

ANALOG



SCIENCE FICTION AND FACT

APRIL 2010

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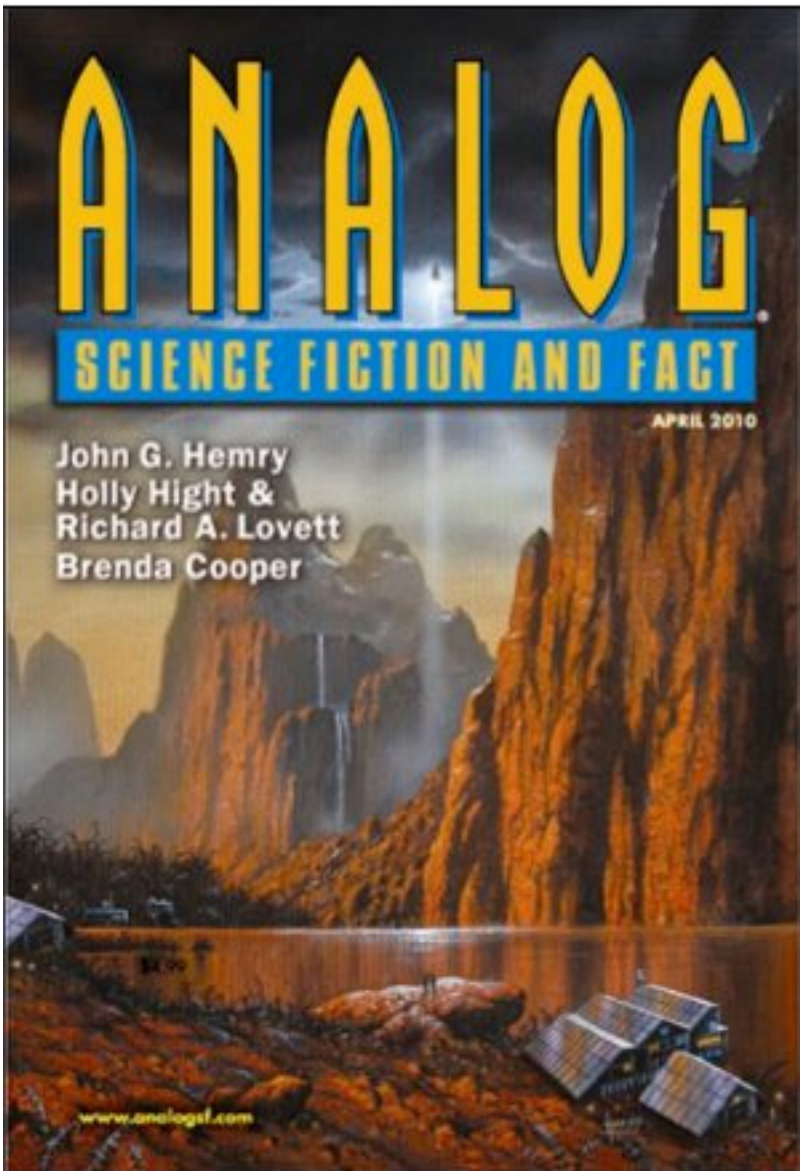
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Reader's Department: **EDITORIAL: THE REST OF THE
DATA** by Stanley Schmidt

In his November 2009 Alternate View column, "Lessons From the Lab," my esteemed colleague Jeffery D. Kooistra lucidly pointed out a widespread flaw in some of the data that have been used to argue for the need to do something about global warming. He cited a study by broadcast meteorologist Anthony Watts to determine the reliability of temperature measurements from a network of stations overseen by the National Weather Service. Watts found frequent errors due to such influences as changing the paint used on the thermometers' housings and locating the thermometers near heat sources such as electronics and air conditioner exhausts. Since most of these errors tended to produce readings that were too high, Jeff wrote, ". . . along with the unreliable data goes much of the case for global warming."

Certainly the errors weaken the case for global warming—but how much? Jeff has long described himself as a global warming skeptic, and up to a point this is an admirable thing. (I haven't ascertained the exact extent and nature of his skepticism, so I apologize in advance if I appear to attribute to him any view he doesn't actually hold.) It's easy for people (on any side of a question) to get swept up in hype and hysteria, so it's always a good idea to cast a critical eye on the data used to support any position.

In the particular case of global warming, there's plenty of room for skepticism about the extent to which it's actually

happening, how long-term or short-term it is, how much of it is manmade, and what if anything we can or should do about it. We need to pin these things down as accurately as we can, without undue delay, because there's potentially large-scale and long-term danger in doing either more or less than the facts warrant.

But while there's ample room for skepticism about these details, it's much harder to be skeptical about whether global warming has been occurring, to whatever extent and for whatever reason, over the last few decades. The data he describes, though clearly flawed, may not be as hopeless as he suggests, and in any case only show that the warming, at least at those stations, is less than previously thought—not nonexistent.

And then there are the rest of the data.

First, consider the data he mentions, gathered by a "network of volunteers" in Anthony Watts's Surface Stations project [1]. The initial analysis suggests that many of the stations were reading high, but not enough to change the measured temperature increase to a decrease. And even if most of them are wrong as they stand, it may still be possible to salvage better data from them.

Often, if you can identify a systematic error, you can correct for it. It may be laborious, but it can be done; and sometimes it's worth doing, especially if the measurements you've taken don't lend themselves to repetition (as is often the case in meteorology and astronomy). Earlier in his column, Jeff describes an experience from his own college days in which he collected some flawed data and his professor

told him, "You have NO data!" But then he admits parenthetically that "there was a simple, albeit tedious, way to recover my data and so save my experiment."

I remember a similar experience from my own college lab work. The first thing I ever did that attracted especially favorable comment from my first-year physics lab instructor was an appendix to a lab report titled "Special Notes on the Collapse of the Apparatus." We were to measure the acceleration of gravity by rolling steel balls down an inclined track and plotting data on a graph whose slope would give us a value of g . But the slope of the graph depended on not only g but also the slope of our incline, so when the whole thing collapsed with a clatter halfway through the experiment, my partner and I first thought the whole experiment was ruined and we would have to start over. Then we realized that we could keep the data we already had, set the track up as close as we could make it to its original configuration, and continue taking the measurements we hadn't done yet. We wound up with a line with a break in it, where the slope changed abruptly from one value to a slightly different one, instead of a straight line with a single well-defined slope. But by comparing the slopes of the two parts, we were able to get *both* a creditable measurement of g and a verifiable measure of how our repaired setup differed from the original.

It may be that something like that, or what Jeff did to salvage his experiment, can be done with the flawed temperature measurements from those thermometer stations. It's likely to be a lot of work—there are a lot of stations—but that's better than simply throwing out decades

of data that's flawed in a known way that can be corrected for. And computers can make the job a lot easier than it would have been when the measurements were begun.

That possibility at least potentially takes care of the first reason for believing that the measurement errors Watts's group found cast serious doubt on the reality of global warming.

Second, a flaw in one set of data does not invalidate a hypothesis. The important debate here is about the reality and extent of, and appropriate response to, global warming—not the reliability of the readings from one group of thermometers in painted boxes. Even if those data were hopelessly flawed and completely useless (and that doesn't seem to be the case), they are by no means the only things suggesting global warming. There are huge amounts of data from many other sources, and a serious effort to answer the big question has to consider *all* of them. There are, for example, other direct measurements of temperature, in places ranging from the Arctic to many parts of the ocean. There are measurements and photographs of glacial and polar ice melt and sea level changes.

And there are a lot of other observations, not as neatly numerical as physicists tend to like, but quite clear and perhaps even more meaningful as indicators of large-scale change on a time scale of decades. Those come from the broad area of biology, conspicuously including ecology. Many observers, like Dan Smiley (whose work I mentioned in "Research I" in April 2009), have collected data in a wide range of places clearly showing a trend in recent years toward

longer growing seasons, earlier blooms, and later fall color changes. In animals, which are inherently more portable than plants, the symptoms are different but the gist is the same. A given species tends to be adapted to a more or less sharply defined range of climatic conditions. If climate changes, the animals move, vacating areas that have become less hospitable to them and spreading into areas that have become more so.

Many of them have been doing just that, and the trend is almost invariably away from the equator and toward the poles, or from warming valleys toward cooler summits. I'm personally familiar with some examples. I vividly remember when the first red-bellied woodpeckers and black vultures, which I'd always thought of as southern species, appeared in the New York area; the woodpecker has now become quite common and the vulture fairly common. An experienced birder who's lived here longer than I have tells me that Carolina wrens got here just a few years before I did, and they're now common, too. If you browse through the range maps in a good field guide to birds, you'll see quite a few notations like "Expanding Northward." I'm not sure I've seen any going the other way. You can find similar trends among other groups of animals, but they're most obvious among birds because of their extraordinary mobility.

One nonbird that's dramatically feeling the pinch is the pika, a small mammal related to rabbits and limited to a narrow zone of rocky alpine areas. Pikas are especially fussy about temperature, so they're being forced higher and higher as their old haunts grow warmer. That means they have less

and less potential habitat, and rangers and naturalists I've talked to in the Rockies are seriously concerned about their prognosis.[2]

A similar concern applies, by the way, to less particular creatures (like us) who have the option of moving farther from the equator. I've heard it argued that a reasonable amount of global warming wouldn't really be that much of a problem for humans, except for the inconvenience of relocating, because if land near the tropics gets too hot, that near the poles will become more welcoming and we can shift our lives and agriculture there. But don't let the distortion of the Mercator projection fool you—the farther from the equator you get, the less real estate there is in any "equal" latitude range such as 5 degrees, as you can easily verify either by calculating or by looking at a globe.

Skepticism—in the sense of questioning everything—is good. But to get its benefits, you have to be open to listening to all the answers, not just the ones that support what you want to believe. And if you find that some of the data being used in an argument are flawed, you must not fall into the trap of thinking that proves or disproves any of the competing hypotheses. You have to look, with a critical eye, at *all* the data.

* * * *

[FOOTNOTE 1: In keeping with Jeff's insistence that the quality of all data should be scrutinized, I assume measures were taken to evaluate the quality of the volunteers' observations, though he didn't mention what they were.]

[FOOTNOTE 2: One that looks like it *might* be an exception is the northern raven, which we've been seeing and hearing more often in our area lately. But ravens are exceptionally adaptable and their range has long extended down the Appalachians, so I suspect this is less a matter of climate driving them south than their general success leading them to spread out wherever they are.]

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Department: **BIOLOG: BRENDA COOPER** by Richard A.
Lovett

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Some writers break in small, slowly working their way up. Others enter with a splash and keep rising.

Brenda Cooper is one of the latter. Her first sale, other than a self-published Internet posting, was a coauthored novelette with Larry Niven ("Ice and Mirrors," *Asimov's*, February 2001). "I will be forever grateful to him," she says. "Essentially that was a student/teacher relationship." (Details of their working habits are summarized in Niven's book, *Scatterbrain*.)

Cooper learned her lessons well. Seven more collaborations with Niven followed, including a novel (*Building Harlequin's Moon*, 2005). Then she was on her own. Her first solo novel, *The Silver Ship and the Sea*, won the 2008 Endeavor Award for best book by a Pacific Northwest author, and "The Robot's Girl," in this issue, will be roughly her two-dozen solo short.

Cooper got into science fiction at a tender age. "My dad is literally a rocket scientist," she says. "We would watch moon launches together."

She was reading by the time she started school and was startled when her schoolwork was much less demanding than what she'd been doing on her own. "They gave me a picture book," she recalls. "I threw a fit."

In college, she majored in management, with an emphasis on computer science: a good choice because she liked computers but not the math required for a computer science degree. Today, she's chief information officer for Kirkland, Washington, supervising a staff of twenty who manage phones and computers. In her spare time she's a futurist,

giving keynote speeches to industry conferences and writing a column at futurismic.com. "I take a topic—cloning, for example—and find the most recent news. Then I talk both about what's going on and about how one or two science fiction stories have dealt with the topic," she says.

Her latest novel, *Wings of Creation* (November 2009) takes a similar approach, dealing with a future in which people have been genetically engineered to have marvelous enhancements (such as the ability to fly), but are essentially slaves to the owners of their genetic codes. "It's pretty much cultural science fiction," she says.

Exploring the impacts of scientific or cultural change is the main thing that separates science fiction from other forms of literature, she believes. "The story has to be engaging, [but] I think the job of science fiction is to make us stop and think about what we should be doing to create the future we want. Whether that means a warning, like *1984*, or telling us something we want, I think that if science fiction doesn't make you think, it's failed as science fiction. It might still be a successful story, but the joy of science fiction is that it also makes you think."

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Novelette: **SWORDS AND SADDLES** by John G. Henry

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Illustrated by Broeck Steadman

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When choices are eliminated, one does what one must....

A long column of soldiers and horses moved across the rolling landscape, an intense thunderstorm pummeling them. At the head of the column walked Captain Ulysses Benton, on foot and leading his mount through the tempest like the rest

of the cavalry company, peering ahead into the murk to be sure of his way. Civilians, who only saw cavalry on the Fourth of July when it paraded in dress uniforms while the band played, thought of horse cavalry as a romantic way of life. Captain Benton knew better, as did all of the troopers walking in column behind him.

The real cavalry was this, trudging through the endless prairie, mud sucking at your boots, grass slippery underfoot, your feet aching from the march, sheets of water being thrown on you from a leaden sky while gusts of wind tried to knock you from your feet and forced water through every seam and opening so that no portion of you remained dry, tugging on the lead of a horse just as weary and worn out as you were, the horse occasionally snapping at you in its misery and irritation or jerking its head with devilish timing so the tug of the reins would threaten to topple you into the mud, your stomach almost empty since there'd been no way to make a meal, and your last seven warm meals had only been bacon and beans, but this day there wouldn't even be that, nothing but soggy hardtack since no fire could be lit under these conditions.

And all for the princely sum of thirteen dollars a month for the privates. It had been sixteen dollars a month, but Congress had cut military pay in this year of 1870.

In the middle of column, the four supply wagons jolted and jumped over the uneven ground, riding light now that most of the provisions they had carried had been used up. Two more days, Benton thought. The company of cavalry would be back at Fort Harker in two more days. The only small mercy was

that he and his men all wore the new broad-brimmed black slouch hats instead of the old forage caps, which wouldn't have provided any real protection from the rain.

Lightning suddenly erupted around them like an artillery barrage targeted on the column, momentarily lighting the world so brightly that men flinched and closed their eyes against the flares. Benton's foot came down hard, the way it would when walking down steps and misjudging the distance to the next step. He staggered, staying up only thanks to the fact that he had the reins wrapped around one hand, and getting another attempted nip from his ornery mount as the tired horse protested being used as a support.

Hearing some muttered curses, Benton blinked against the renewed darkness, locating Sergeant Tyndall. "Are you okay, sergeant?"

"Yes, sir, cap'n, except for being cold, tired, wet and miserable, begging your pardon, sir."

"If you want to see a good time, join the cavalry," Benton quoted the recruiting motto.

"That's right, sir. It's bad enough out here in October. I hate to think of campaigning on the plains again come winter. And then that lightning, like we were back fighting Johnny Reb again. But just then I thought maybe we'd stumbled across a prairie dog town."

"Did you miss a step, too?"

"Yes, sir. I wondered if the dogs had torn up the ground, but I can't see none of their burrows, and we couldn't not see them even in this mess."

They plodded onward, men and beasts enduring the storm because they had no other choice. In a small mercy, the storm began lifting before sunset, and by the time dark came on, the clouds had split to reveal the innumerable stars above. Benton walked among his soldiers after the company had halted for the night, ensuring they had taken what care of their mounts they could in these conditions, with everyone and everything soaked to the skin. There was little he and Sergeant Tyndall could do but reassure the men that another couple of days would see them back in Fort Harker.

Lieutenant Garret, who had been walking with the rear of the column behind the supply wagons, straightened to attention and gave a precise salute. "I've had what dryhardtack remains distributed to the men, captain."

"You found some? Well done." Benton rubbed his forehead, feeling exhausted but knowing that like everyone else he'd be sleeping in soggy clothing on wet ground. At that, he was better off than the enlisted men, because his uniform was of decent quality and cut, while they were still forced to wear left-over uniforms hastily and cheaply manufactured for the Civil War since the War Department had no intention of buying new enlisted uniforms until every old one had worn out.

For that matter, he should have an experienced first lieutenant in the company as well as a brand new second lieutenant, but Lieutenant Randall had died of cholera four months ago and the slow-turning wheels of the War Department had yet to produce a replacement. Fortunately, Randall must have contracted the ailment off the post,

because no one else had fallen ill with it. "You've done well out here, lieutenant. Very well for a newly commissioned officer on his first field maneuvers."

Garret seemed to lose a little of his own fatigue at the words. "Thank you, sir. At one point I thought I'd literally lost my balance today."

