc. Some attribute the recent instability of the stock market to the influx of former-SSC physicists with new schemes for market manipulation.

Accelerator physicists in this country—that sub-group of physicists who specialize in the design and construction of large accelerators—have suffered the devastating impact of two successive closures of major high-energy physics collider facilities by the U.S. Government; ISABELLE in 1985 and the SSC in 1993. Nevertheless, they are pushing forward again with the design for a new multi-billion-dollar collider facility, which they call the Next Linear Collider (NLC). In this effort they are in direct competition with a design group at the DESY laboratory in Hamburg, Germany that is proposing the Tera Electron Volt Energy Superconducting Linear Accelerator (TESLA) facility, and a design group at the KEK laboratory in Japan that is promoting the Japan Linear Collider (JLC). All of the proposed machines are “linear,” using a long straight line of accelerating structures as opposed to the circular magnet-ring design of the SSC and LHC. This is because when high energy electrons with some total energy E travel in a curved path, they lose energy rapidly due to synchrotron radiation at a rate proportional to E4. Above energies of about 100 GeV, this mechanism dumps energy so fast that curved-path acceleration doesn't work. Therefore, a linear accelerator must be used.

At the July 2001 high-energy physics gathering at Snowmass, Colorado, with the theme “The Future of Particle Physics,” there were detailed presentations from all three of these rival projects. The projects are very similar in many ways. All would collide electrons and positrons at an energy of 0.5 to 1 TeV (1012 electron volts) in the center of mass of the collision, with a luminosity (rate of collisions in a given area) of about 1034 collisions per cm2 per second. Each facility would be constructed in a tunnel about 30 km (19 miles) long containing two linear accelerators, each 15 km long, aimed at a collision point and detector complex at its center. Each would accelerate the electrons and positrons in several tens of thousands of superconducting cavity resonators that develop average accelerating electric fields of about 50 million volts per meter of cavity length. Each would require six to eight years to construct, once funding was secured. And each would have a large cost. At this stage the cost is not well specified, but informed guesses range between two and six billion dollars (or roughly this year's cost overrun for NASA's International Space Station Project).

In the present design studies, the two non-US facilities would be located in places that would exploit existing accelerator complexes in Japan and Germany. In one JLC design study, the collider would be centered at the KEK laboratory near Tokyo, with the linac arms extending away in oppositely-directed tunnels under suburban neighborhoods. Another JLC study, however, envisions using highway construction techniques to blast the accelerator tunnel from the stone under a mountain range near Tokyo, saving about a factor of 10 in tunnel construction costs but requiring more equipment construction because the existing KEK infrastructure could not be used. The JLC facility would also use the high-energy electron beams of the facility to create an x-ray laser. The free-electron laser formed by the ultra-low emittance electron beam would produce both incoherent and coherent beams of hard x-rays for applications in condensed matter physics and in molecular biology.

The design study for the TESLA facility would use the DESY laboratory in Hamburg as one injection station of the facility, with the village of Westerhorn 30 km away as the other injection station. The collision point and detector complex would be located at the village of Ellerhoop, half way between Hamburg and Westerhorn. The tunnel would be bored under urban and suburban neighborhoods and farmland in the vicinity of Hamburg. The Germans anticipate no*not-in-my-back-yard* (NIMBY) problems with local residents in doing this, because the DESY facility has been constructed in the same way—in tunnels deep under the city of Hamburg.

No site in the United States has been specified for the NLC design study done here. However, if the project goes forward, one can envision extensive site-selection hearings and site proposals similar to those that preceded the selection of the SSC site. The site-selection process for the SSC was very interesting to watch, because it brought the united interests of basic science, pork-barrel politics, and regional boosterism into direct conflict with the NIMBY concerns of the nearby residents and the sizable fraction of the population that has a deep-seated superstitious fear of anything nuclear. The culmination of the site selection process, with the selection of Waxahachie, Texas, ultimately based on the geology of the Austin Chalk beneath the site, was controversial, with many of the losers accusing the powerful Texas Congressional delegation of stacking the deck. If the NLC ultimately goes forward, the site selection should be a three-ring circus.

* * *

In about 2005, the new CERN LHC will bring pairs of protons into head-on collision at 7 TeV. That collision energy is about seven times greater than the energy of the three proposed linear colliders that were showcased at Snowmass. Therefore, it's fair to ask why we would need these machines at all if they run at lower energies than the LHC. The answer is in the details.