"What's that?" Benton frowned at him. "Was it when the lightning hit?"

"Yes, sir. The ground wasn't quite where I thought it would be. The men around me and my horse all stumbled, too. It was very odd."

Benton's frown deepened. "It appears many of us experienced that, lieutenant, the lay of the ground being different in small ways than it had been a moment before. Did an earthquake strike, do you think?"

Garret looked around as if seeking evidence of such an event. "I didn't think Kansas was earthquake country, sir."

"I don't know about Kansas, but there were those earthquakes sixty or seventy years ago in Missouri. They still talk about them. One of them supposedly made the Mississippi River run backwards for a short time." Benton shook his head. "Well, if it was an earthquake, it didn't last long or do any damage we know of aside from minor adjustments to the prairie. Get what sleep you can tonight, lieutenant. The horses are nearly spent. We'll have to walk all day tomorrow at an easy pace to let them recover."

"Yes, sir."

* * * *

The next day dawned clear and crisp. Benton stood up, wincing from the body aches inspired by sleeping on the wet ground.

"Good morning, cap'n," Sergeant Tyndall declared, offering a steaming cup.

"Coffee? How'd you get a fire going, sergeant?"

"An old Indian trick, sir."

Benton couldn't help smiling as he took the coffee.

"Lieutenant Garret, I should inform you that any time Sergeant Tyndall accomplishes some remarkable feat he attributes his success to an old Indian trick."

Garret smiled despite the fatigue still shadowing his young face. "You must have known a lot of old Indians, sergeant."

"Yes, sir, lieutenant," Tyndall agreed before searching the horizon and pointing. "Look there, cap'n. Those elevations. Right where they should be. We didn't lose our way at all yesterday afternoon." He squinted. "Looks like something's up on one of them, though."

Benton pulled out his field glasses and focused them on the higher ground. One was crowned by a squat tower he didn't recall seeing before. "What do you make of that, lieutenant?"

Garret studied the view for a while. "It appears ruined to me, sir, as if it were taller once. You see those blocks of stone to one side?"

"That explains it. It's not ruined, lieutenant. It wasn't there the last time we came this way. Someone must be building a tower up there and the stone hasn't fallen, it just hasn't been set in place yet."

"Maybe Colonel Custer had the 7th build a monument to him, cap'n," Tyndall suggested, deadpan.

Tyndall, like many cavalymen, didn't have a high opinion of Colonel Custer. Neither, for that matter, did Benton, but he couldn't openly agree with an enlisted man on the subject. So he confined himself to addressing exactly what Tyndall had proposed. "The 7th Cavalry went through here in May, sergeant. I think we would have noticed something like that before now."

Less than an hour later the column was under way again, clothing, horses and men drying under the warmth of the rising sun and with the assistance of a brisk breeze. They walked their horses through increasingly familiar flat stretches and across rolling hills and vales, stopping at the upper reaches of the Little Arkansas River in the middle of the day to water horses and men.

Tyndall cast a puzzled glance around as they led their horses through the river, the column having to shift northward as several men and horses unexpectedly floundered into deeper water. "Sir, the ford's not the same. It should be down there a little ways."

"Lieutenant Garret and I wondered if we'd experienced an earthquake during the storm," Benton commented. "Perhaps that changed the ford, sergeant."

"Could be, sir." But Tyndall kept throwing suspicious glances at the river until it was out of sight.

In the late afternoon they came up out of a long, shallow gulley, following a well-known route, though oddly lacking in any signs that other horses or wagons had passed this way

for a long time. "Cap'n?" Sergeant Tyndall was looking up and to the side, a baffled expression on his face.

Benton followed the sergeant's gaze, blinked in disbelief, then looked again. "Where did that come from?" A low elevation overlooked the plains here, not so much a hill as a high point with gentle slopes in all directions. He had ridden past this area at least a dozen times that Benton could recall, and the ground had never shown anything but the long grasses of the prairie, a few outcrops of weathered sandstone, and crossing it at an angle the ruts from an old northern section of the Santa Fe Trail. Now something else stood there, what seemed to be the sprawling ruins of a fortress that had once covered at least fifty acres, if not more.

Tyndall was rubbing his eyes and then staring at the ruins. "You see it, too, sir? Cap'n, I figure we're twelve or thirteen miles south-southeast of the fort, and that ain't never been here. How the hell could someone have thrown that up since we came past last time?"

"I don't know." Benton held up one hand. "Column halt! Lieutenant Garret, remain here with the company while the sergeant and I go examine that . . . whatever it is."

Handing off their horses' reins to the bugler, Benton and the sergeant found the walk to the edges of the ruins to be unexpectedly difficult, as the ground close to the walls proved to be studded with fragments of partially buried sandstone blocks. As they neared a broken section of the wall, Tyndall let out a low whistle. "Look at them rocks. Someone went to a whole lot of trouble building this place, cap'n."

Someone had, Benton thought, studying the size and number of the sandstone blocks that had been set into thick walls, which might have risen a dozen feet when whole. He hoisted himself through a gap in the remains of the wall, Tyndall following.

Picking their way along streets buried by blowing dirt, the tall prairie grass growing everywhere the dirt had found lodgment, they discovered badly eroded and fallen-in buildings covering the area inside the wall. The ever-present Kansas wind blew through the ruins, sighing as it swayed the prairie grass and caressed the ancient sandstone. At the end of the street they were following, Benton saw a massive structure whose walls still seemed mostly intact, though like all the other buildings, the roof had long ago collapsed. Walking up a short grass-covered slope that had once been a broad staircase, he passed through a broken entryway and into a courtyard.

Sergeant Tyndall walked over to one wall, studying drawings that had been deeply incised into the sandstone before it had hardened, and were still mostly visible. "Lots of horses. But they ain't drawn like the Indians do 'em."

Benton came over to look closely at the drawings, nodding in agreement. An entire herd of graven horses gamboled across the broken wall, their lines still visible despite long weathering. The horse portrayals had a fluidity that he'd never seen in the drawings that the Indian tribes produced. Then he noticed the top of the wall. Part was missing, but on the remaining portion symbols he didn't recognize had been

carved in a series of long unbroken lines. "Do you recognize any of this, sergeant?"

Tyndall shook his head, looking mystified now. "No Cheyenne built this, cap'n. No, sir. And look how that sandstone's been weathered. I never seen anything built of sandstone weathered that bad. It'd take, I don't know, hundreds of years. But that's crazy. This wasn't here when we rode past last."

That tower on the hill that Garret had thought ruined hadn't been there before, either, Benton recalled. "Go get Lieutenant Garret and send him up here while you stay with the column."

"Yes, sir." Tyndall seemed glad for the chance to leave the mysterious ruins, moving as fast as the broken surfaces permitted back toward the column.

While he was waiting, Benton dug a little ways into the dirt. He found the remnants of what might have been a wooden beam, the wood long since turned to dust, but the dust blackened by the charring of fire. This place hadn't simply died. Someone had destroyed it.

Lieutenant Garret arrived, examining everything with a stupefied expression. "Captain, I had no idea the plains Indians had built anything like this."

"As far as I and the sergeant know, they didn't." Benton indicated the ruins. "You had a classical education back east, lieutenant. What do you make of this?"

Garret hesitated. "Honestly, sir?"

"You can safely assume that when I ask you something I want your honest answer, yes, lieutenant."

"Yes, sir." Garret made a helpless gesture. "It looks almost Biblical, sir. Like something from Babylon. Or maybe even a little older. The way the wall is built, what's left of the houses. I've seen paintings of what people think the Hanging Gardens looked like and they'd fit in here, sir."

"The Hanging Gardens of Babylon?" Benton decided not to make a sarcastic reply. He had asked for the lieutenant's opinion, after all. "What do you make of that?" he asked, pointing to the wall of horses and the symbols above the drawings.

Garret examined it for a long time, then shook his head. "I don't know, sir. I haven't seen art like that. Those symbols look like early writing, but I'm sure it's not cuneiform." He gave Captain Benton a worried look. "Sir, horses came to this continent with Europeans, a few centuries ago. But these depictions of horses, this whole place, feels a lot older than that."

"How old does it feel to you?" Benton asked, realizing that he agreed with the lieutenant.

Garret took a moment to think about that. "Older than anything I've ever seen, sir. Really old. A thousand years, maybe."

That sounded ridiculous, but then again saying the ruins were even a decade old, even a month old, would be equally absurd. They hadn't been here and now they were.

Picking their way out along another path, Benton paused before a deep opening that gapped in the earth, kneeling to examine it. "I think this was a salt mine. A long time ago it was a salt mine, anyway. This place must have been built

around the mines to protect them. A whole walled town grew up here." It all made sense, except that he wasn't talking about the ancient Middle East but about the central Kansas prairie.

Benton wanted to have those disquieting relics out of sight, so he kept the column moving until the impossibly old ruins were no longer visible, the cavalry reaching the low, wooded areas alongside Thompson Creek before halting for the night.

"What do you think they'll say at Fort Harker when we report that, cap'n?" Tyndall asked.

"They may call us crazy." Benton shrugged. "But they may have already heard of it. Plenty of civilians ride through this area."

"Yes, sir. I been meaning to ask you about that, cap'n." Sergeant Tyndall pursed his mouth, clearly and uncharacteristically hesitating to speak. "Where are they, sir? This area's been plenty settled in the last few years, especially since the railroad came in as far as Ellsworth. But we've seen no one else and seen none of the trails we should've crossed."

"You think everyone disappeared and that ruined city appeared in their place?"

"I don't know what happened, cap'n, but I do know that I'll be real happy when I lay eyes on Fort Harker again."

* * * *

By late morning the next day even Benton was feeling extremely uneasy. They should have passed some roads and

farms by now, but the only road they'd found wasn't where it should have been and seemed to have been wide and very heavily traveled in the past. Aged ruins of abandoned buildings, some still bearing the scorches of fire on their walls, were spotted near once-cultivated fields gone wild. Even stranger, another desolate tower lay tumbled to one side of the large road not far from where the cavalry column crossed it. Lieutenant Garret was sent to investigate and came back bewildered. "It's not the same architecture as the fortress ruins, sir. The tower seems sort of Roman, like the ones on Hadrian's Wall."

First the Hanging Gardens of Babylon and now Hadrian's Wall. "Kansas seems to be gaining ancient historical artifacts at a very unusual rate, lieutenant. How old is that tower, do you think?"

"It seems a lot younger than the city, sir. I'd guess it's maybe a hundred years old, or maybe two hundred. That's just a guess." Garret had been growing more and more puzzled. "Captain, are these ruins being kept secret for some reason? I've never heard a word about them."

"That's because they haven't been here, lieutenant." Feeling increasingly unsettled, Benton turned to face the column. "Mount up!" With he and his men settled into their saddles, he ordered the company into motion again, eager to see Fort Harker and the adjacent town of Ellsworth as soon as possible.

It was well after noon when they came over the last of the rises before the river lowland holding Fort Harker and Ellsworth. They had come up from the south, so both the fort

and the town should have been almost due north of them. The Smoky Hill River, which skirted both places, was there, but otherwise the landscape was marked only by another wide road leading east. There was no sign Fort Harker or Ellsworth had ever been here, no indication the railroad line coming in from the east and then up along the Smoky Hill had ever been built here. How could an entire town and a fort with more than seventy buildings have vanished within a couple of weeks? How could the rail line and the warehouses beside it, which had been there for a few years, also have disappeared without a trace?

Sergeant Tyndall made a strangled sound as he looked east. Within a few miles the road entered a broad cultivated and cleared area, running through it, and up to the sealed gates of a city walled in stone which had been built between Spring Creek and Clear Creek. The city was miles east of where Ellsworth or Fort Harker should be, much bigger than either Ellsworth or the fortress to the south that they'd seen in ruins, and it was undisputedly still occupied. "Cap'n, begging your pardon, sir, but what the hell? Where's the fort and where's the town and what's that?"

"It's not Ellsworth." Benton leveled his field glasses, making out banners on the top of high walls and some sort of castle or citadel in the center of the city. "There's fighting going on. People on the walls are defending the city against a force encamped before it. See the ladders the attackers are putting up against the walls?"

Lieutenant Garret nodded, peering through his own field glasses. "Sir, I don't hear any gunshots."

Neither did he, Benton realized. Nor could he see the impossible to miss clouds of gun smoke that should have veiled the battlefield.

"What do we do, sir?" Tyndall asked.

His instructions from the colonel hadn't covered this particular set of circumstances, but they had left him the authority to use his discretion if he encountered something not mentioned in those instructions. "There's a city under attack. That's clear enough. We're to defend Ellsworth and other towns or settlers if they come under attack. That's not Ellsworth, but it's a city. We'll ride that way, evaluate the situation as we get closer, and take appropriate action."

Tyndall nodded, clearly relieved now that an officer had laid out a familiar and rational course of action.

Benton rode up close to Garret and spoke softly. "The men know something is wrong, lieutenant. They don't know why any more than we do, but as long as their officers appear to be dealing with events in a calm and controlled way, the men will stay calm and controlled. Don't let the men see anything in you that might feed alarm in them. Understand?"

Lieutenant Garret nodded, his worried expression smoothing out. "Yes, sir."

The cavalry rode down from the hills to the river, splashing across and up onto the edge of the open area. The closer the column got to the walled city the more details they could make out. "They're fighting with swords," Garret announced at one point. "I think they're wearing armor, too."

Whoever had been attacking the city seemed to have noticed the cavalry company. While infantry continued to

climb ladders to assail the walls, many other attackers ran back to their camp where a large herd of horses was visible, mounting up and forming into a mass facing the approaching cavalry. Benton watched the activity through his field glasses, shaking his head at the archaic armor, the brightly colored banners, and the lack of firearms. "Whoever they are, they're not dressed or armed like Indians. Neither are the people on the wall. But the city people aren't settlers like those in Ellsworth, either."

"The ones attacking the city look more hostile to me, cap'n," Tyndall commented. "It appears they're aiming to hit us, too."

"I'd prefer to parley first, but if they want a fight, they'll get it. Bugler, sound form a line." The sweet notes of the bugle resounded as the troopers in the cavalry column swung out to ride abreast, the two platoons of the company forming two lines, one behind the other, extending across a front facing the oncoming riders.

Benton halted the cavalry, standing in his stirrups and raising one empty hand high in the universal sign of parley.

The mass of horsemen facing them, now less than two miles distant, waved swords and lances over their heads as they came riding toward the cavalry without much semblance of a formation.

Captain Benton evaluated the terrain, looked at the enemy with their armor and swords, and made his decision. Experience told him that the people in the city should be settlers, and the attackers hostiles. Moreover, the attackers gave every sign of having decided to attack the cavalry as

well. His company's horses were tired, there were only about one hundred men all told in the company against what seemed four or five times that number of attackers, and he wasn't about to have his soldiers trade saber blows with a mass of men wearing armor. "Lieutenant Garret, Sergeant Tyndall, form two dismounted lines of battle."

Tyndall saluted, turned to face the cavalry, and bellowed his commands. "Company B, dismount! Form line of battle, first platoon front, second platoon rear!" The commands echoed along the cavalry ranks, the cavalymen pulling their Sharps carbines from their saddle scabbards and dismounting. One of every four took control of four horses, leading them back a ways to where the wagons waited, while the remaining three soldiers fell into two long, open lines facing the enemy, the front rank kneeling and the second rank standing, each man about a yard from the men to the left and right of him. Less than a minute after Tyndall had shouted the orders, the cavalry was arrayed for battle.

Benton remained on his horse, riding slowly along the line. "Uncase the colors." Canvas tubes came off the swallow-tailed guidon of the 5th Cavalry regiment and the flag of the United States of America, the banners unfurling to flap proudly in the breeze.

The oncoming horsemen were less than half a mile away, increasing their speed to a gallop. "They're going to wear out them horses, charging that hard that far," Tyndall observed, apparently unconcerned. He'd fought at Gaines' Mill in the War of the Rebellion, and since then in dozens of other battles and skirmishes. This was just one more.

Benton raised his empty hand again. "Halt! We are United States Cavalry." He doubted those charging toward the cavalry could hear him over the sound of their own horses, and in any case the attackers seemed oddly unconcerned by the steady lines of carbines facing them.

Drawing his pistol, Benton waited as the horsemen grew closer, the earth shaking from the pounding of their horses' hooves. "Mark your man and aim your shots," he called, riding slowly across the back of the second line of dismounted cavalry. "Standby. First Platoon, fire!"

The kneeling rank fired their weapons in a rippling volley, immediately afterward breaking open their carbines to eject the spent cartridge from the breech and reload as Benton called out his next order. "Second Platoon, fire!"

The shortest pause to allow the first rank to finish loading. "First Platoon, fire!"

"Second Platoon, fire!"

The volleys crashed out and the horses of the attackers went wild, bucking frantically, bolting and panicking. Armored men fell everywhere, some dead or wounded from hits by the heavy .50 caliber carbine bullets, other losing their seats and being hurled from the saddle by horses gone berserk. The attack had dissolved into total chaos, the survivors of the first four volleys fleeing as fast as they or their mounts could tear across the landscape.

"Company B, cease fire!"

Sergeant Tyndall stared at the remnants of the attack, shaking his head. "It's like those horses had never heard a shot fired, cap'n." His horse, like all cavalry mounts, had been

trained not to flinch at the sound of gunshots. "And why can't those men keep their seats?" Then his expression cleared. "They don't have stirrups. Just like Indians. But those ain't any Indians I ever saw."

Looking past the ruin of the mounted charge, Benton could see the infantry that had been assailing the city frantically coming down off of their ladders and running through their camp, not to form a defensive line but away from the cavalry, joining their mounted comrades in panicked flight.

Sergeant Tyndall watched the rout, scratching his head. "Well, I'll be damned. I guess we won. Now what do we do, cap'n?"

Benton wished for a moment that he had someone superior in rank to ask that same question. But there seemed only one realistic course of action. "Company B, mount up." He waited until the soldiers in the rear had brought forward the horses and the cavalry once again formed two mounted lines. "Bugler, sound advance. Let's go get a better look at that city. Sergeant Tyndall, make sure the wagons close up with us."

They rode at a walk, wheeling the lines to bypass to one side of the dead and dying horsemen, but close enough for Benton to get a good look at some of them. He saw blond hair, brown hair, and black hair, skin and facial features that seemed mostly European but sometimes Asian, and weapons and armor that seemed out of the early middle ages or late Roman Empire.

This was all inexplicable, yet Benton knew he had to lead his company through whatever was going on. Already a bit

emotionally numb, Benton focused tightly on the routines and procedures that needed to be followed now.

As the cavalry lines approached the city, they rode through the empty tent camp of the former besiegers, who were still visible in the distance but running for all they were worth. On the walls of the city, defenders were waving swords, spears, and axes over their heads and cheering. "Company B, halt! I guess we'd better find out who these people are and where we are, sergeant. Lieutenant Garret, hold the company here while the sergeant and I go parley."

Benton rode toward the walls, Sergeant Tyndall on his horse just behind. Spotting a cluster of figures near some blue banners embroidered with many-pointed stars, Benton headed that way, assuming they would be the leaders of the defenders. Holding up his right palm again, Benton checked his horse just under the walls. Still skittish from the battle, his horse danced sideways as more cheers erupted from overhead.

Looking upward, Benton called out. "I am Captain Ulysses Benton, United States Cavalry. I wish to speak to your commanding officer, leader, or chieftain."

A babble of noise broke out above in which Benton couldn't make out a single familiar word, though some of the words teased at him in the way of sounds which share the same root as a word in a known language. Then the shouts died down rapidly as one of the defenders stood up on the rampart, gazing down a good twenty feet at Benton. This person wore a chain-mail shirt, with more mail forming a hauberk around the neck, what appeared to be leather trousers, and heavy

leather boots that came up to the knee, almost meeting the mail shirt where it hung down. The chain mail was torn in several places where the blows of swords or axes had struck home. On the defender's head, a bright helm topped with a white horse-hair plume shone in the sun. Raising one hand to mimic Benton's gesture, the defender called down a long sentence, not one word of which Benton could understand.

But that wasn't why he stared up, momentarily shocked into silence. The leader of the defenders, face streaked with sweat and dust, sword still wet with blood, had spoken in the unmistakable voice of a woman.

All right, then. The leader of the city was a woman. Compared to the disappearances of Fort Harker and Ellsworth, that was a relatively easy thing to accept.

Behind Benton, Sergeant Tyndall made a baffled sound. The captain turned in the saddle, facing the sergeant. "Did you recognize anything she said?"

"Sir . . . cap'n . . . that's a woman!"

"It seems so, sergeant, now tell me if you recognized her language. Is it in any way related to Cheyenne or Arapaho?" He already thought he knew the answer. It hadn't sounded a bit like a plains tribe language. If anything, some of the words had sounded vaguely European.

"No, sir." Tyndall shook his head. "Not them, and not Sioux or Pawnee. I've talked to some of the civilized tribes down south, Cherokee, Choctaw, and the like, and it didn't sound like none of them, neither."

"I think I'd recognize Shoshone," Benton said. "It's not Crow, either. Did it sound a little Spanish?"

"Maybe a little, sir," Sergeant Tyndall agreed. "But it's not." He scrunched up his face. "And I ain't never seen a señorita like that, cap'n."

Looking closely, Benton could now make out the feminine features under the helm. Unless he was mistaken, as many as half of the other defenders might be women as well.

"Amazons. In Kansas. Maybe that's Greek they're speaking." The idea was absurd, but no more so than what he was seeing. "Lieutenant Garret!"

Garret rode up, saluting.

"You know some Greek, don't you?"

"Classical Greek, yes, sir. From Homer. Just a little."

Benton gestured upward. "Try it on her."

Gazing at the Amazon, Garret hesitatingly spoke a few words. The woman spread her hands to show she didn't understand and called down again. "Captain, I—That's strange. It almost sounds like a lot of languages, but it's none of them."

Benton tried again. "We're from Fort Harker, in the state of Kansas, United States of America." He didn't need a translator to see that no one on the wall recognized any of those names.

The woman called once more, gesturing in a way that conveyed she wanted them to wait, then hopped down inside the wall and disappeared from view. After a few minutes, the sound of heavy objects being moved came from behind the walls, and then the massive gates of the city swung open and the woman came out riding toward the cavalrymen astride a horse that seemed part Arabian and part plains pony. Behind

her came a small party of other mounted fighters from the city, both men and women, though those all stopped perhaps fifteen feet from the cavalrymen while the woman came on until she reined in close to them.

"No stirrups," Sergeant Tyndall murmured. "Just like the others."

Benton checked, having been distracted just watching the Amazon ride up, seeing that her saddle did lack stirrups and had high ridges in the front and back, doubtless to help the rider keep a seat during battle.

"Be careful, cap'n," Tyndall added in a low voice. "Women can be tricky."

The woman crossed her arms over her chest and bowed in her saddle, speaking again in a way that conveyed authority, then held out her hands to show what she held. "Bread and salt," Garret said in a surprised voice. "That's an ancient gesture of hospitality, captain."

"She's welcoming us?"

"Yes, sir, welcoming us as guests. You're supposed to take a little of both to show you accept the hospitality."

Benton kned his horse forward a couple of paces, coming within easy reach of the Amazon. This close he could finally judge her age, thinking she was probably in her mid-to-late thirties, not all that different from Benton himself. Reaching carefully, Benton grasped the bread and took a bite, tasting a hearty loaf with a strange nutlike aroma, which didn't match any wheat variety he had encountered. With his other hand, Benton rubbed a finger in the salt, feeling the warmth of the

woman's palm under it, then raised the finger to his mouth and licked it.

She turned to hand the bread and salt to another woman who rode up hastily. This Amazon was a bit older, stouter, her armor bearing signs of long wear and careful maintenance. Something about the way she carried herself and answered the first woman's instructions made Benton glance at Sergeant Tyndall. "I think we've found the leading sergeant here."

Tyndall looked as if he couldn't decide whether to be scandalized or fascinated. But he could surely tell that Captain Benton was willing to accept the idea, so the sergeant seemed ready to follow his captain's lead here as he had so many times before.

The leader of the city pointed toward Benton again. No, not just toward him, but to his uniform blouse and trousers, and then upwards before inclining her head respectfully toward him.

"Any guesses what that's about, lieutenant?"

"No, sir."

The Amazon swept off her helm, revealing dark hair cut short above her shoulders and making it easier to see that her eyes were the blue of a stormy sea. No, definitely not an Indian, but not Greek, either. Pointing to herself, the woman said two words. "Odwan Freya."

"Her name?" Garret speculated.

"Maybe name and rank," Benton replied. "She seems to be in charge." He saluted her. "Captain Benton, ma'am."

Pointing at him, the woman repeated the words. "Kiptin Bintin-miim." Sergeant Tyndall coughed, doubtless covering up a laugh.

"It's just—" Benton paused, then pointed to himself. "Captain Benton."

She nodded. "Kip-tan Bin-ton." The woman extended one hand toward the city and said, "Astera."

Turning once more, the Amazon gestured out to where the fleeing enemy could still be seen, shaking her head. She covered her eyes, made a series of motions mimicking someone coming stealthily this way, then drew a flat hand across her throat and pointed toward the enemy again. "She thinks those fellows might come back tonight when they can't be seen and cut our throats, cap'n," Tyndall remarked. "We'll have to post a lot of sentries."

But the woman was pointing toward the gate, then made a gesture encompassing the entire company of cavalry, before indicating the gate once more and nodding vigorously. "Achates," she declared, once again gesturing toward the cavalry and then at everyone with her and on the walls.

"Friends?" Lieutenant Garret wondered. "She's inviting us inside, sir."

Benton thought about that. He knew what could easily happen to his troopers inside the streets of a strange city. That wasn't cavalry terrain at all, and his soldiers would be badly outnumbered by the people living here.

But they needed stables and forage for the horses, food and water and shelter for the men. The sun wasn't far from

setting, and having the city walls between the cavalry and those hostiles wouldn't be a bad thing, either.

The Amazon looked steadily into his eyes, no trace of deception or hostility apparent. Drawing her sword slowly, she held it out hilt-first toward Benton.

That gesture of peaceful intent was impossible to mistake. Benton noted approvingly that the woman had obviously wiped the sword blade clean of blood before returning it to its scabbard. She knew how to take proper care of a weapon. He nodded at her, studied the width of the gate for a moment, then turned to Garret. "Lieutenant, form the company up into a column of fours, then lead the column here. We will enter the city."

"Yes, sir." Garret saluted, a gesture the Amazon watched with interest, then galloped back to the cavalry. A moment later the bugler sounded the signal, the clear tones echoing from the walls of the city, and the cavalry moved quickly from their two lines into a column, four men abreast, first platoon to the front and second platoon to the rear, the wagons taking their places in the center of the column again.

The woman had resheathed her sword and now watched the cavalry form up, an approving smile appearing on her lips. Holding up her arms, she made a fist with one hand and pounded it repeatedly into her other palm. "Extos!" she cried.

Other men and women from the city made the same gestures, which struck Benton as applause, some calling "extos" as well. The open admiration for how well his cavalry drilled helped dispel Benton's doubts.

As the head of the company reached him, Benton kned his mount ahead to take up position in the lead. It wasn't until he turned to ride along with the column that Benton realized the Amazon had followed and now rode beside him as the cavalry approached the gateway. As they reached the gates, the guards there raised their weapons in salute to the woman and stood aside for the cavalry. The road inside jogged sharply to the right between towering walls, then led through a second gate and into the city proper. The inhabitants of the city, some still armored and carrying weapons and others either too young or too old to defend the walls, lined the broad street leading into the city, many making the fist pounding into their hand gesture.

Lieutenant Garret was looking around as if astounded. "Captain, it's like an ancient city. The walls, the weapons, the defensive arrangements, the buildings, the people, everything."

Benton heard the cheering rise in volume behind him and looked to see that the national colors had just entered the city. The inhabitants were pointing to the banner excitedly. "They recognize the flag. Thank God, they recognize the flag." He called out to the crowd, "United States of America!" several times.

But the city's people stared back blankly, before pointing at the U.S. flag and chanting "asteri" and then pointing upwards.

Lieutenant Garret understood first. "Asteri. Astra. Stars. Like the name of the city, Astera. They must consider stars important, so they're excited to see the stars on our flag."

"That big flag of theirs had a lot of stars on it, too," Sergeant Tyndall agreed.

"And our uniforms, captain," Garret continued. "She made special note of your uniform. Light blue trousers and dark blue blouse."

"The color of the sky." Hope died in Benton as quickly as it had blossomed.

"We're not in Kansas, that's for certain."

But Sergeant Tyndall was shaking his head. "I don't know what this is, cap'n, and I don't know who these folks are, but that land out there is the land around Fort Harker and Ellsworth. I'd swear to it. I just don't know where those places went and where this one came from."

Kansas but not Kansas. "Lieutenant Garret, Sergeant Tyndall, we have to make every effort to learn the language of these people, or teach them ours, well enough to find out where we really are and how to get home."

* * * *

The barracks to which the cavalry was led were clean and built of stone, as were the stables for their horses. Sergeant Tyndall, accompanied by the stout Amazon, actually seemed impressed. "Real nice quarters, sir, and they seem to know how to take care of horses. I got across to Belisa what our horses needed and she made sure it all showed up fast."

"Belisa?" Benton asked.

"Uh . . ." Tyndall indicated the stout Amazon. "She . . . uh . . . seems pretty capable, cap'n."

After he explained with gestures to Odwan Freya that he wanted to stay with his men, Benton found himself and Lieutenant Garret offered private rooms, plainly but practically furnished. Before the men and Benton were even settled in their quarters some of the city folk were coming with large kettles filled with hot food. The dishes served, which seemed to be mostly a kind of beef mixed with grains and dried fruits, were unfamiliar, but none of the famished cavalymen turned up their noses at the food.

Odwan Freya came by to ensure the cavalry had been well taken care of just as the bugler reported to Captain Benton. "Sir, do I sound Taps?"

Benton looked at Freya and nodded. "Yes. Let these people hear Taps."

The bugler saluted, then marched out into the hallway and raised his instrument to his lips as Odwan Freya watched. When the last long, slow notes of General Dan Butterfield's tune had sounded, her face reflected astonishment and admiration. Turning to Benton before she left, Freya inclined her head and spoke in a quiet tone appropriate to the music she had heard. "Extos."

The next morning, Benton resolved to send Lieutenant Garret out with a squad to collect the brass from the battle. He had yet to see any sign of gunpowder weapons here, and the inhabitants of the city regarded the cavalry's carbines and pistols with an undisguised awe that seemed to reflect total unfamiliarity and suspicious fear in combination. The cavalry might end up having to make their own reloads, and while

lead was easy enough to form into bullets, the brass cartridge casings wouldn't be simple to replace.

But Benton had barely eaten breakfast when Odwan Freya, along with the Amazon he increasingly thought of as "Sergeant" Belisa, and two men came by, Freya indicating they wished him to accompany them. Collecting Lieutenant Garret and Sergeant Tyndall, Benton followed the Asterans a short distance to a large room letting out onto what seemed to be a parade ground. A line of guards stood sentry outside, not watching the cavalry but facing outward to hold back the crowds of city people who were gathered outside the barracks.

Freya pointed to the two men. "Decires Agani, Decires Costoni." Decires was obviously a title of some kind, and both men appeared to be soldiers. Both also deferred to Freya, so the Odwan must outrank them.

Agani and Belisa unrolled a large sheet of vellum onto a table filling the center of the room, pinning down the corners with polished stone blocks and looking at Benton expectantly. "Lieutenant Garret. What do you make of this?"

Garret peered at the drawing. "It's a map, captain."

"Very good. A map of what?"

The lieutenant flushed slightly at the dry rebuke, then studied the beautifully hand-drawn map intently. "They're tapping that symbol. It must be this city. Yes, that matches the river and the hills, doesn't it?"

Sergeant Tyndall, peering over Garret's shoulder, nodded. "Right, lieutenant."

Encouraged by the sergeant's agreement, Garret spoke with more confidence. "Then this over here . . . sir, this is like some very old maps I've seen. It doesn't have a consistent scale. The area around the city is pretty clearly shown in large scale, but then this to the east must be the Missouri River and this the Mississippi River. The courses of those rivers are unmistakable."

Benton ran his own hand across the map. "Once it leaves the vicinity of this city, the map shifts to small scale, showing large areas. No, here's some city on the Missouri, and they show detail around it. That must be their map rule, shifting scale around cities to provide more information while leaving open countryside in a different scale. Hell of a way to draw a map."

"Yes, sir." Garret pointed to the lower portion of the map. "This area would be down near New Orleans. They show a town of some sort there. But many of the cities east of here seem to be missing, and these political boundaries don't match anything I know of."

"I can't make them out, either," Benton agreed, tracing the way west. "And this is the west coast. California. Look at all of those cities. It's as if the continent was settled first in the west and then settlers moved east."

Garret was following the west coast line north, then halted. "Sir? This goes into the new Alaska territory, but look. It just keeps going west up here. They show a broad strip of land going west until it reaches this other land mass. That's got to be Asia, captain."

"A land bridge? That big?"

The lieutenant had gone pale, his breaths coming rapidly. "Sir, sir, look. It is a land bridge. They're saying that North and South America are connected to Asia and Europe by this big isthmus."

"They're not," Benton said, wondering why Garret was getting upset.