Protons are composite particles made of three quarks pasted together with gluons. The proton has a mass of about 936 MeV, but the quarks that form it have masses of only about 10 MeV each. The

remainder of the proton's mass is contained in the gluons and in the “Fermi motion” of the quarks, the kinetic energy of the quarks as they rattle around in their little box. The result of this is that when the quarks in two protons collide, they carry into the collision only a small fraction of the proton's total energy. Moreover, their collision energy is somewhat indefinite, because it is smeared by the quark Fermi motion. Thus, a proton collider is a shotgun, propelling multiple pellets at each other, each with a somewhat indefinite energy.

On the other hand, the proposed electron-positron colliders are more like a high-precision rifle. The electron and positron in collision are “pointlike” particles. They therefore bring all of their energy to each central collision. For this reason, a 1 TeV electron-positron collider is roughly equivalent to a 10 TeV proton-proton collider. Moreover, the electron-positron collision energy is not smeared by Fermi motion. Therefore, a 1 TeV electron-positron collider has particle production capabilities that compare very favorably with those of the LHC collider, and it offers many advantages in experiments where precise collision energy is important.

Why do we need such a machine? The problem facing contemporary particle physics is that the Standard Model, the current theory of fundamental particles and their interactions, works too well. It is in good agreement with the complete body of data collected by particle physics experiments during the past decades. However, it is not a theory that provides any deep understanding of the inner workings of the Universe. It is a paste-up theory that depends on about two dozen arbitrary “constants": particle masses, force strengths, and interconnection strengths. We have no idea where these constants come from or how they are related to each other. We are sure that there must be a better, more fundamental theory behind the Standard façade, but we cannot discover it without data at higher energies. We need an accelerator with enough energy to make the Standard Model “break.” We must find places where its predictions fail, so that we can learn what lies beyond. It is not clear that the LHC, with its 7 TeV proton collision energy will be able to do this job.

One dark cloud on the e_e+ collider horizon appeared during a panel on new facilities at the Snowmass Meeting. Michael Holland of the Bush Administration's Office of Management and Budget stated that in order to make the case for either the NLC or U.S. participation in the other projects, the particle physics community would have to demonstrate that the new facility was important not only to their own area of research, but also important to “science as a whole". Since no one can speak for science as a whole, this requirement would be almost impossible to satisfy.

Another panelist, Luciano Maiani, Director-General of CERN, declared that he found such a stringent criterion for federal support “unfriendly to science” and an inhibition to progress in basic research. Several members of the audience asked why NASA's Space Station and various defense-related projects were not being held to the same standard.

One key point on which the SSC Project foundered was the lack of international participation. The Europeans were pushing their own smaller project, the LHC, and President Bush (the elder) failed to directly ask Japanese Prime Minister Miyazawa for Japanese participation in the SSC construction during his famous up-chuck visit to Japan in January, 1992. This time around, if there is to be a 1 TeV electron positron collider somewhere in the world, it*must* be an international collaboration, with the strong American, European, and Japanese groups all working as a team to construct it and extract the physics lessons it will provide. Deciding where it will be built will be a major problem for all of the competitors. Persuading the chauvinistic and mercurial U. S. Congress and the Bush Administration, which has so far been accumulating an anti-science record, to become a major contributor to the project will be a major problem for the particle physicists of this country, particularly if the machine is constructed elsewhere.

Since no one else has yet had the temerity to venture into these waters, let me make a modest proposal. I

suggest building the new electron positron collider in the Australian outback. Then, like most U.S. National Laboratories, it would be located in a remote and forbidding place, roughly equidistant from all of its designers and users, and constructed on inexpensive neutral ground where none of its promoters will have an advantage and everybody will be equally uncomfortable.

References:

Background on the cancellation of the SSC Project:

Einstein's Bridge, John Cramer, Avon (1997), ISBN 0-380-78841-4.

See also the URL: http://faculty.washington.edu/jcramer/EBridge/EOS.html

The Japanese JLC Project:

See the URL: http://www-jlc.kek.jp

The US NLC Project:

See the URL: http://wwwproject.slac.stanford.edu/lc/nlc.html

The German TESLA Project:

See the URL: http://tesla.desy.de

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The Reference Library

Reviews by Tom Easton

Do you sometimes wonder why I review a lot of TOR books? They bring out a lot of good stuff, but so do other publishers. I review a lot of TOR books because a lot of TOR books show up in my mail.

Publishers who think I don't pay enough attention to their books thus have only themselves to blame. I live in a rural area, where the post office has for years periodically changed the number of my rural free delivery postal route and even the number on my mailbox. When they do so, I try to notify publishers of the change, but some just don't seem to pay attention—some are actually still sending books to a box/route combination twenty years out of date! The post office and UPS folks know me well enough to get many such books to me anyway, but not all. Many get returned.

However, even rural areas can catch up to modern times. Thanks to E-911, I now have a house number and street name: 218 Waterville Road, Belfast, ME 04915.

Publishers and authors please take note.

The Free Lunch

Spider Robinson
TOR, $22.95, 255 pp.
(ISBN: 0-312-86524-4).

I hadn't heard much from Spider Robinson for awhile, so it was a pleasure to find **The Free Lunch** in my

mail. It was a pleasure to read it, too, and I am quite sure you will agree.

The premise is simple: Disney has been topped by Dreamland, a theme park whose rides and areas derive in part from the many realms of science fiction and fantasy. Fireworks, elves, unicorns, trolls, and Lummox the Star Beast. Heinlein is there, and so is Robinson (Callahan's Bar, of course). The fun stuff, you know.

And here comes Mike, a twelve-year-old boy fleeing the Real World. He's smart and clever, and he has a plan, to slip off the Unicorn's Glade ride, disguise himself as an Elf, and merge with the scenery, to move into Dreamland permanently. He barks his shin, but he's doing fine, really, until an audioanimatronic Elf whirs up to him and says, “If you leave that bloodstain out there on the set, they'll know, and they won't rest until they find you.”

Meet Annie, who has been “Under” for the last thirteen years and is known only as a rumor of the “Mother Elf.” She takes a liking to Mike and shows him the ropes. Meanwhile, far away, the evil master of Thrillworld, a darker, more violent theme park, is scheming to destroy Dreamland. He even thinks he has a handle, for surveillance has shown more Trolls leaving the grounds at the end of a shift than ever went in at the beginning. Something strange is going on, and if he can just figure out what, he can blackmail or expose and thereby destroy. So he rubs his hands and twists his mustache and chortles and calls his black-hearted henchman, Conway.

Meanwhile again, Annie has also become aware of the extra Trolls. She too wants to figure out what they're about, but not to destroy Dreamland. She's afraid they're part of some nefarious plot aimed at her home, and she wants quite fiercely to defend. Mike's with her, and when he suggests that the extra Trolls are beaming down from a mother ship somewhere Out There....

Conway tries to kidnap Annie, but Mike ingeniously and courageously foils the scheme. Then he intercepts a pair of the surplus Trolls, Hormat and Durl, figures out where they really come from, and tries like mad to get them to say what they're up to. Meanwhile, here comes Conway again....

All's well that ends well, of course, and all ends very well indeed here, albeit with a surprising note of bittersweet at the very end.

Mike and Annie are the kind of characters that return to mind long after the book is done, and the tale is as jaunty as only Spider can make it in his Callahan mode. How can you possibly fail to enjoy this one?

And how can Hollywood fail to see the potential here?

Ghost of the White Nights
L. E. Modesitt, Jr.
TOR, $ 24.95, 398 pp.
(ISBN: 0-765-30095-8).

L. E. Modesitt's “Ghost” trilogy began from the premise that ghosts could be real, appearing after traumatic deaths, lingering, and spooking folks enough to make war difficult. As a consequence, history took a different course. The Dutch remained a strong presence in North America, from New Amsterdam up through New Bruges (New Hampshire). New France occupied Mexico. And the Hapsburgs undertook to unify Europe much as the Nazis tried to do in our own past.

The series’ protagonist is Johan Eschbach, once a secret agent and government minister, now a professor of environmental economics and politics at a small New Bruges college. His wife, Lysette DuBoise, a refugee from the prison camps of what used to be France, is a professor of music and a superlative singer, a diva without peer kept from the stage by politics. In*Of Tangible Ghosts* , Johan found himself in the middle of a scheme to create and destroy ghosts at will. Since creating a ghost means separating

the ghost from a living human and turning the human into a zombie, the ability to create ghosts would add a powerful weapon to the world's arsenals. The ability to destroy them would, by removing distractions and reminders of evil from battlefields, make war more feasible.

In*The Ghost of the Revelator* , Lysette was invited to perform in the Salt Palace of Great Salt Lake City, capital of the nation of Deseret, and then at an awards dinner in Washington, capital of Columbia. Johan found his ghosting tools useful in obtaining energy technology for Columbia, and Lysette found her performing career back on track. There was even a CD that did quite well on the classical market and edged onto the popular-music charts.