"The map seems accurate as to terrain, sir. As far as we know. Except there."

"I'll grant you that."

"Look at these people, sir! They're not Indians. They're like Central Europeans or something, maybe with more Asian in their blood. In our history, there wasn't any easy way from Asia and Europe to North and South America, so every human migration headed west from Asia and ended in Europe. But here they could go east from Asia on foot or horseback as well, to North and South America, and some of them did. Nothing we know is here. Instead there's the ruins we found, the language these people speak, the weapons and armor they carry, this city..."

A terrible suspicion filled Benton. "Are you saying what I think you're saying, lieutenant?"

"This isn't our *world*, captain." Garret seemed ready to pass out. "We haven't just lost Fort Harker. We lost our entire world. History changed somehow while we were on that patrol, but it didn't include us. There's never been a United States of America. There's probably never been an England or a France. North America was never isolated from the rest of the world. People did colonize the west coast first, maybe

thousands of years before Columbus found the Americas in our world."

"Great God Almighty," Benton murmured. He didn't want to believe such an outlandish thing, but Ellsworth and the fort were gone, ancient ruins rested where nothing had been before, and this city didn't belong to any history of which he had ever heard. Nor did Freya belong in the North America he knew, a woman wearing armor, leading her people and wielding a sword in battle, as if Joan of Arc had lived in Kansas of all places. How could such a thing have happened though? His mind seized on the memory of the moment after which nothing but the land had been familiar, and the land itself had undergone tiny changes. "That lightning during the storm. For an instant it felt as if it were tearing the world apart. Maybe it did. If you're right, lieutenant, what happened to the Indians?"

"Probably the sort of thing that happened to the first inhabitants of places like England in our history, sir. They were either wiped out by waves of invaders or assimilated, with maybe a few survivors pushed into areas no one else wanted."

The idea was impossible. But so was this city. So were these people. He wasn't an ignorant man. How could such a place exist anywhere on Earth and he not have heard of it? If it did, why did the land so closely resemble the land he knew, and how had the company of cavalry been transported there instantly without its knowledge?

Lieutenant Garret's theory was impossible, but explained what they had found here. Every other explanation required ignoring the evidence of their senses.

Freya had been watching Benton and Garret talk, and now gestured to the map and then to Benton, clearly asking him to show where he was from.

That should have been an easy enough question to answer, but as Benton gazed at the map he realized every possible answer had problems. Strictly speaking, if Lieutenant Garret was right, then he and his cavalry company weren't "from" anywhere that existed in this world.

This city was near where Fort Harker had stood. That answer was probably as good as any other. So Benton pointed to the city.

Freya shook her head patiently, pointing to herself and then the city symbol, then to Benton, Garret, and Tyndall before waving her hand over the map again with a questioning look.

Benton pointed to the city once more, firmly, keeping his eyes on her.

She looked annoyed, then something seemed to dawn on her and Freya spoke rapidly to the other Asterans. The two men, Agani and Costoni, spoke back just as fast, their faces lighting with enthusiasm.

Freya pointed to herself and tapped her city's symbol again, nodding anxiously to Benton. He tapped himself and then the same symbol as well, nodding resolutely in return. With a dazzling smile, Freya drew her sword and raised it overhead, shouting so loudly it echoed through the room. The

other Asterans did the same, and outside Benton could hear the cries being repeated, followed by prolonged cheering from the crowds. Belisa turned to Sergeant Tyndall, hugged him, then planted a kiss on his mouth while Tyndall looked startled. The two Asteran men had grabbed Lieutenant Garret and were almost shaking him as they smiled and spoke quickly and incomprehensibly. Sheathing her sword, Freya stepped close to Benton, her eyes shining, reaching one hand to seize his upper arm in a comradely grip and squeeze so hard it hurt. "Achates! Cronun t'achates!"

"Cap'n?" Sergeant Tyndall asked. "What did you just tell 'em?"

"I'm not sure, sergeant."

"Whatever it was, it sure made 'em happy."

* * * *

It took several days before Lieutenant Garret had learned enough of the Asterans' language, and they had learned enough English, to be able to provide the answer. "We've been asked to a meeting, sir, to formalize our alliance with the city state of Astera."

Benton gave Garret a questioning look. "Our alliance? Did you promise them something?"

"No, sir. You did, sir. As best I can tell, these people think we're a wandering tribe of sorts, warriors who've been kicked out of our own lands for reasons they're too polite to ask about. When Odwan Freya asked where you were from and you kept pointing to this city on the map, they decided that

meant we had decided to settle here, to join forces with them."

No wonder the Asterans had been so happy. From what little they'd been able to learn so far, the cavalry company was like nothing in this world. Benton looked out across the parade ground. "That wasn't what I meant, lieutenant, but maybe that's not a bad idea."

Garret nodded unhappily. "We don't seem to have anywhere else to go."

"No. Here we have shelter, food, walls to protect us, and civilized people who need us." He blew out a long breath. "Damn. Part of me says we should ride until we reach the east coast if necessary, confirm with our own eyes that Fort Riley and Fort Leavenworth and St. Louis and Chicago and Pittsburgh and Washington, D.C. aren't there anymore and never were there. But another part of me already knows the answer. This is the area around Ellsworth. We couldn't mistake the terrain. But there's never been an Ellsworth here, never been a Fort Harker. Instead there's sandstone quarries and salt mines dating back a thousand years."

The lieutenant shook his head this time, his eyes haunted by worry. "I've been learning everything I can, captain, and I still haven't found anything the least bit familiar in the history of this place."

"Me, neither." There'd been assorted city-states over the last thousand years, empires rising and falling apart. The latest such empire had its capital where San Francisco should be and had covered most of the land between the west coast up to about where the Oregon Territory lay, south into

Mexico, and as far east as the Mississippi. But that empire, which had built the watchtowers, had slowly disintegrated over the course of the last century, leaving city-states squabbling over the remnants. "I can't find out much about Europe, and they barely seem to know anything about Africa."

"Yes, sir. They don't know much about either place. I'd wager there are settlements from Europe on the east coast, but these people don't have much knowledge of what's east of the Appalachians." Garret looked around as if evaluating the city again. "The technology here is a millennium behind ours, captain. No gunpowder, no steam power, no printing presses. They seem just as intelligent as we are, I swear they're learning our language faster than we're learning theirs, so maybe people just got started later here somehow."

"Or they didn't advance as fast for other reasons." He recalled that the stirrup had come into the Roman Empire along with some of those barbarian invaders from the east. How many innovations, how much progress, had been because of those migrations all dead-ending in Europe? If some of them had gone east instead, would progress have been slower everywhere? "Or maybe a combination of those things. There doesn't appear to be any way home, though."

"No, sir." Garret squinted at the city around them. "We're actually already there, it's just not the same there."

"Corporal Fuller is impressed by the local blacksmiths."

"What about ammunition, captain?"

"It turns out Private Merrick worked in a powder mill as a boy. He even remembers the right proportions for the ingredients. These people have a lot of livestock, so getting

saltpeter won't be a problem, and charcoal is easy enough to come by. We just have to explain what sulfur is and see if the locals can provide that. Our saddlemaker is busy showing the Asterans how to make stirrups. We'll have to see how long we can keep the advantages of stirrups and gunpowder confined to Astera."

Lieutenant Garret looked impressed and concerned. "You seem to have thought out what we need to do, to stay here a long time."

"It's my job to think things out, lieutenant." Benton sighed. "And we both have to assume that we're going to be here quite a while. A few of the men were married. I still haven't worked out how to tell them we're on permanent campaign."

"Maybe we'll be like Odysseus, sir, and have some strange adventures but make it home eventually."

"Maybe."

* * * *

The negotiations were hard, rendered difficult both by the still limited language both sides shared and by the Asterans' apparent insistence on driving what they thought a fair bargain. At one point, as Garret and Costoni spent an extended conversation trying to figure out what the other meant, Benton saw Odwan Freya giving him a hard look and comprehended that he had been gazing at her for a while without realizing it.

Now Freya said some things, and Costoni said some things, and Garret went back and forth with them for a while

before turning a worried glance on Benton. "Captain, I'm pretty certain that they're insisting that Odwan Freya is not part of the deal."

"What? What does that mean?"

"Ancient treaties were often sealed by marriages or, uh, other arrangements, sir."

Benton's reaction must have showed, because the Asterans seemed to lose some of their tense watchfulness. "Tell her—no, I have to say this directly to her. Odwan Freya, please accept my apologies for any implied inappropriate interest on my part. I would never . . . make your person a part of any agreement. You are the leader of these people and a free woman, and I would not so insult you as to barter for you. My country recently fought a terrible war, one which only ended five years ago, and in which many thousands of men died in order to establish the principle that no human being should ever belong to another, ever be bought or sold or treated as property. I am sworn to uphold those principles in my professional duties, and I personally believe deeply in them."

He had no idea how much of that Odwan Freya and the other Asterans had understood, but enough seemed to have gotten across. Freya nodded to him, then surprised Benton by rendering him a passable imitation of a regulation salute. Benton returned the gesture, knowing neither of them had made it in a subservient way, but as mutual gestures of respect among equals.

* * * *

The people here did not campaign in the cold season, so the company settled in to wait out the frigid fury of the plains winter in a degree of comfort unheard of for them. The men remained baffled as to where they were, but content to be living in comparative luxury among a citizenry who almost worshiped them. Benton continued to apply himself to learning the Asterans' language, but found that, just as Garret had said, the Asterans seemed more adept at learning English. Aside from getting home, the security situation concerned Benton the most, so he questioned Freya about it as her grasp of his language improved.

"The army that was attacking Astera, the Wikosans." Wikosa occupied roughly the same location as Kansas City had in Benton's world. "Do you know why they attacked us without talking first?"

"Bad people, Wikosans," Freya responded.

"But why did they assume we were enemies? Why did they try to ride us down?"

Freya seemed to think about the question this time before answering. "You get off horse. All walk, make long, thin line. Not many of you. They think, ride over you. Easy. Then *bwam, bwam!* Smoke and fire, like demons."

Of course. Like the British infantry square, troops armed with pikes or spears would have had to be tightly packed, shoulder to shoulder, in order to defend against a mounted charge. Modern firearms changed that, but the hostile horsemen hadn't known of such weapons. To them the thin line of dismounted cavalry must have looked extremely vulnerable.

The more they learned about Astera the more Benton realized that whichever fate had led them here had at least sent them to a people deserving of rescue. Astera had grown large and fairly well-off during the period when the last empire kept the peace on the plains. Trade had flowed along the road running east and west, and there had been major routes going north and south accessible through Wikosa. The surrounding area had boasted numerous farms and fields with a variety of livestock. But since the collapse of the empire, Astera had suffered from the loss of trade and the unstable security outside its walls. Nonetheless, the city had remained a bastion of learning, order, and civilization in a region where such things had become all too rare.

The Wikosans, on the other hand, had tried to maintain their city's wealth by plundering surrounding regions, something which had worked in the short term but now required them to range farther and farther afield since the communities near them had been looted dry.

"Cap'n, sir?" Sergeant Tyndall asked awkwardly a few weeks after their arrival. "We got a situation that needs handling. Private Murphy keeps asking me when we're going to hold church services."

He should have realized the troopers of Irish descent would worry about that more than the others. "Have you found any Catholic priests, sergeant?"

"No, sir. What do I tell Murphy and the others?"

"Let me talk to the Odwan, first." He wasn't surprised to learn from Freya that the Catholic church didn't exist as such in this world, or at least in this part of this world, but on the

other hand the Asterans had no objection to others practicing their own beliefs as long as such beliefs didn't involve human sacrifice. Benton informed his troopers that they could hold services as they wished and that he would officiate at any of them if asked.

The next crisis was one Benton had assumed was inevitable. Sergeant Tyndall escorted Private Bannock into Benton's quarters, the Asteran "Sergeant" Belisa hovering in the background with an unreadable expression. With a worried glance at Tyndall, Bannock saluted. "Captain, request permission to marry, sir."

"What happened, sergeant?" Benton asked Tyndall.

"Thanks to Bannock, one of the city girls is in a family way, captain. Belisa tells me the girl's family is okay with that, as long as Bannock does his duty by her."

The Asteran nodded soberly. "He binds to her and her only. Marriage? Yes. Or he pays child-price."

"What's child-price?"

"Enough to take care of child until grown."

Private Bannock owned little but the uniform on his back, and that was technically the property of the U.S. Government. Benton gave Bannock a sharp look. "You plan on marrying her? Do you understand that this will be a legal marriage that you can't just ride away from?"

"Yes, sir."

"Do you have any idea what I'll do to you if I find out you have in any way mistreated that girl or acted in any way which might disappoint the people of this city in our company or damage the reputation of the United States Cavalry?"

"Yes, sir. No, sir. I'll treat her right, sir."

"Permission granted."

The cavalry company hunkered down within the city as winter hit hard, the winds howling from the north, and snow drifts piling up against the walls of the city so deep in places that groups of citizens were sent out to clear them before anyone could use the drifts as ramps to enter the city.

His language skills improving daily, Benton found he could speak more and more naturally with Freya in a strange mix of English and the Asteran tongue. The Odwan had proven skilled at working out any conflicts among the cavalry and the city, mediating in a way that had impressed Benton. Lieutenant Garret, when not helping to supervise the company and its efforts to become self-sufficient, spent a lot of time in the city's library, puzzling his way through documents, some of which were written in languages the Asterans themselves had little command of.

Unfortunately, the more they learned, the more obvious it was that one company of cavalry couldn't miraculously solve all of the problems here. The Asterans had been able to use diplomacy to play different potential foes off of each other. This had limited attacks on the city, but as the experience with the Wikosans had shown even the most Byzantine diplomacy had its limits when it couldn't be backed up by sufficient power. Astera's position remained perilous, cut off from trade and with many crops and much livestock lost to the same Wikosans who had attacked the city. It would take time to get a gunpowder mill set up and a steady source of sulfur identified, and until then the cavalry was limited to the

ammunition they had brought with them. The idea of equipping the Asterans with rifles manufactured here had been raised early on, but the city simply didn't have enough of the right metals and tools to even produce more than a few such weapons on a handcrafted basis over the winter.

On a crisp day in what Benton thought was January, a once-more awkward Sergeant Tyndall stopped by. "Begging your pardon, cap'n. But there's something I've been wondering. You see, sir, there's a lot about this place that's different, and sometimes it takes a while to figure if different is good different or bad different or just something you can make either way."

Benton nodded solemnly. "I suppose that's right, sergeant."

"Well, cap'n, an old Indian once told me that when the Great Spirit gives you a horse, you don't go around looking for another dog instead. What I mean is, even if something isn't the way you always thought things should be, maybe it's still okay."

"Is that about Belisa, sergeant?"

Tyndall's face flushed red. "Yes, sir, cap'n."

"Do you want to know if it's okay to get to know her better?"

"I think I already know her real well, cap'n. Not to imply anything improper. No, sir." The sergeant let exasperation show. "But, cap'n, come campaign season, if the Asteran army goes out, Belisa goes with it. She's made it real clear that won't change. At first I was thinking, all right, Tyndall, you'll rescue the lady if she needs it. But I've watched Belisa

training and practice fighting an' all, and now I'm thinking it's just as likely she might be the one rescuing me. And I don't know what to think about all that, sir. Her fighting in a battle and being real good at it. She's a fine top sergeant as well as a fine woman, cap'n. But that ain't what I was brought up thinking a woman should be."

It was the sort of question he had thought would have arisen more than it already had. "Sergeant, I've already given considerable consideration to just that question. I believe it comes down to this. You appreciate the woman who Belisa is. If she were a different woman, would you think the same of her?"

Tyndall scratched his head. "I don't know for sure, cap'n. Maybe not. She wouldn't be Belisa. Now, she wasn't raised a Christian, either, but that don't bother me. The Good Lord understands that kind of thing, and Belisa seems a better Christian than many a church-goer I've seen, if you take my meaning, sir."

"Then, Sergeant," Benton advised, "I'd tell you to take Belisa as she is. She's not what we were raised to expect, but she is, as you say, a fine woman. Maybe changing what we expect isn't a bad idea."

Grinning, Tyndall nodded. "Yes, sir. Thank you, sir. That's the truth, isn't it? Though she's not the only fine woman here. Not by a long shot. That Odwan Freya, she'd make a fine officer's lady. Hell, I mean she's a fine officer in her own right. Oh, damnation, what I mean is—"

"I understand, sergeant." After Tyndall had left, Benton sat thinking, surprised at his own reactions to the sergeant's

words about Freya. She was a fine lady, indeed, and the more he learned of her the more he thought of her. But his inadvertent implication at the negotiations that he might use her need for the cavalry's support to force her favors had been bothering Benton ever since then. Surely Freya had not forgotten, either. As an officer and as a gentleman, he could not allow her to believe that he ever intended demanding her as a price for the protection the cavalry company provided the city.