And now here's**Ghost of the White Nights** , in which Lysette is invited to St. Petersburg to sing before the Tsar in a high-profile exchange concert. As before, Johan is asked by his government to dust off his secret-agent skills. Lysette's mission is real and valuable and appreciated, but would he please take advantage of this oh-so-legitimate cover to try to give the Russians a bit of environmental technology to help ward off the Hapsburgs and to help gain an oil concession in Russian Alaska? As usual the most important part of his mission is the least explicit: the Russians are flying “research” rockets that just might be able to carry military payloads; they have the technology for destroying ghosts; a rebellion of university students was put down with slaughter, according to rumor; the university is now vacant, closed till the next term, with no sign of ghosts haunting the grounds, and the registrar's records of current enrollment are nowhere to be found. Johan puts the pieces together to see a chilling whole. Then he schemes and acts to forestall what might all too easily turn into a global disaster.

Modesitt has a good hand with both characters and plot. This one is very satisfying and well worth your attention.

Alien Taste
Wen Spencer
ROC, $6.50, 313 pp.
(ISBN: 0-451-45837-0).

Wen Spencer's**Alien Taste** is a very promising first novel. Ukiah Oregon is a young man whose childhood memories are of the wolf pack that raised him. Until he was found in a wolf trap, gnawing on rabbit guts, he had no language, no parents, no place in the human world. But the woman who found him took him home to her partner, named him for the town where he was trapped, and discovered that unlike other feral children, he was not irretrievably damaged. Indeed, he learned to speak very quickly, became socialized, soon came to love his Moms, and in due time showed an ability to track that went well beyond anything a wolf can do. He could even read DNA to identify bloodstains!

Perhaps not surprisingly, he became the partner of a private investigator, Max. Ukiah's specialty is finding missing persons, and his record is excellent. It is thus just another job when the cops call for assistance on a multiple murder: three college girls carved up with a sword and their roommate missing.

Ukiah tracks the roommate into the woods of a nearby park, finds her with the sword, and nearly dies before he shoots her. And that's where the strangeness begins: mysterious folks lurking in the shadows, speaking a tongue that Ukiah dimly recalls from the distant past. Organs that turn into small beasts to chew their way out of sample bags and slaughter the coroner. A criminal gang, the Pack, whose members cannot be kept in any cell. A second gang whose members attack those of the first on sight. A kind of vampirism. A Mars Rover that suddenly starts ignoring control signals and takes off across the Martian landscape.

Do you get the feeling that Ukiah isn't quite human? It takes him quite a while to reach that same conclusion, but by then it doesn't matter. Spencer has made him a very appealing protagonist; he is loving and honorable, a warrior against chaos and disaster, the kind of friend anyone would be proud to have

beside them, well deserving of the love of his Moms and Max and FBI agent Indigo Zheng.

I think you'll love him too, at least enough to look forward eagerly to Spencer's next.

Dervish Is Digital

Pat Cadigan
TOR, $22.95, 230 pp.
(ISBN: 0-312-85377-7).

Dore Konstantin, whom we last met in *Tea from an Empty Cup* (reviewed March 1999), returns in **Dervish Is Digital** , and Pat Cadigan is still playing strange games with artificial (aka virtual) reality, her chief concern remaining the exploitation of the innermost self.

In *Tea* , she had people going online wearing whole-body "hotsuits" that stimulate nerve endings enough to make AR very nearly indistinguishable from the real thing. One gimmick was preempting signals to wear another's body as if it were an online persona. Now we have a woman who runs an online haute-couture salon accusing her ex, Hastings Dervish, of turning into a totally digital creature (turning his body over to an AI) and infesting the AR infrastructure, including the walls etc. of her salon.

Konstantin is spending most of her time hunting down copyright-infringers. One investigation takes her to the Hong Kong mound, where she runs into the reality behind rumors of brainwashing: if the local cops don't like the way you mouth off, they "regularize" you. She bails and promptly runs into a PO'd Japanese cop who doesn't like the way she stomped into the middle of his own investigation. Next assignment: Susannah Ell, the lady who thinks she's being stalked like no one's ever been stalked before, and it doesn't take long for Dervish to make it plain that he is one evil son of a gun, for the Japanese cop to pop up again, and for the plot to turn a bit hectic.

Konstantin can't solve the problem of exploitation, just as cops can't solve the problem of crime. The best anyone can do is fight one battle or skirmish at a time and hope to come out alive at the end of the day. Konstantin manages, and by tale's end it is clear that she will be back, perhaps in a different venue.

I'm looking forward to the next installment of her AR adventures.

Thor's Fist

Frank O. Dodge
Wildside, $15.95, 253 pp.
(ISBN: 1-58715-346-7).

Frank Dodge must have loved the old Pratt and de Camp "Incomplete Enchanter" stories, in which Harold Shea visited assorted mythological realities, rationalized the magic, and gave readers a great deal of fun. Dodge plays much the same game with much the same result in **Thor's Fist** , which begins with the heroic death of Viking warrior Jar Haz and the ascent of his spirit to Valhalla, borne by Valkyries.

Skip to the modern world, where ace insurance salesman Jerry Haskins dodges a kitten in the rain and runs his car over an embankment. His wife Janet, thrown clear, extracts his body from the blazing wreck and cradles him, sobbing. At this point, a small fellow in a rain-soaked turban appears, assures her that the hospital won't be able to help Jerry—he's a goner—but just maybe, if he can find an ancestor at the point of death...

And presto! Jerry is in Jar Haz's body just as the dwarf Brokk (the very one who supposedly made Thor's magic hammer), emerges from under a rock to rescue him and his battered war-dog. Brokk's wife Freya patches Jerry-Jar Haz up, Brokk makes him a marvelous metal prosthesis to replace his amputated hand, and the two soon come to regard him as a foster son.

So he's alive. But he is separated from the love of his life, and he would dearly love to change that. Meanwhile, Janet feels much the same, the swami is willing to help, and when the state cops find the accident, there are two bodies, not just one.

Perhaps, says Brokk, the gods could help, though it's a long trek through perilous lands to reach the foot of the Ultimate Peak and climb to Asgard.

Just point the way, says Jerry Jar-Haz, already known as Thor's Fist for the strength of his metal hand. You're not going alone, say Brokk and Freya, and soon the expedition consists of dwarves, a goblin, a company of honorable mercenaries, elves, and a giant or two. They fight off ambushes, defeat an evil baron by flying a fleet of hang-gliders over the castle walls, learn how to avoid predatory trees, and in due time meet the gods, who turn out to be...

Naw. I'll just hint. Remember what Pratt and de Camp did with magic, recall Clarke's Law, figure that Janet's spirit is off in the lands of myth too, and plan on a quest that will take at least one more volume.

You'll have fun. I did.

Cell Phones: Invisible Hazards in the Wireless Age: An Insider's Alarming Discoveries About Cancer and Genetic Damage
George Louis Carlo & Martin Schram
Carroll & Graf, $25, 300 + xviii pp.
(ISBN: 0-7867-0818-2).

Are you afraid your cell phone will give you brain cancer? The FDA says the evidence to date does not indicate any clear connection between cell phones and cancer, but that isn't stopping the lawsuits by brain cancer patients who want to blame their phones, the research continues, and a few people think they see evidence enough to worry. Public health scientist George Louis Carlo and journalist Martin Schram have written**Cell Phones: Invisible Hazards in the Wireless Age: An Insider's Alarming Discoveries About Cancer and Genetic Damage** to make the case against both cell phones and wireless Internet devices. Unfortunately, they aren't convincing. Their case amounts to saying in a hysterical, reckless tone that few definitive studies have yet been done, radio energy can penetrate the skull and produce chromosomal damage in blood cells, and it's*shocking* that a device with so many unanswered questions is being marketed to an unsuspecting public!

Should you worry? About six cases of brain cancer occur per 100,000 Americans each year, meaning that of 100 million cell phone users about 6,000 will develop brain cancer each year, without taking their phones into account. If the phones are any sort of dramatic hazard, we'd expect more than 6,000 cases, and we don't see that.

Worried anyway? Carlo and Schram recommend using headset phones, fulling extending the antenna, not using the phone when signal strength is low, and redesigning phones so the antenna sticks out away from the head. They also note that “Emerging studies, and common sense, make clear that handheld phones should not be used while driving a vehicle.”

If they had added headset phones to that last recommendation, it would have made even more sense. Phones combine with driving almost as badly as booze; the evidence for the deadly effect of distraction is much stronger than that for radio waves.

The Satanic Gases: Clearing the Air about Global Warming
Patrick J. Michaels &
Robert C. Balling, Jr.
Cato Institute, $10.95, 236 + xii pp.
(ISBN: 1-882577-92-2).

Do right-wing think tanks such as the Cato Institute really think science is a liberal plot to make Big Business and Republicans look bad? The way they inveigh against reports of ozone holes, global warming, and overpopulation, one might well wonder, but they do have points to make and they deserve a hearing. For a good example of why, see **The Satanic Gases: Clearing the Air about Global Warming** , in which climate contrarians Patrick J. Michaels and Robert C. Balling, Jr., argue that much of the talk of global warming catastrophe is media hype and politics, not science. Warming is real, they say, but there's not much we can or should do about it, given that the pattern for the next century is surely set already, reducing carbon emissions would be colossally expensive, and anyway increased carbon dioxide enhances crop growth and warmer temperatures will save more lives in winter than they claim in summer.