Only a few days later, Freya asked him to speak privately with her. The weather was mild that day, so she led the way to the city walls, where they could stand on a rampart isolated from anyone else and speak knowing that no one was close enough to overhear.

Freya leaned on the wall, looking east. She wasn't dressed for battle, but wearing one of the outfits in which she usually conducted business, a white blouse embroidered with depictions of horses that seemed to bear some ancestral debt to the drawings in the ruins south of here, dark trousers with more embroidery in many colors, a long over-skirt split almost all the way up the center and back so it fell gracefully at rest but didn't hinder movement or riding, and over all a high-collar, knee-length coat with more needlework, this time of warriors and battles moving among signs and emblems of various kinds. It wasn't like any outfit that Benton had ever seen a woman wear, yet he found it very pleasing to the eye. "We must speak of war," Freya said. "The Wikosans plan to attack Astera again, as soon as the threat of freezing storms lessens, but before we expect them."

"Your scouts told you this?"

"Yes. Scouts. Spies. I think both words are right. They say the army will be at least ten decires strong."

"Decires? I thought that was a military rank."

"Decires are also those who lead decires." Freya held up her hands, all fingers spread, then closed all but two.

"Twelve?"

"A decire is a twelve of twelves."

Benton did the math. "One hundred and forty-four. Ten of those. So about one thousand five hundred." Very nasty odds if only his cavalry company was counted, but Astera had its own army. "How many soldiers do you have?"

"Able to defend the walls? About eight decires. The ones who could face the enemy in open battle only number about six decires, though."

A question had kept occurring to him, and now he voiced it. "What happened? There's a lot more young and elderly people in this city than there are men and women of military age, and you had plenty of room for my men in your barracks and for our horses in your stables."

Freya's face grew somber and she let out a long sigh, her forehead resting for a moment on the cold stone of the parapet before she raised it again. "The last Odwan gathered the largest force that Astera could muster, and marched it to meet Wikosa in battle. He didn't know the Wikosans had forged a temporary alliance with Telasa, which controls the lands south of us to the great gulf. As our army fought the Wikosans, the Telasans fell upon us from the rear." She shook her head. "Some of us managed to hold our formations

together and fight our way clear. If night hadn't fallen we wouldn't have gotten away, but under cover of darkness we escaped. We left many comrades behind, those who had died holding their places. Now you know why we greeted your alliance with such joy."

It must have been a battle rivaling some of those during the southern rebellion against the United States. "The alliance has benefited us as well. How many mounted troops do you have?"

"Half a decire. Brave, but not the equal of yours, even if you did not carry the carbines."

All right, then. About one hundred U.S. Cavalry, counting all ranks, against fifteen hundred enemy soldiers. "We can fight on horse or on foot, outside the walls or inside, depending on what seems best."

"It is wise not make firm plans until we know more." But despite her words Freya appeared unhappy, and she finally faced him full on. "I have deceived you in part. Not by saying what is false, but by not saying all that is true."

Benton frowned at her, shocked by how badly that statement had rattled him.

"There can be no half-truths between us if we are to fight as one," Freya continued. "Now, under the sky, I give you a full answer to what you asked before. You wondered why the Wikosans attacked your company without speaking first, without learning who you were. That was my doing."

That had been the last thing that Benton had expected to hear. "You told the Wikosans to attack us? And they did?"

"No, no! Not that way. They would have heeded nothing from me. But on the walls we saw you coming. We could tell even from a distance that you weren't from any place we knew of. We had nothing to lose. I ordered everyone on the walls to begin cheering and pointing toward you, as if you were expected allies who had come to relieve the siege of the city."

He stared now, momentarily wordless at Freya's audacity. "You fooled the Wikosans into thinking you were happy to see us and that we were coming to help you?"

"We *were* happy to see you," Freya replied with a half smile, "and you *were* coming to relieve the city. You just didn't know it yet." The smile grew and became mischievous before fading into regret. "I should have told you. But I feared your response, and Astera needs your cavalry so badly."

He really ought to be angry that she had provoked the Wikosans to attack his company, but Benton found himself laughing. "That was a stratagem worthy of U.S. Grant himself! Sergeant Tyndall was right when we first met you and he told me to watch out for tricks from you." Only after the last sentence had left his mouth did Benton realize he shouldn't have said that to her.

But Freya didn't seem offended, instead smiling. "You must thank your sergeant for me for giving me such praise."

Praise? Well, why wouldn't she see it that way? Male commanders who outwitted their opponents by using clever tricks or stratagems were happy to be praised for such skills.

Why wouldn't a woman commander feel the same way? "I'll be sure to tell him you were pleased."

"Who is this U.S. Grant? Your leader?"

"Yes. He was a general, a war leader, and he was recently elected our president. That is, the people of my country voted for him to lead us."

"Oh. An Odwan. Like me."

"You?" Benton found himself staring at Freya again. "I thought you were some sort of princess." Caught up with learning about the past here, learning the language and keeping an eye on the company, he'd neglected to learn much about how the city was run. It simply hadn't been necessary when he could deal directly with Odwan Freya.

"Prin-cess?" she now asked.

"Yes. Hereditary royalty. Your family rules because they're always in charge."

Freya's smile vanished. "Don't you believe I could earn this position on my own? Be elected because I'm the best at it?"

He could feel the heat of an embarrassed flush on his face as he realized that was exactly what his thoughts had been, even though Freya had repeatedly proven her intelligence and skills as a leader. "My sincere apologies. I spoke without thinking."

She seemed uncertain whether to accept the apology. "Our people belong to groups. By where they live, by what they do for work. The groups elect leaders, who form the council. The council votes for the Odwan."

A form of democracy then, instead of the monarchal setup he had assumed. "I am sorry."

Freya gave Benton a direct look. "Why did you think otherwise? Your men, they seemed surprised by our women. I did not wish to pry, but now I ask why?"

"Because back home our women don't fight alongside men and don't hold positions of authority."

Her gaze sharpened. "Unless they are a princess?"

"Yes."

"This is a very backward place you come from. I had thought it very civilized, but now I see otherwise."

He bit back an angry rebuttal. *Backward? When we have carbines and pistols and you have bows and arrows? But she's not talking about weapons or technology. She's talking about . . . civilization.*

When he was twelve years old, Benton's mother had drawn up and proposed a few changes in the laws of his hometown. His mother, well read and with a keen mind, had crafted ideas that had impressed twelve-year-old Ulysses Benton, and which he still thought would have been of great benefit to the town. However, the proposals had been rejected without discussion or debate, but with a goodly portion of scorn because they had been made by a woman. His mother had never again ventured to do such a thing, though he had seen the well-hidden resentment in her whenever politics was discussed in her hearing, and young Benton had often wondered that the most foolish and least educated man in town could vote in elections and his mother could not.

He thought of the West he had known with a different way of seeing it, thinking of the women there who from necessity or desire worked at tasks regarded as unfeminine by his

civilization. That civilization had not yet established a firm grip on those who lived between the Missouri River and the Sierra Nevada, and Benton now realized for the first time that when that happened, and women in the West were confined to corsets and kitchens, something of great value would have been lost. *Maybe changing what we expect isn't a bad idea*, he had told Sergeant Tyndall. "You have a point there. You have a very good point there."

His response finally seemed to mollify Freya. "But you do not truly think like that. I see this. For a moment I feared you were like the Wikosans."

"They're that different from your people?" Benton asked.

Freya pointed west. "We are from those who came out of Palenkaza long ago. Along the waters of the greatest ocean."

"The west coast."

"Yes. The lands there. We, the peoples to our south and west and some ways north, all came out of Palenkaza, where the men and women work as one. This is as our ancestors were and as the Light wishes. But the Wikosans are of those who came out of Bareos, from the north out of the cold lands. They, and the people north and east of them to the mountains, do not live as we do."

Waves of migration, as Lieutenant Garret had speculated. "They don't have women soldiers?"

"Of course they do! What city could stand if half of its people didn't bear arms along with the other half? But the Wikosans use their women only to guard the city. On the attack, they use men, and they allow no women to lead their armies."

It felt odd to know that he would have agreed without question with the Wikosans not long ago, and even odder to realize how much his opinions of women had changed from being around those of Astera.

Freya inclined her head toward him. "Do I have your forgiveness for my deception?"

"Yes, Odwan Freya. I respect you all the more that you admitted to it, and for the cleverness of your stratagem. But you're right that we must keep each other apprised of such stratagems in the future."

She smiled, and Benton realized she had really cared how he would react. But then, the safety of her city and her people rested on how he had accepted the news, didn't it?

* * * *

Six weeks later, a courier raced down the road from the east, bringing news that triggered a full council of war. Besides Freya and Benton, it included Lieutenant Garret, the Decires Agani and Costoni, Sergeant Tyndall, and Belisa.

Decire Agani laid out the news brought by the rider. "They come early, before their full force is ready, to strike us with surprise when we believe ourselves still safe. The Wikosans number only about six decires. This is a great opportunity. We can strike them and wipe them out."

Freya ran her hands across the map before them, tapping an area that Benton estimated was about twenty-five miles to the east-northeast of Astera, near where Salina had been. "We could do it here, near the crossroads." She frowned. "Why do I feel doubts?"

Benton glanced at Lieutenant Garret, who gestured at the map. "It seems like a perfect opportunity, sir."

Sergeant Tyndall cleared his throat, and Benton turned his gaze that way. "What do you think, sergeant?"

Tyndall squinted at the map, his mouth twisting. "Captain, an old Indian once told me that when you see one wolf, you ought to be wondering where the rest of the pack is."

Lieutenant Garret frowned in puzzlement, but Freya gave the sergeant a careful look. "You think this is a trap? Why?"

"Ma'am, I'm no general, but I'm looking at these guys and there ain't all that many of them. They outnumber us, sure, but even if we didn't have our carbines we'd still be in a fort. I'm thinking, what if they're bait? The Indians do that, send out a few braves to lure us into chasing them, and then before you know it there's a lot more Indians on all sides."

Belisa was nodding. "The Telasans. Like last time."

"The Telasans cannot come north this early in the year." Decires Agani pointed at the map. "If we fail always to act, we will never win. This is a great opportunity."

"True," Freya agreed. "But the chance seems too good. Are the Wikosans so foolish? They know we have the carbines of the cavalry now."

"Our messenger says the Wikosan fighters have been told it was a trick, a noise to frighten them but one otherwise harmless."

"They'll learn otherwise," Tyndall remarked with a grin.

"But," Benton added, "their own leaders may have convinced themselves it's true. Those killed by our shots didn't make it home."

Freya nodded. "They were buried on the field in one grave. So, the Wikosans believe us to be desperate and still weak. They would think this bait would be irresistible. We could not risk not taking it. It is in my mind to find the hook, that which would strike us when we go for the bait, and to deal the surprise to them."

Benton was studying the terrain. "Will they expect you to attack them in that place you showed us?"

"There or closer to Astera. No farther off, because we would not risk such a long march from our city, leaving it lightly defended in our absence."

"I can see a crossroads, but is there a town there? What do these symbols mean?" Salina had boasted a population of about one thousand, but it was surely gone along with every other human artifact he had known of in Kansas.

Costoni shook his head. "The ruins of a city. Over there, to the northeast of the crossroads. It's been empty for a very long time. Right there, not far away from the ruins, there was a town in the time of the empire, but it was new and too small to defend itself when the empire fell, and was abandoned as well a few decades ago."

Benton nodded, trying not to let what he had known of human habitation in that area get in the way of what was now there. "There's not a lot of cover on the plains, but a force moving along a watercourse would be low and screened by the trees growing alongside the water." He moved one finger the length of a stream. "Is this Spring Creek, sergeant?"

"Yes, sir."

"This would offer a great approach for that hook you spoke of, Odwan Freya. They could move along here, concealed from being spotted by anyone on the road roughly paralleling them to south."

The Asterans followed his gesture, nodding. "Six decires on the road," Decire Costoni remarked. "That leaves at least four for the hook. I distrust our reports on this. If the Wikosans gathered even minor help from cities such as Lacanan," he pointed to near where St. Louis should be, "or Midasa," pointing to a place about midway between Omaha and Sioux City, "they could easily have at least six decires in the hook, or perhaps another hook to the south as well." Costoni pointed to a another watercourse running south of the area. "What do you call this?"

"Dry Creek," Tyndall replied. "Cap'n, if someone followed Dry Creek where it bends west, it'd take 'em toward that same area with Spring Creek to the north."

"Cannae?" Lieutenant Garret wondered. "That's what Hannibal did at Cannae, tricking the Romans into attacking and then surrounding them on both flanks."

"None of us would escape this time," Freya murmured, her expression as she looked at the map becoming concentrated like that of a cougar eyeing her prey. "But we are not so desperate as they think. If we turn their own plan upon them, Wikosa will suffer such a blow that for years they will be busy defending themselves from those they have preyed upon." Her hand moved as she talked, sketching out movements of forces, while the others watched and listened, Benton with growing approval, Garret obviously surprised but listening

closely, the two Decires nodding, and Tyndall's own jaw slowly dropping.

As they left the room, Sergeant Tyndall shook his head. "What do you think, cap'n?"

"I think it's bold and has a decent chance of success." Benton smiled. "I once compared Odwan Freya to U.S. Grant. I guess I was more right than I knew."

"U.S. Grant? Hell, cap'n, if she pulls this off she'll be Grant, Sherman, and Sheridan all rolled into one."

The Asterans had developed fairly decent weather forecasting ability, being as reliant on the skill as any people who depended on grazing, farming, and trade for their survival. When the forecasters declared a mild period was coming up, Freya ordered the Asteran forces to prepare to march at any time. Captain Benton took his company out on the field before the city and drilled them out of their winter ease, getting the cavalry ready for offensive operations.

Additional mounted scouts were sent out in all directions. The city could ill afford to spare them from its battle forces, but it would need all the warning time it could get if any other enemy army came marching toward the city from an unexpected route.

When word came down the road that the Wikosans were coming, and with the predicted six decires, the Asterans and the cavalry set out. Benton looked up at the walls as they rode away, seeing many young women waving to his soldiers, and the soldiers waving back. "Just like old times," Sergeant Tyndall commented. "Remember riding off in 1861?"

"Yes, sergeant, I do. We were going to have the rebellion crushed before the year was out. That's what they said, anyway."

"Things don't always work out like we plan." Tyndall looked over to where the Asteran column was marching, accompanied by the small Asteran mounted force. The saddles of the Asteran riders now had stirrups, but otherwise they were still equipped just as the Wikosans would be. It had been bittersweet as well as amusing for Benton to see that the Asterans had carefully copied the cavalry stirrups right down to the "U.S." embossed on the leather.

"Are you all right?" Benton asked Tyndall, knowing that Belisa was with that mounted force.

"I think so, cap'n. But when we parted, Belisa said she hoped I'd come home with an enemy's head tied to my saddle. Do you think she meant that?"

He hadn't seen any signs of such primitive, bloodthirsty behavior among the Asterans. "It sounds like a traditional thing to say to someone going off to fight. Something from their ancient past that isn't meant literally anymore."

The sergeant nodded, his brow furrowed in thought. "I expect you're right, sir. Or, at least I hope you're right. I do like Belisa, cap'n, but there's some things I draw the line at doing even when a woman asks me."

Scouts searching with extreme care well off to either side of the road had confirmed the suspicions of the Asterans and the cavalry. There were mounted forces moving on both the north and the south sides of the road, far enough away to be unseen by anyone watching the Wikosan infantry march up

the road itself. Wikosan scouts coming down the road had sighted the advancing Asteran infantry and raced back to tell their commanders.

Benton led his cavalry overland, moving as quietly as possible, using any cover available, traveling far enough to the south to outflank the Wikosan mounted force planning to outflank the Asterans on the road. Much farther to the north, Odwan Freya was leading a force of Asteran infantry and the small Asteran mounted force to outflank the Wikosans on the north side.

The Wikosans appeared to have at least six hundred mounted fighters, against the combined numbers of a U.S. cavalry and Asteran mounted force of less than one hundred fifty. Little wonder the Wikosans advanced with too much confidence and too little care, trusting in their deception and their strong superiority in numbers.

The final approach to the battlefield was in the predawn dimness, the cavalry column moving silently through prairie grass dry and brown from the winter. The wagons had been left behind in the city, unneeded for such a short period in the field, and too likely to be spotted by the enemy. As the sun rose, Captain Benton led his company through small, unnamed courses and creek beds south of Dry Creek.

"Lieutenant Garret."

"Yes, sir."

"We're leading our horses to conserve their strength. Did your professors teach you the other reason for walking horses rather than riding them?"

"No, sir."

Benton pointed upward. "A man on a horse has a much higher silhouette than a man and a horse walking. A man riding a horse can be seen by a man on the ground much farther than they can see that man."