The book suffers in several ways. For one, it came out the year before the Intergovernmental Panel on Climate Change's 2001 report, which said things are looking even worse than we thought. For another, it pays no attention at all to studies that say warm-climate diseases are likely to move into temperate zones. Nor does it recognize studies that indicate the growth-boosting effect of extra carbon dioxide is likely to be very limited. That is, it tends to select data that support its case, and much of that data is not up-to-date. It also spends enough time inveighing against liberal politicians (such as Al Gore) and career bureaucrats and scientists to make my initial rhetorical question look reasonable.

That said, there is indeed an awful lot of hype swirling around the global warming issue. The climate may be warming, but no matter what the newscast says, you can't tell by one season's or year's weather in one city, state, or country. Climate is an average, long-term, wide-scale sort of thing. Even if it is warming, you'll have cool spots. And there's an awful lot of jitter in the graph.

If the catastrophists are right, do we really face catastrophe? Probably not. Low, flat nations such as Nauru will vanish beneath the waves, and their people will protest mightily as they are relocated—but they'll adjust. Some farmers will complain bitterly of drought and flood, but others will smile as conditions in their area turn more benign; agriculture as a whole will adapt. Heat waves? A Texan must laugh out loud when I say that means anything over 90 here in Maine; we'll adapt. Politics? Expect vast waves of hot air, as well as plenty more media hype.

Right now, though, the Republicans and Big Business are missing a huge opportunity. Instead of saying global warming is not really a problem, or we can't afford to reduce carbon emissions, they should be putting much more funding into energy technologies that don't emit carbon. If we could come up with a good one, the problem would be solved, Big Biz would have a product for the export market, and the economy would hum like mad.

Alas, politicians rarely seem to know what a win-win solution looks like.

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Upcoming Events

Compiled by Anthony Lewis

25-27 January 2002

VERICON (Harvard University student SF conference) at Sever Hall, Harvard Yard, Cambridge, MA. Info—Harvard-Radcliff Science Fiction Association, c/o 4 University Hall, Harvard College, Cambridge, MA 02138. URL—www. vericon.org

15-17 February 2002

BOSKONE 39 (New England regional SF conference) at Sheraton Framingham, Framingham, MA. Guest of Honor—Neil Gaiman; Official Artist—Stephen Hickman; Special Guest—Marv Wolfman; Featured Filker—Tom Holt. Registration—$38 until 4 September 2001, more thereafter and at the door. Info: Boskone 39, Box 809, Framingham MA 01701.
Fax: (617) 776-3243, email—Boskone@nesfa.org, URL—www.nesfa.org/boskone

22-24 February 2002

CONCAVE 23 (Kentucky-area relaxacon) at The Hampton Inn of Horse Cave, Horse Cave, KY. Guest of Honor—Bill Francis. Registration—$20 before 12 February 2002; $30 at the door. Info—Concave c/o Gary Robe, PO Box 3221, Kingsport, TN 37664; (423) 239-3106; email—grrobe@chartertn.net

29 August-2 September 2002

CONJOSE (60th World Science Fiction Convention) at Convention Center, et al., San Jose, CA. Guests of Honor—Vernor Vinge, David A. Cherry, Bjo & John Trimble; TM—Tad Williams. Registration until 31 December 2001—Attending $160, Supporting $35, Child (3-12) $50, Child under 3 FREE. [These are the latest rates posted on the Internet as of the time this column went to press; expect them to increase after 31 December 2001.] 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. Info: ConJose, Box 61363, Sunnyvale, CA 94088-1363. email: info@conjose.org, URL: www.conjose.org

Information on your convention must be received at least 6 months in advance of the issue date of the magazine.

Convention runners: If your convention has a telephone/FAX number, email address, or Web page URL, please let us know so that we can publish this information.

Convention attendees: 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 IRC if the convention is in a different country.

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Upcoming Chats

Webs of Wonder

January 8 @ 9:00 P.M. EST
David Brin, Julie Czerneda, and Tom Easton talk about science fiction in the classroom.

Anthropology and SF

January 22 @ 9:00 P.M. EST
Jack McDevitt, Kage Baker, Eleanor Arnason, and Liz Williams on how anthropology inspires and transforms SF.

Go to **www.scifi.com/chat** or link to the chats via our home page (**www.analogsf.com**). Chats are held in conjunction with *Asimov's* and the Sci-fi Channel and are moderated by *Asimov's* editor, Gardner Dozois.