Reaching their objective, Benton halted the column and pulled out his field glasses, then handed his horse's reins to the bugler and hiked up the side of the gulley they were in to look north, keeping low as he reached the top. He gazed through the field glasses, slowly traversing the landscape, but from here couldn't see the main Wikosan force coming up the road, or the Asterans coming up to meet them. There was no sign of the left or right hook of the Wikosans, either, or of Freya's force farther north. "Lieutenant Garret, go back west along this gulley and see if you can spot any of the moving forces. Sergeant Tyndall, get our own scouts out to the north and see what they can find."

Benton lowered his field glasses, unhappy at his inability to communicate with the other parts of the Asteran force but knowing there was nothing he could do about it. The people of this world knew all about using mirrors to flash simple messages quickly over long distances. Indeed, the ruined imperial guard towers they'd seen had done that as part of their mission. But attempting to flash messages between the different parts of the Asteran force now would only betray their presence to any Wikosans moving in the same line of sight.

As the sun climbed in the sky, it beat down into the gulley, the air growing warm despite the season. Down here, the almost ever-present Kansas wind couldn't penetrate well, so

the cavalry sat and literally sweated out the wait, most of the cavalrymen grabbing a nap with the practiced efficiency of veterans.

Lieutenant Garret finally came back, moving bent over to keep from being seen by any Wikosan looking this way, and knelt beside Benton. "Captain, the Asterans are coming up the road just as planned. They and the Wikosans on the road are in sight of each other and both sides are spreading out on either side of the road for a fight."

Several minutes later three of Benton's scouts scuttled out of the grass and slid into the gully. "Sir, them Wickies are there in Dry Creek, all right. About five hundred yards north of here. All cavalry, near as we could tell," Corporal Stein reported. "About three company's worth of them, I figure."

Roughly three hundred, then. "Do they have any scouts out on this side?"

"No, sir. Not a one. And all of them are looking north toward the road. I reckon we could've walked up and carried off a couple of them and the rest wouldn't have noticed."

"Show me where they are." The scouts pointed, Benton studying the area carefully through his field glasses and now spotting a few plumes among trees growing in the creek bed. Some careless Wikosans were wearing helmets that stood up high enough to see. "Is there anything for the horses to worry about between us and them?"

Corporal Stein pointed east. "A little prairie dog town over that way, captain. That's it."

"Good job. Lieutenant Garret, let's get the company lined up."

They'd learned all about this from the plains tribes. How to sneak up on an enemy, ensuring surprise, the importance of scouting the terrain carefully, and then an overwhelming attack before those being assaulted had time to gather their wits.

Moving with care to avoid making noise, the company formed into one line facing toward the enemy, each cavalryman holding his horse and ready to mount, about one yard between the men and horses as they stood abreast. "Pass the word down the line," Benton ordered. "The men are to use their pistols. They are to fire a volley just before contact with the enemy, and only after emptying their pistols are they to draw sabers and fight with blades."

Sergeant Tyndall passed the word, then grinned at Benton. "Good thing you got the company some of them new Smith and Wesson revolvers, cap'n."

Good thing, indeed, given the odds facing them. The .44 caliber Smith & Wessons that the Army had bought this year could fire six shots almost as fast as a trooper could pull the trigger, whereas the old Model 1860 Colt cap and ball pistols had taken a while to fire each shot and a long time to reload.

Then they could only wait. Benton kept looking north, but his thoughts were often not on the Wikosans, but on the Asteran force to the north commanded by Odwan Freya.

"They'll be fine, cap'n," Sergeant Tyndall startled him by saying in a low voice. "Belisa says that Odwan is one tough fighter."

"Thanks," Benton muttered, embarrassed that Tyndall had read his feelings.

A moment later, the sounds of horns floated over the prairie. "Those are ours, cap'n," Tyndall confirmed. "Asteran, I mean. They're ordering the infantry on the road to advance."

The feint attack was going in. "Pass the word for the men to prepare to mount," Benton ordered.

Tyndall took a long drink from his canteen, then spat to one side. "Faking a retreat is hard to do right, cap'n. You think that Agani and Costoni can do it?"

"They've got the best troops the Asterans can muster as well as the worst, and the best ones are supposed to form a shield wall in the rear to keep the weaker ones from really running." That was how it was supposed to work, anyway.

More Asteran horns, Tyndall listening carefully. "That's the order to attack, cap'n."

"Mount up."

All along the line, cavalrymen swung into their saddles, one hand grasping their bridles and the other drawing and cocking their pistols.

"Uncase the colors."

The flag of the United States of America and the guidon of the 5th Cavalry regiment came free of their canvas tubes, unfurling in the breeze.

The sounds of the horns were confused now. Decires Agani and Costoni had command of the force on the road, which was even weaker than it appeared since half of it was made up of the sort of older, younger, or inexperienced fighters whom Freya had characterized as only good enough to defend the walls. Those soldiers would be falling back now as the

Wikosans advanced, the enemy no doubt thrilled at how easily the Asteran attack seemed to be crumbling.

Benton raised one hand. "Company B, advance at a walk!" His hand came down and the cavalry surged into a walk, moving as one, the line of men and horses coming up from the gully and heading toward the still-hidden mounted force of Wikosans. Dressing their line to keep it as straight as possible, the company advanced.

This was the hard part for any cavalry force, to wait to commence the charge until they were the right distance from the enemy. Charge too early, and the horses would be spent when they made contact. Charge too late, and they might not have enough speed up.

The metal-on-metal clanging din of battle on the road could be heard now as well as the calls of horns, and Benton saw the Wikosan mounted force, still screened from the road but every man in their own saddles now, every head turned north toward the fight.

Three hundred yards, the cavalry moving steadily through the high prairie grass, silent but for the rattle of harness and the crackling of the dry grass being shoved aside by the horses. Two hundred yards, the Wikosans milling about, plainly eager to go but waiting for some signal.

"Bugler," Benton ordered. "Sound the trot."

As the notes of the bugle rose over the prairie, the line of cavalry kicked their horses into a trot.

The enemy horsemen looked back as the sounds of the bugle finally rose over the racket of the nearby battle and the noise of the Wikosans' own horses and gear. Their mouths

gaped open in shock, then Benton heard them shouting warnings to each other.

One hundred and fifty yards. "Bugler, sound the gallop."

This time the bugle call was more insistent, and at the demand of their riders the cavalry horses leaped forward, the straight line maintaining its order even as the horses raced faster toward the enemy. Benton gripped his pistol harder, the wind whipping at his face.

The Wikosans were turning their horses and colliding with each other as the enemy force struggled to reorient toward the new threat.

Roughly fifty yards. "Bugler, sound the charge!" Benton shouted over the thunder of one hundred horses galloping to the attack. The bugle sang urgently and continuously, its notes ringing over the battlefield, and now the cavalrymen roared as they kicked their horses into an all-out assault, the flags flying open behind the color bearers as Company B hit the enemy with the mass and momentum only a cavalry charge could create.

Benton leveled his pistol at a Wikosan who seemed to be shouting orders, firing a few feet short of contact with the enemy, other pistols going off all along the line as the rest of the troopers fired. The Wikosans, already wavering, broke frantically toward the road, all thought of attacking fled as the cavalry herded them north, firing and shouting, the Wikosan horses panicking at the noise again and throwing many of those riders who weren't being felled by the .44 caliber bullets from the revolvers that punched easily through the armor of the Wikosans.

He could see the road now, the Asteran force holding a blocking position along the road to the west while the Wikosan infantry pressed forward against it. But the sound of the gunshots from the cavalry had already alerted the Wikosans on the road to their peril, and Benton saw them beginning to fall back. He shot another Wikosan at point blank range, the impact of the shot knocking the enemy out of the saddle, then took two more shots to drop a Wikosan with a lance. His next bullet went into a dismounted Wikosan who was staggering around waving an axe.

The cavalry was near the road now, herding the surviving Wikosan horsemen toward their infantry, the horns of the Asterans on the road sounding as their holding action turned into a slow, steady advance. The Asteran line thinned, extending outward to either side to curl around the edges of the Wikosan infantry formation as the Wikosans fell back.

From the north, more Wikosans came, riding frantically, then hauling in their reins as they saw the cavalry charging up from the south, pistol shots still crashing over the lesser sounds of swords on shields or armor. The small Asteran mounted force appeared just north of the road beyond the Wikosans there, the blue banner spangled with stars identifying them clearly as they blocked the road, then Asteran infantry came into view to the north, advancing quickly in line, shields locked, pressing the northern hook into the Wikosan infantry on the road where the fleeing remnants of the southern hook were already stampeding into their own infantry.

Benton wheeled his formation, forcing the Wikosans ahead of him to crash into the Wikosan infantry as they tried to escape. The enemy mounted force that had formed the northern hook was mostly intact since it had been able to outrun the Asteran infantry, but it was also forced into its own infantry as it tried to flee and the Wikosan force was pressed on all sides. The cavalry wheeled again and Asteran infantry pushed forward and around, the forces on the road moving to link up with the northern advance as it reached the road behind the Wikosans. The Asteran mounted soldiers charged into a band of fleeing Wikosan mounted men who seemed about to escape, driving those Wikosans back upon their infantry as well.

A line of Wikosan infantry headed for the last open escape path, moving southeast with their shields joined to form a solid defense.

Benton slowed his horse, turning to shout at the thirty or so cavalrymen closest to him. "Carbines!" The cavalrymen checked their mounts, drawing their carbines and aiming at the escaping Wikosans. Shooting from the saddle was notoriously inaccurate, but the wall of Wikosans was almost impossible to miss. "Fire!" A ragged volley erupted from the carbines, and several of the Wikosans in the front rank were punched backward by hits. The rest of the escaping Wikosans hesitated, stumbling to a halt.

Sergeant Tyndall led another group of cavalry close to the Wikosans, reining in their horses only twenty feet from the infantry and firing their carbines in a devastating salvo.

The Wikosan infantry broke, running back toward their comrades, smashing into other Wikosans who had tried to follow them out of the trap.

The southern flank of the Asteran infantry under Agani and Costoni made contact with the southern edge of the Asteran infantry that had come from the north, closing the net and completely encircling the Wikosans.

The Wikosans on each side of the formation tried to force their way to the other side to escape, only to discover an unbroken line of Asterans on all sides. The enemy army turned into a mob as panic set in and the vengeful Asterans locked shields and pressed in harder, an unyielding wall of armor and weapons ringing in the Wikosans, who were increasingly packed too tightly to fight well and were no longer offering any effective resistance.

"Bugler, sound assembly." Benton's mount was exhausted, almost staggering as he reined the horse to a walk. This was the infantry's battle now. The surviving Wikosan mounted forces were trapped in the heaving mass of foot soldiers, their horses lashing out at their own side in panic.

He looked down at the saber in his hand. He couldn't clearly remember holstering his empty pistol and drawing the saber, but the blade had a slick of blood on the edge where he had struck a Wikosan.

Lieutenant Garret rode up, his face pale but his eyes still lit from the excitement of battle. "Two dead, six wounded, sir. Four horses down."

"Thank you, lieutenant." Benton, trying to keep his hands from trembling, carefully wiped his saber blade and returned the weapon to its scabbard. "Who are the dead?"

"Private Murphy and Private Frost, sir."

"Damn. Sergeant Tyndall, check on the wounded, let me know how serious their injuries are, and make sure the Asteran surgeons know we have wounded who need treating."

Tyndall saluted and rushed off at the best pace his winded horse could manage.

Lieutenant Garret stared toward where the Asteran infantry was still crushing the helpless rabble that had been the Wikosan army. "As close to another Cannae as matters, captain."

"Yes, lieutenant. Congratulations on your first battle. You handled yourself well." Benton sighed, looking back at the fight before kicking his reluctant horse into motion again. "The Wikosans don't stand a chance now, but they keep trying to fight. The Asterans don't need us to assist in the slaughter. Let's see to our dead."

Corporal O'Hare was standing sentry with the bodies, his face stiff with grief, and saluted as Benton approached. "Beg to report, captain, that Private Murphy and Private Frost are dead."

"I heard." Benton dismounted and knelt by the bodies. The dead soldiers had already been laid out properly, their eyes closed. "They were good men."

"Yes, sir. Captain, sir, how do we bury them, sir?" O'Hare seemed very agitated as he asked the question.

"Like any soldier, corporal. A sad duty, but it's one we've carried out before this. Why do you ask?"

"Captain, sir, it's—" O'Hare waved a hand to encompass their surroundings. "I haven't seen a church here, sir. Not one. And not one man of God, neither. The city folk are nice and all, but they've never heard of Him. How can we give our men a proper burial if . . . if the Lord's not here to accept them?"

Benton stood up, raising one hand to clasp O'Hare's shoulder. "Corporal, were you taught that He is everywhere?"

"Yes, sir. That I was."

"Then He is here, corporal. We will bury our men as they would have wished to be buried, with the full regulation service, and He will take their souls in His hand, because He is here with us."

O'Hare's face cleared, anxiety being replaced by a relieved smile. "Of course, sir. I knew I should ask you right off, captain. Yes, sir. At the city, sir? We'll bury them there? The city folk won't mind the crosses on the grave markers, will they?"

"No, corporal, the Asterans won't mind."

As Benton mounted again, Lieutenant Garret came to stand by his stirrup. "Captain, that thing you told the corporal," Garret asked quietly. "Do you believe it?"

Benton leaned forward, looking down at Garret, "Lieutenant, during the war the 5th Cavalry fought in a lot of battles. The Wilderness was one of them. It was also the nearest thing to hell I ever hope to experience. During the Wilderness, I thought the only way I could possibly live

through the fight would be if the Lord stayed right beside me. As you see, I did survive the battle. If the Lord could be with me through that, I'm sure He's here, too."

"But what if our world is still there somehow, if both it and this world exist at the same time?"

"If General Grant could handle more than one division, I reckon the Lord can handle more than one world, lieutenant. Make sure O'Hare has all the help he needs to get Private Murphy's and Private Frost's remains prepared for the ride to Astera."

Wearily, Benton rode back toward the fight. The massacre seemed to have stopped, and now the Asterans were holding under guard about two hundred Wikosans who had finally surrendered rather than fight to the death. Benton guessed that something on the order of fifteen hundred Wikosans lay dead on the field.

He spotted Freya riding toward him, a trickle of blood welling from a long cut on one side of her somber face, and Benton's breath caught for a moment. Freya was wearing the same battle gear as when he had first seen her, and though the rents in the chain mail then had since been repaired, there were new gashes in the mail from today's fight. *Thank heavens she's all right. What a woman, to conceive and win such a battle as this. No. All I need say is what a woman. I don't need to add more than that.*

Freya reined in next to him and gave Benton an Asteran salute. "My friend and ally. Thank you. This could not have happened without your cavalry. The mounted forces facing us

fled when they heard your weapons. I thank the Light that you have survived and brought home the head of an enemy."

There seemed to be a lot of emotion behind Freya's words. Wondering if that was just because of the passions generated by the battle, Benton looked away and found himself gazing toward the surviving Wikosans, who were staring back at him with dread and despair. "What's going to happen to them?"

Freya shrugged. "They laid down their arms rather than die holding their place, so they belong to us now, and there's much work to be done in and around Astera."

It took him a moment to realize what she meant. "They're going to be enslaved?"

"Made to work, yes, as long as they live. They are ours." She must have noticed his reaction. "What is wrong, my friend?"

He took a deep breath before speaking, wondering if the promising alliance with Astera was about to founder at the moment of its greatest success, and whether his friendship with Freya would also wither. "I have told you of the war my country fought only a few years ago. In just one battle of that war more than six thousand men died and tens of thousands more were wounded. We fought that war to save the Union, but also to eliminate the stain of slavery from our nation. Our Odwan then, a wise man named Lincoln, said 'as I would not be a slave, so I would not be a master.' My company will not fight to enslave others, Odwan Freya. To do so would be to betray our comrades who died in that war and to betray the beliefs we hold that slavery is always an evil and a wrong."

Freya listened without interrupting, her eyes on his, and remained silent for a long while after Benton finished. "Did you fight in that war?" she finally asked.

"I did, Odwan Freya. So did Sergeant Tyndall and some other members of my troop."

"It is well you survived that, too." Turning her horse, Freya rode a short distance until she was right next to the huddled prisoners. Rising in her new stirrups, she addressed the Wikosans, using only those words of her language that she knew Benton could understand. "Choose twelve among you to return to Wikosa. You will tell Wikosa that they may buy your lives and your freedom with any Asterans they hold, and with horses, cattle, sheep, grain, gold, and other metals. What Wikosa has taken will be returned to us, and more besides if they wish you back whole."

She rode back to Benton, ignoring surprised looks from the other Asterans. "Wikosa will pay. It will need them to defend itself when the wolves come to howl at its walls. My people will accept this when they see it profits us. Is this well?" she asked. "Would your Odwan Lincoln approve?"

"He would. Thank you, Odwan Freya."

"Thank you for frank words that ring true. You must tell me more of this Odwan Lincoln. I once said your civilization was backward in some ways, but it seems we can learn from yours just as you have learned from ours."

* * * *

It turned out that there had been one decire of mounted fighters from Lacanan among the Wikosan army, but they had

been completely wiped out in the battle, with none to bring home the tale of their defeat. Freya assigned a messenger to bring the news to Lacanan, along with an offer of alliance that would have been scorned before, but in the wake of this battle would surely receive serious consideration.

In the week after the victorious forces returned to Astera, a Telasan force seven decires strong was spotted marching north, but turned back when brought news of the Wikosan defeat. One of the wounded cavalymen had suffered such serious injuries to one arm that Benton feared he would have to lose the limb, but the Asteran surgeons worked on it and applied their salves and treatments, afterwards declaring that both man and arm should recover fully. Private Murphy and Private Frost were buried with full military honors, the poignant notes of Taps sounding in the city for the first time for that purpose. Construction began on the powder mill, even though Astera was still trying to secure a reliable source of sulfur. Three more cavalymen married local girls, and the grateful Asteran city council agreed to formalize the regular payment of salaries to the cavalry so Benton could once again be sure of routinely being able to pay his men. He was especially pleased that the pay rate the Asterans agreed to was equivalent to at least twenty dollars a month for the privates.

On the seventh night after returning, Benton walked out onto the walls surrounding the city, looking west toward where the lights of Fort Harker and Ellsworth, Kansas, had been, should have been, but in this world had never been.

"Something troubles you." Freya had come near and now spoke quietly.

"There's someplace I should have gone, Freya, someplace I should have returned my company. But I failed in that."

"Failed? I do not believe you could have failed."

Benton smiled bitterly. "I'm a fairly good officer, I think, but not outstanding. No one would ever confuse me with Sheridan or Sherman."

"More of your Odwans?"

"No, just war leaders."

Freya waited a moment to see if Benton had more to say before she spoke again. "You are better than you believe, I think. Your men seem happy."

"Most of them, yes. Most of them believe we're still going to get home someday, and in the meantime this is as nice a posting as any cavalryman can hope for. Most of the men in the company didn't have a wife or a steady girlfriend back home," Benton explained. "A few do, though, and that's a hard thing, to know you may never see them again."

Freya paused, then spoke carefully. "Do you have such a woman, Captain Benton?"

He didn't answer for a moment, decided to only reply in the negative as he usually did when someone asked that, then found himself saying much more. "No. My wife died several years ago, during the war with the South. It's . . . not easy to think of even now, because when I left for the war she was so worried that I wouldn't return, that I'd never be able to come back to her. But while I was campaigning she fell ill and died, so when I came home she couldn't be there. I

. . . can't think of it without hoping she didn't know her last hours were her last, because it would have hurt her so to know she wouldn't be there waiting for me when I came back." Benton couldn't recall the last time he'd spoken of that to anyone.

Freya regarded him gravely. "May the Light ease the burden of your grief and the stars shine in memory of the one you have lost." The words sounded ritualistic, but she said them with real feeling.

"Thank you. What about you, Odwan Freya?"

She made a sad sound. "I had a man who died nearly half my life ago, in battle. He stays young in my memory. Now I am bound to my duty as Odwan. There has been little room for anyone else. You understand?"

"Yes, I do. I'm sorry for your loss. I'm grateful there is room in your life for my friendship." It felt both comfortable and strange to be speaking so with a woman, one who truly did share so many things with him, who also knew how the burdens of command could force out personal wants and needs. The only thing standing between them like a wall was a truth that Benton hadn't yet shared with her. "I need to tell you where we actually came from, Freya."

She shook her head. "Whatever led you from there is nothing I need know."

"Yes, I think you do." He explained his world, the storm, the changed world they'd found afterward, and Lieutenant Garret's theory. "We have no idea how to get back, but if we ever found a way, we'd have to use it. I have a duty to fulfill."

To his surprise, Freya didn't express any disbelief, instead nodding knowingly. "The lightning. Its ancient name is the fire-writer, that which the Light uses to cast messages in the sky, messages whose meaning we often cannot read. The lightning brought you here from the world you knew, but the reason may never be clear." She sighed. "Your cavalry has saved Astera not once but twice and guaranteed our safety for years to come. You have already done so much. Yet, you may also help us and other cities build peace in this part of the land again, the type of peace no one has seen since the days of the fallen empire. But our debt and our duty is clear. If Astera, if I, can ever help you reach your home again, we will. But the lightning never repeats the same message twice."

"We say much the same thing," Benton replied, turning away from the darkness where his duty had lain, turning to face Freya.

She smiled and touched his face gently with one hand. "No matter what the lightning does, you will always have a home here."

* * * *

Postscript

Though historical memory of the Benton Massacre has been eclipsed by the Fetterman Disaster in 1866 and Custer's Last Stand at the Little Big Horn in 1876, it attracted considerable attention for a brief period and remains an enduring military mystery. On October 4, 1870, a company from the 5th Cavalry Regiment under the command of

Captain Ulysses Benton left Fort Harker on a routine training patrol of the area south and west of the fort in preparation for campaigning later in the season. The company of cavalry did not return as scheduled, and every attempt to locate Captain Benton or any of his men failed. Nearby tribes all denied knowing what had happened to the cavalry unit, but an official investigation concluded that the only plausible explanation for their disappearance had to be a massacre of the entire company and the concealment of their bodies and equipment. No trace of Captain Benton's command has ever been found.

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Science Fact: **WHAT'S IN A KISS?: THE WILD,
WONDERFUL WORLD OF PHILEMATOLOG** by Richard A.
Lovett

* * * *

"Since the invention of the kiss, there have only been five kisses that were rated the most passionate, the most pure. This one left them all behind."

—The Princess Bride

* * * *

"When you kiss me, without uttering a single word, you speak to my soul."

—Source unknown

* * * *

"We are all mortal until the first kiss and the second glass of wine."

—Eduardo Galeano

* * * *

Search the Internet, and it's easy to find hundreds of quotes like this. Every writer or poet with even a hint of a romantic streak seems, at one time or another, drawn to rhapsodize on the power of the kiss. And not just the first kiss. Consider this quote from John Keats (1795-1821): "You

are always new, the last of your kisses was ever the sweetest."

But what exactly is involved in these lip-locks?

Love, obviously. Hopefully, some happily ever-aftering.[1] But that's not all. According to osculologists[2]—scientists who make their careers studying kissing—there's also an enormous amount of neurotransmitters, evolutionary biology, and instant assessments of potential life-mates. "It can be highly positive or highly negative," says Helen Fisher, a professor of anthropology at Rutgers University. "Often the first kiss kills a relationship,"

Many customs vary widely from culture to culture, but kissing isn't one of them. As far back as the mid-nineteenth century, Charles Darwin noticed this and mailed questionnaires to missionaries, asking if people in the isolated tribes they dealt with kissed each other. The overwhelming answer was yes. In the 1950s, the study was repeated, with similar results. "Even where people found it disgusting, they did all kinds of other things," said Fisher, in a pre-Valentine's Day press conference at the 2009 meeting of the American Association for the Advancement of Science. "Blow on the face. Tap on the face. Nip on the face."

Unless this is a truly massive coincidence, it means that kissing must do something biological: self-reinforcing, so that once people discover it, it drives out the types of cultural alternatives science fiction writers might otherwise invent (such as, say, pairs thumb-twiddling).

One prospect is that it shifts the body's hormone balance. To test this, Wendy Hill, a professor of neuroscience at

Lafayette College, in Easton, Pennsylvania, recruited fifteen couples (all college students) and asked them to spend fifteen minutes alone together. One group held hands and talked. The other kissed. (Ah, the sacrifices we make in the name of science . . .)

Before and after, the researchers collected samples of blood and saliva, analyzing them for two critical hormones: cortisol and oxytocin.

Cortisol is a stress hormone. Oxytocin is related to feelings of trust, closeness, and pair bonding. Some scientists think it might be stimulated, early in life, by nursing and (in some cultures) pre-mastication, in which mothers chew food before giving it to their infants. Since both of these are oral behaviors, it's possible that later in life, the same warm-fuzzy hormone is stimulated by other oral actions . . . such as kissing.

Also significant is the fact that humans aren't the only animals to exhibit such behaviors. Bonobos kiss and elephants put their trunks in each other's mouths. Foxes lick faces. "Some form of facial contact is common not only in mammals but also in avian and reptilian species," says Fisher. Darwin wondered if kissing might be a natural instinct. "This might be in our hard-wiring," says Carey Wilson, a student researcher at Lafayette College who helped with Hill's studies.

Precisely what our "hard-wiring" is leading us to search for, via kissing, is a subject of some debate. One prospect is that men are trying to taste sex hormones, such as estrogen, in women's saliva, subconsciously attempting to determine which women are most likely to be fertile. Another is that

they're trying to make their dates more randy by passing on testosterone from their own saliva. Supporting this argument, Wilson notes, is the fact that while women tend to view kissing as a form of mate assessment and of maintaining a strong relationship, men often see it more as a prelude to sex.

Men also seem geared to maximize the exchange of saliva. "Men are more likely to like wet kisses with an open mouth with more tongue action," Fisher says.

* * * *

Kissing in the Med Center

Hill's team found that even at baseline, the women had higher levels of oxytocin than the men: sad confirmation that most men might truly have only one thing on their minds.[3]

After kissing, cortisol declined in both men and women (compared to the hand-holding control group), indicating that stress had been reduced. But contrary to expectations, oxytocin increased only in the men. In women, it actually decreased slightly.

Perhaps something is wrong with the theory—though it's hard to understand how kissing might undermine the pair-bonding of already established couples.[4] Alternatively, perhaps the study group was too small to produce anything more than statistical noise in this part of the study.

Hill's team thinks the problem may have been that the experiment was carried out in the student health center. "It was done there for the convenience in drawing blood," says EvanLebovitz, another of the student researchers. But that

may not have been an ideal choice. "The setting wasn't very romantic," Hill admits. "There were flowers and music, but it was a place where students go when ill."

She speculates that the setting may have been more disruptive to the women than the men. "We are in the process of running the study again in a more romantic setting."

* * * *

Human Pheromones

Insects produce pheromones: airborne sex chemicals that signal interest or draw prospective mates. Could people do something similar via kissing and related behaviors?

Quite possibly, say some researchers. Sarah Woodley, a neuroendocrinologist from Duquesne University, notes that the simple act of blowing kisses might, to some degree, signify such intents. And many children, she notes, learn early to "throw" hugs. "Are we 'throwing' pheromones around?" she asks.

There is considerable debate over whether humans truly produce pheromones, but it's possible to sidestep that argument by speaking in terms of "chemosignals."

Such chemicals might well be transmitted via kissing. One older study reputedly asked people if they'd have sex with someone they'd never before kissed.[5] Not surprisingly, quite a few men (about half) said sure. Women, however, were highly unlikely to do so.

In another much-better-publicized study conducted three decades ago, scientists sprayed androstenone, a male sex

hormone, on chairs in dentists' waiting rooms. Women sat slightly more often in the sprayed chairs.[6] "But the data are problematic," Woodley said. "There is a great deal of variability in the ability of people to detect it [androstenone]. A lot can't at all, and some find it sickening in smell, almost like urine. Others say it's like vanilla. So it's a complicated story."

Also of interest are "MHC" genes.

MHC stands for "major histocompatibility complex," comprised of about a hundred genes. All are involved in immune function, but for some unknown reason they affect body odor.

What this means is that by smelling someone (or kissing them), you may be able to determine the strength of their immune system: valuable information in trying to determine if they'll be around long enough to raise your kids. Or you might be determining how genetically similar (or dissimilar) they are to you. Kissing someone with too close an MHC complex might produce subconscious cues akin to kissing your brother (or sister), good protection against inbreeding.

To test this, several research teams have asked people to sleep in the same T-shirts for several nights in succession. Then, other people were asked to rate the odors on the shirts, assessing, among other things, their pleasantness (or lack thereof) and sexiness.

Six such studies were recently reviewed by a team that included Craig Roberts of the University of Liverpool, Woodley said. Most found that people preferred odors from people whose MHCs differed from their own.

Chemo-sensing (in this case by smell) appears to be real. But it's hard to pin down because there are plenty of cultural practices (up to and including arranged marriages) that can override it.

* * * *

My Adventure or Your Comfort Zone?

All of this is only the beginning. Fisher believes kissing may stimulate brain-affecting hormones and neurotransmitters linked to reproduction. She groups them into three basic brain "systems." One is the sex drive. We've already talked about testosterone and estrogen in saliva and how kisses, particularly of the sloppy, wet variety, can exchange them. "Men do see kissing early in a relationship as a step toward copulation," Fisher reiterates.

But in the long run, neurotransmitters might be more important. Fisher and her colleagues recruited forty-nine volunteers who were madly in love and put them in a brain scanner to see what parts of their brains lit up when they thought about the objects of their affections.[7] Seventeen had fallen in love recently, seventeen had been in love for years, and the rest had recently been dumped.

She found considerable activity in brain centers known to express two major neurotransmitter groups. One was dopamine, a natural stimulant linked to many types of pleasurable activities, including intense romantic love. This was particularly evident in the people who had recently fallen in love, who showed considerable activity in the brain's reward centers—what Fisher called "the brain systems for

wanting, for craving, for focused attention." So much for that single-minded perfection of new love: you're high on neurotransmitters. In addition to the dopamine, Fisher says, there's probably norepinephrine, which produces sweaty palms and a pounding heart.

This neurotransmitter cocktail, Fisher says, is an even stronger drive than sex itself. "People in stories kill for love, live for love, and die for love," she says. Cupid's arrow is tipped with dopamine.

Rejected lovers had similar brain activity, plus some in regions of the brain active in cocaine addicts. No surprise, Fisher suggests. "Romantic love is an addiction when it's going well and horrible when not."

The long-term lovers were a bit different. They still showed activity in some of the flashy dopamine centers, but also had activity in parts of the brain associated with producing our friend oxytocin. "They're feeling not only romantic love, but also deep attachment," Fisher says. They also exhibited a lot of activity in a serotonin-producing region associated with calmness. "These people are in love, but that early intensity and anxiety is now replaced," Fisher says.

How does kissing affect this? Well, new experiences stimulate dopamine and norepinephrine. "And certainly the first kiss is wildly novel," Fisher says. "So it's entirely possible the novelty, [by] driving up dopamine and norepinephrine, could also trigger the brain system for romantic love."

Combine this with Hill's oxytocin/cortisol research, and other groups' findings regarding sex hormones in saliva, and it appears there's a lot going on in a "simple" kiss. In fact,

Fisher suggests, it may have evolved to stimulate all three of the brain's relevant hormone/neurotransmitter systems.

"[The] sex drive got you out there looking for a range of partners," Fisher says. "Romantic love got you to focus on one at a time. Attachment evolved to at least allow you to tolerate this human being long enough to raise a child together."

But Cupid doesn't hit everyone equally. Some people are strong in one neurotransmitter, some in another. Some appear to produce large amounts of one hormone, some another.

To learn more, Fisher teamed up with online dating giant match.com to determine what type of biochemistry produces the type of relationship chemistry we all crave.

Going into the partnership, she had determined that there were four basic hormonal/neurotransmitter types, or patterns: dopamine/norepinephrine, serotonin, testosterone, and estrogen/oxytocin. So she developed a survey to distinguish them—a sort of biochemical Myers-Briggs personality inventory. "We got seven million responses," she says.

The four groups were quite distinctive. "Dopamine is more risk-taking, novelty-seeking, [and] creativity," she says. "Serotonin is calm, social, cautious but not fearful."

High-dopamine people have energy and optimism and are good idea generators with many interests. They're also curious and verbal. Think "Obama," she says. But they can be easily bored, impulsive, reckless. Addiction is a possibility.

The word they're most likely to use in their online ads is "adventure."

High-serotonin people are more conventional. They have more close friends, are good at cooperation, and are persistent, stoical, conscientious, and tend to be more religious. But they can also be stubborn, closed-minded, rigidly moralistic, and controlling. In their ads, the most important words were "family," "loyal," "respect morals," "trustworthy," "caring." They also tend to be rural. "I could point out the red states and blue states and see where the serotonin and dopamine was, and why these people don't understand each other," Fisher said. "The whole language is different."

As an example of a high-serotonin person, Fisher suggests George Washington.

High-testosterone people are analytical, direct, decisive, tough-minded, work well in "rules-based" systems, and are good at math, computers, chess, and music. They're also emotionally contained. "If you watch a high-testosterone person on television, they're really only moving their lips," Fisher says. "They're not moving much of the rest of their face at all." The downside is that they can have poor verbal skills and be aggressive and uncompromising.