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Brass Tacks

Letters from Our Readers

Dear Stan,

It seems Dr. DeCusatis got a bit wild with his numbers. Take page 46—"giving a group velocity inside the chamber of about—c/330." That is less than 600 miles per second, corresponding to a refractive index of 330. That is certainly not exceeding c. On page 47—"an apparent length contraction of 330%." I learned more than 60 years ago than nothing could be reduced by more than 100%. A 6 cm chamber reduced by 330% would have a negative length of 13.8 cm, but how can you get a negative length? His description of 6 cm reduced to 1.8 cm would be a contraction of 70%. This would correspond with a velocity of 3.33 c. The velocity would be 333% of light or 3-1/3 c, not 330 times light velocity which he claims on page 46. I have a feeling that he does not distinguish between per cent and simple ratio.

Marion Wolfe

Glendale, CA

The author replies....

The group velocity inside the chamber is indeed negative and is correctly given by -c/330; in other words, the group velocity index was measured to be -330 in the original experiments by Wang et. al. which were reported and discussed in the journal *Nature* (my article references 2 and 4). When my article was printed, the negative sign was on one line of text and the value was on another, so it may not have been obvious at first that the group velocity was negative, although this is an important result. The negative group velocity occurs when the phase of different frequency components are shifted by the medium through which they travel, so that the wavepacket they form at the exit is brought forward in time compared with the same pulse traveling through a vacuum. The article subsequently relates this time shift to the corresponding change in length that would be observed if we used the pulse entry and exit times to measure the chamber length. In this experiment, the pulse exiting the chamber traveled nearly 2000 cm (330 times the chamber length) beyond the exit before it had completely entered the chamber. If we used the pulse entry and exit times to estimate the chamber length, we would conclude that the chamber length would be 6 cm / 330 or about 0.18 cm (this was incorrectly listed in my article as 1.8 cm, sorry for any confusion regarding the per cent change in the observed chamber length). The length of the chamber is not negative, but the group velocity can be; as noted by Wang et. al., this result is "in contradiction to traditional views that a negative group velocity of light has no physical meaning" (ref. 4). As discussed further in my references, a negative group velocity can be understood by comparing the time it would take for identical pulses of light to cover some distance L in a vacuum (traveling at velocity c) and in a superluminal medium (traveling at velocity v). The difference in transit times would be given by L/v—L/c and is a negative number if v is superluminal. Thus, if v is negative then the difference in transit times can become sufficiently negative that the peak of the pulse emerges from the medium an instant earlier than when the peak of the pulse enters.

Casimer DeCusatis

Dear Dr. Schmidt,

Ben Bova is usually a fine writer of reliably good hard science fiction, but I have some issues with his serial, "The Precipice," which ran from May to September, 2001.

My first gripe is scientific: On p. 111 of Part II, in the June issue, we find "...kicked up puffs of dust that

lingered lazily in the gentle gravity of the Moon." First of all, you don't get puffs of dust in a vacuum. Puffs are the result of interaction with an atmosphere, of which there is none to speak of on the Moon. Secondly, Galileo knew that all objects fall with the same acceleration under the influence of gravity, and Newton explained why. A particle of dust would fall just as fast as a 50-ton boulder. Of course, the acceleration due to gravity is a lot less on the Moon than it is on Earth, but it could hardly be described as "lingering lazily."

My second complaint is legal: The villain, Humphries, was charged with murder and plea-bargained it down to involuntary homicide. Fair enough, but there was a second crime, kidnapping. The abduction and subsequent imprisonment were described in sufficient detail, and there were enough witnesses, plus the testimony of the victim herself, to generate an open-and-shut case, but there was no complaint, no arrest, and no trial, and in fact the k-word wasn't even mentioned in the story. In cases like this, the perpetrator usually is charged with every crime the prosecutors can think of, so that he will be sure to be convicted of something. I find it hard to believe there is no law against kidnapping in Selene.

But my most serious objection is literary: There was no, or anyway insufficient, closure. I had to wait three months from the first installment to the last, and after that amount of time, I expect the story to be complete, but it clearly is not. The hero is dead, the villain is still in a position of power, and the story ends with the secondary hero and the villain snarling threats at each other. Obviously there is more to come. This is a rip-off, as far as the reader is concerned. Compare with Edgar Rice Burroughs' Barsoom series. It's a very long series, yet each novel is complete and satisfying in itself. Have we forgotten how to do that?

Bruce Foreman

The author replies....

I'm glad Bruce Foreman got so interested in *The Precipice* that he wants more. Believe me, more is on the way! As for the descriptions of walking on the Moon's surface, I got the information from some of the guys who've been there. Selene's legal system is not like Earth's, and obviously (in the context of the story) Stavenger and the leaders of Selene are breaking new ground in deciding what to do about Humphries.

Ben Bova

Dear Dr. Schmidt,

This is further to the letters in the September issue of *Analog* on copyright and Napster.

If I were asked what I think the readership of *Analog* is like, I would say that I expect it to be science-minded and reasonably bright—a modest elite. (Bright doesn't exclude crackpots; there are more ways for an intelligent person to go mad.) But reading the letters on this, some of them seem just plain dumb.

Could you convey my thanks to Mike Meyer for pointing out that you have a vested interest? Without his comments, I would never have dreamt that part of your income, as an author and editor of a magazine, might conceivably have some dependency on the copyright system. But he has a point on free power; I believe that in India, something like half the power generated is tapped illegally, and India survives.

A quibble on Robert L. Minteer. He says that the Constitution granted Congress the power to provide for copyright and patent protection for very specific reasons: "To promote the progress of science and the useful arts." I have little direct knowledge of the U.S. Constitution and I'm too lazy to try to look it up, but I wonder whether he's got it quite right. I have the impression that it draws a distinction between

the useful arts (the subject of patent protection) and the fine arts (the subject of copyright protection).

And a quibble on George Inzer, who says that people don't generally keep copies of music from Napster permanently, as it's wasteful and with little return (you say that that's true for you with VCRs). My office supplies catalogue lists 80-minute CD-Rs (presumably write-once CDs) at about 50¢ each (pack of 10), and CD-RWs (presumably rewritable) at about $2 each (for 5—it's slightly more for one). Not that expensive, and not that bulky. I suspect that for most people, keeping a catalogue up to date would be the most onerous part.

More generally, maybe the publishing industry did, and maybe still does, rip authors off. So, the argument seems to go, anything (like Napster) which hurts the publishing industry is a good thing. That line fails to consider what other effects may result. And it perhaps shades into a general anti-big-business attitude. One can say that it's idealism, but misplaced idealism can be dangerous.

Actually, you could perhaps do a Devil's Advocate piece on the advantages of extreme freedom, deregulation, and so on. Let Ian B. Miller set up a computer company under his initials. Let him register IBMCompany.com. Let people go to concerts and tape them and sell the tapes for whatever they can get. Let me masquerade as Meyer, peddling my views as his—and while we're about it, using his intangible credit card numbers as well. Let people run off copies of books whenever the photocopying cost is less than the publisher's price. Let people produce fake branded and designer goods—and, indeed, any goods (like aircraft parts, brake linings, drugs, and so on and so on); after all, people should be treated as adults capable of choosing what they buy.

Michael Harman

Actually, I think you did that Devil's Advocate piece quite nicely in one paragraph! And as a reminder to all and sundry, we normally print letter-writers' addresses if they appear under the signature (or if the writer asks us to) but not if it doesn't (or if the writer asks us not to).

Dr. Schmidt,

I was surprised at your comment in the September 2001 issue that responded to Juliette M. Moran. If one were to use English's existing gender-unspecified, third person pronoun more frequently, one's writing would be much better than those who use the awkward "He/she" (or even the English teachers that taught me that "He" referred to one of either sex).

L. M. Jennings

Maybe, but English still doesn't really have the kind of pronoun I'm talking about—"one" is too specialized. One can use it to talk about a completely *general, unspecified person, as in your example, but not as a stand-in for a* partially *specified person—"If a professor cares about one's job..." just doesn't work.*

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In times to come...

Our March issue will feature a diverse smorgasbord of intriguing fiction from writers both familiar and unfamiliar to these pages. H. G. Stratmann has a novelette, "Hearts in Darkness," about some of the problems very old human activities can cause in very new environments—and just what "ethical" means, which is seldom as simple as it sounds. Ron Collins offers "Parchment in Glass," a new episode in his

“Stealing the Sun” series. And we'll have short stories by a couple of writers new or almost new to *Analog* fiction, plus a sneaky little tale by a writer making his *Analog* debut, but very well known elsewhere: Michael Swanwick. And, of course, Part III of Robert J. Sawyer's *Hominids* .

The science fact article is an unusual, thought-provoking item by Steven Bratman, MD. Most *Analog* readers are familiar with both the human genome project and the concept of “artificial life"—constructs “living” and evolving entirely in a virtual environment. Dr. Bratman draws some surprising conclusions about what one may imply about the other.