"I think John McCain is a perfect example," Fisher says. "He was proud of being a maverick." Not that this category is exclusively male. Fisher puts Hillary Clinton in the same group.[8]

Estrogen is usually viewed as a female hormone, but men can express it as well. "Football players have been found to be high estrogen as well as testosterone," she says.

If you're looking for a good example, she says, think the other Clinton: Bill. Such people are consensual, holistic, able to see the big picture. They're imaginative, linguistic, intuitive and emotionally expressive, and have strong verbal and social skills. But they can also be indecisive, unfocused, gullible, effusive, ruminating, and unforgiving.

In dating ads, their favorite words are "passion," "real," "heart," "kind," "reader," "sensitive," "sweet," "empathic."

Again, she points to the former President Clinton. "*I feel your pain*," she says. "Only this type would say that." And she notes, "His book was 963 pages. We all know he can't stop talking."

* * * *

So who do these people pair up with?

In most cases, Fisher says, similar brain chemistries attract. High-dopamine/norepinephrine people go with high-dopamine/norepinephrine people; high-serotonin people go with high-serotonin people. In other words, "adventurous" people go with other "adventurous" people and traditionalists want traditionalists—with the obvious caveat that other factors play big roles, ranging from intelligence and socioeconomic background to childhood experiences and religious preferences.

A lot of this makes biological sense. Emotionally, people who mate with similar neurotransmitter types are going to

agree. High-serotonin types may both want to build a family, go to church, have a traditional Thanksgiving, etc. One question Fisher asked was whether people would rather have loyal friends or interesting ones. Only the serotonin preferred loyalty. "We all want loyal friends," Fisher said, "[but] the other three can't tolerate uninteresting friends."

The exception to likes attracting are the testosterone people. "Testosterone goes for estrogen and oxytocin," she says, again pointing to the Clintons. "In this case, opposites attract."

From an evolutionary perspective, she adds, high-dopamine people might be programmed to seek out mates with wide-ranging interests that expand their own. High-serotonin people might be seeking to reinforce their own strengths. And testosterone-estrogen pairs may seek each other out in order to combine divergent resources.

Not that all of this is written in concrete. It's possible, her survey found, to rank high on more than one of the four scales. "I've found people who are high on three of the four," she says. "The outlier is serotonin. If you're expressive of it, you're low on the others, mostly."

All of this obviously has a lot to do with Valentine's Day, but what does it have to do with kissing? Possibly a lot. There's got to be a reason why so many cultures use kissing as a preliminary step in mate assessment. "I think we'll find that kissing is a real adaptive mechanism," Fisher says. "The brain becomes very activated."

Her main point, though, is much simpler. "Who you choose to mate with is one of the most important things you do," she says.

Thus, it makes sense that we have a lot of biological processes designed to help us do it right. On top of that is the fact that we have "these four very broad constellations" of personality types. "These play a role in attraction when you kiss."

So, when you kiss your sweetheart this Valentine's Day, remember that you might be exchanging a lot more information than you think. But remember also that humans are creatures of will and spirit as well as biochemistry. I know one couple (both high-serotonin types) who chose not to kiss until their wedding. A silver anniversary later, they're tightly enough pair-bonded you'd think they'd been mainlining oxytocin. Others worship from afar for months, or even years, before they finally acknowledge it. And then—well, it's *Princess Bride* time. Maybe the normal "kiss" signaling has been done by other means. Humans are, after all, complex creatures.

If we weren't, what fun would science fiction be?

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[FOOTNOTE 1: Not that this is required. "The default assumption is that people kiss in an erotic or romantic situation," says Donald Lateiner, a professor of classical studies at Ohio Wesleyan University. "But there are other occasions." In some cultures, for example, social kissing is

common among people of equal status. In others, kissing can be a sign of deference or superiority. "[That's] sometimes called kissing up, or down," Lateiner said. (An example would be kissing a bishop's ring.) But this article is timed to come out near Valentine's Day, so let's go with the cultural flow and focus on romance.]

[FOOTNOTE 2: Sometimes called philematologists (but don't try to find either word in the dictionary).]

[FOOTNOTE 3: Although, she notes, these were college students, so any efforts to generalize must take that into account.]

[FOOTNOTE 4: Being trapped for a quarter-hour with a bad kisser or someone with extreme halitosis might have that effect, but these were couples, not people who'd never kissed before.]

[FOOTNOTE 5: The citation is hard to find.]

[FOOTNOTE 6: M.D. Kirk-Smith and D.A. Booth (1980), "Effects of Androstenone on Choice of Location in Others' Presence," in H. van der Starre (Ed.), *Olfaction and Taste* (Vol 7., pp. 397-400).]

[FOOTNOTE 7: Ideally, such studies would involve kissing in a brain scanner. But, as one commenter at the AAAS symposium pointed out, it's hard to kiss in a brain scanner. "There's not much room."]

[FOOTNOTE 8: Nor are there any differences among gays and straights. Five hundred thousand gays have taken the survey in the U.S. alone, Fisher says, and the same four personality types emerge. "If you're a curious person, you're going to be curious, whether you're gay or straight. If you're

stubborn, you're going to be stubborn, whether you're gay or straight. We're measuring temperament scales rather than sexual orientation."]

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Reader's Department: **IN TIMES TO COME**

It's not uncommon to hear a gripping story described as a "page turner," but next month (May) we have a real one for you: "Page Turner" is its name. It's by Rajnar Vajra, so it won't surprise you to hear that it's not quite like anything you've ever read. But neither will it surprise you to find that, despite its close-to-home setting, it weaves a fascinating array of ideas, offbeat characters, and distinctly unordinary happenings into something uniquely exotic, highly entertaining, and memorable.

H. G. Stratmann is back with a story completely different from his recent series, while David W. Goldman, a newcomer who made a considerable splash with his first couple of stories here, returns with his first new one in much too long. The rest of the fiction line-up covers a wide spectrum with entries from Lee Goodloe, Walter L. Kleine, David D. Levine, and Rick Cook.

The fact article, by Stella Fitzgibbons, MD, sounds as science-fictional as anything else in the issue, but it's actually about things with which you may come (at least figuratively) face-to-face on your next hospital visit. It's called "Robots Don't Leave Scars: What's New in Medical Robotics?"

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Novelette: **SNOWFLAKE KISSES** by Holly Hight & Richard A.
Lovett

There are things so pervasively important to
people that it's hard to define their essence....

Seattle, 2010

I sit in the park, watching children play. I imagine their packs swinging as, earlier, they'd sprinted home from school, glad to be released into a spring afternoon. Later, dinner will be clanking silverware and gulps of milk. Then it'll be study time and bath time, with bedtime stories and goodnight kisses, reassurances in the hall as the light's left on. But for now, it's slides and jungle gyms, softball and tag.

It wasn't like I didn't know what I was doing when I chose the tenure track over the baby track. In the sciences, twice as many women as men are divorced or permanently single. But I'd always figured I'd be one who beat the odds. After all, I was dedicating my career to studying love, or at least the neurochemistry behind it. Think serotonin, norepinephrine, estrogen, testosterone—hormones with forms like snowflakes looking for matching snowflake-receptors in the brain. But I lost most of my grant funds today: the dream I'd nurtured just as surely as these parents nurtured theirs.

I see a small boy, two or so, with hair the color of straw and eyes like the sky. He wants to swing, like the older kids as they kick their feet up, daring each other to go higher. His

mother helps him onto the seat, holding the chains as she gently pushes. Soon, he's far enough up for it to be scary, but she isn't going to let him fall, and he knows it. He's flying, pretending he's a big kid.

My research involves putting couples in brain scanners and watching the parts of their brains that light up as I try to puzzle out what it is that wires some for love, while others spend their lives searching. Sometimes, I give them printouts of their scans, small supernovas of brilliant hues set against black, the hieroglyphics of experience. When I see a good one, full of serotonin and dopamine and norepinephrine in just the right places—something my software renders in red and yellow the shade of a summer's-eve sun—I count it as true love.

The one I keep tacked above my desk is from an older couple, in their seventies. They eat lunches in the local buffet, play Boggle in the afternoon, spend summer evenings gardening. She likes petunias and he likes squash. "She makes the best fried squash around," he'd said, squeezing her hand. Their scan reminds me that true love really exists. It thrives in Alice and Victor Burgess.

The two-year-old has had enough. Before he can start to fuss, his mother plucks him from the swing and bounces him on her hip. Toddlers have short attention spans.

My grant covered two grad students and a postdoc. Not much in the big scheme of things but in the calculus of grant committees, too much for too few papers. But doing science isn't like being a toddler on a swing. You can't just shut it off when someone decides you've had enough. As I walk from

the playground, I make a decision. I've got six months left on an older grant. Not a lot of money, but enough, if I'm frugal. This project means too much to me. I'll continue as best I can.

* * * *

Baltimore, 2003

Nausea pulsed through me as I prepared for the symposium, my notes laid out by the hotel-room sink. Was it just nerves? I peeked out the bathroom door to where Carl still slept, the heavy curtains drawn.

The night before had been late: sushi and sake with a dozen others from this wonderfully diverse meeting, one of the few where we could both present. Astrophysics one day, neurochemistry the next.

Carl had drunk. I hadn't.

I locked the door and slipped up a palm to touch a tender breast, my brain whirring with what I'd tell him when he woke. "Carl, I think I'm—" No, wait. There couldn't be any "think"; I had to be sure. "Hey, Carl, I'm—" No, too direct. He'd need time to adjust. "Hey, Carl; I need to talk to you about something . . ." He'd have his dark head bowed, looking at some journal, "Yeah?"

"I need to talk to you."

He'd look up. "Uh-huh."

"About something really important."

He would set the journal aside and bite his lower lip. "What is it, Julia?" There would be a hint of impatience.

I'd catch it, chicken out. "Never mind."

"No, what is it? You've got my attention now."

"I think I'm—" And then I'd do it all wrong because I'd say the first thing that came to mind, not what I'd rehearsed, which is what I do when I'm nervous.

"You're *what*?"

"I didn't say I was; I said I *think*—"

"You *think*?" He'd stand, throw his hands up in exasperation. "What do you mean you *think*? Damn it, Jules. Weren't you careful?"

"Yeah."

"Then how did this happen?"

I'd shrug, redden a little. "I don't know." Perhaps it was a blessing.

What would *that* conversation be like? *I know we didn't plan this, but maybe it's a good thing.* This conference was the first thing we'd done together in ages. Maybe a child would pull us back together.

But even then, I knew it wouldn't work. Because what I wished he'd say was as impossible as my mother's Christmas gift.

* * * *

The Christmas I turned seven, my mother bought me a doll—a nice one, with a porcelain face and features like a real child's, with raven hair and real pink silk. It must've taken her months to save the money. We were poor and she was single.

I still have it in a drawer, her hair still as black and the silk still as pink. From the start, I knew she was one of those toys that are too nice to really play with, the type adults talk about

when they tell you how things used to be. Eventually, I named her Poinsettia because she came on Christmas, and would carry on long, intimate talks with her from her shelf in the darkness of my bedroom. But that was later. At the time, what I wanted was a snowflake.

Of course, that's what I told my mother. Seven-year-olds can be cruel. It wasn't that I didn't appreciate the doll. It was just that there was something else I wanted more. A perfect, feathery, one-of-a-kind snowflake like I'd seen in my grade school science book.

She could have satisfied me with a Christmas ornament, or even by teaching me to cut snowflake shapes from folded paper. But for some reason she chose to take me literally as I tried to wrap my seven-year-old vocabulary around the intricate, fractal images in my picture book. "I want a snowflake," I said. "One I can hold forever."

She looked away, bit her lip, went to her bedroom. A moment later, she came back with a jewelry box. Once, she'd kept pearl earrings in it, earrings she'd gotten from a man she'd loved.

"Open it," she said.

I did, but it was empty.

"Look hard."

I looked, but there was nothing.

"You can't hold a snowflake."

The box still reminds me of the earrings she used to wear on special outings with my father, but I've never dared put anything in it. I never knew what happened to them, but the earrings represent all things lost and gone forever.

* * * *

I slide into the brain scanner I've moved to the basement lab, the only space my shrunken funds now justify. At least I was able to keep the scanner. It's big enough for two and fast enough to catch the play of their brains interacting. I listen to its clicks and hums as I recalibrate it, feeding it my own shifting emotions. I have the monitor turned so I can see from inside. The images are like aurora borealis, dancing curtains of color encoding joys and tragedies, sparked by a slide show of selected pictures.

The first are neutral. A fluffy cat on a gingham couch. A black-and-gold barge on a stormy sea. A skyscraper flashing sunlight from blue-tinged windows. Then I move up the emotional scale to an old green Volkswagen, a yard with grass yellowed by August sun, a tiny figure on a twilight beach. Another notch and it's my father's young, handsome face with the playful smile. A Christmas tree with ornaments from the 1970s. My mother's hands and the knit blanket she made when I started kindergarten. What do I see? Reds, oranges, and yellows. Heat. Energy. Soul. Me at my best, and worst. Humanity's core.

I shut the slide show off, close my eyes. Breathe. Shove myself out and look again at the images of my brain on fire. I wipe a tear, rain after the blaze, and gaze at the color, the topography of my life, wishing it were different.

* * * *

"Julie?"

I'm caught in a memory, six years old.

My mother's face is gilded in candlelight. She's trying not to cry. "Daddy wanted me to tell you how much he loves you." Her voice breaks and I feel her arms around me. Too tight. "He had to go away, you know..."

I look up, into her face. "Where?"

"Far away."

"But where?"

She looks at me. "Europe."

"Where's that?"

"Across the world."

I try to imagine it. Fanciful birds and exotic animals. Fantastic buildings. Tall people. "Why'd he leave?"

"He had something important to do."

I go to bed dreaming of Europe. Does it smell different? Is the grass a different color? What about the sky? I can't sleep. I peer through the skinny crack in the door, watch as my mother cries at the kitchen table, the tiny flame dancing with her breath. I wonder why she's so sad; Dad's doing something important. She must miss him. I feel a pang. I miss him, too.

* * * *

On the final night of the conference, a dozen of us celebrated in the hotel bar: martinis, imported microbrews, wines from half the globe. I drank a virgin margarita, still thinking I had a secret. I looked around, wondering how many of the others once had similar secrets. In nine months, I was going to be one of the lucky few who danced between

the tenure track and the baby track. One of the few who found and held love. I touched my belly under the table, looking over at Carl as he discussed string theory or the first picoseconds of the Big Bang or something equally incomprehensible. He made it sound like gossip, exciting and juicy. More exciting to him, I suddenly knew, than the news I was waiting the right moment to tell.

I got up, went to the bathroom, and that's when I saw it. Blood. One small, damning stain. My heart sank, the realization setting in that maybe the miracle wasn't going to happen, that maybe it was for the better, anyway. The baby hadn't really been what I'd wanted. The real dream might as well still be a snowflake.

I returned to the table a different person. I flagged the waiter. Deadpan, I said: "One Manhattan and a Long Island Iced Tea."

He looked at me. Hesitated. "You want both?"

"Both."

"At the same time?"

I held them up. "I've got two hands, don't I?"

* * * *

Thirty minutes later I left, both drinks next to my plate, untouched. In the room, I couldn't stop crying, even when I heard Carl's key card in the door.

"What the hell's wrong, Jules?"

"I hate this."

"Hate what? This room? This hotel? The sushi roll? What?"

I sat up. Drew a breath. "I want more, Carl."

He sighed, long and hard, melodramatically. "This again."
"Please listen to me."

He shrugged out of his jacket, tossed it on a table. "I'm tired, and we've been through this before." He kicked off his shoes. "You cling, Jules. You try to grab so tightly that you crush the life out of whatever you're trying to hold."

I sat up straighter, as though slapped. But when we got home, it was Carl who filed for divorce.

* * * *

What is love? Whatever it is, it starts with neurochemicals. Maybe that's all it is: snowflakes meeting snowflakes. Link them the right way and something beautiful happens. Pair them wrong and they melt and disappear.

I type the ad: *Researcher looking for students willing to participate in study about love. What makes for good and lasting relationships . . . ?*

They will kiss, I decide. And as they kiss, I'll look at the sparklers in their brains. Love will exist as neurological firecrackers, snared on a machine, if only I can tease it out of the background of exams, car payments, soccer kids, or whatever else might be going on at the same time. I've been doing this now for seven years. Ever since Carl. Mapping brain activity against neurotransmitters, trying to tease out the secrets of the emotion that binds . . . and destroys.

I glance around the lab. For years it's been a storeroom and private work space, collecting an amazing assortment of detritus: a three-year-old horse calendar still turned to giant Belgians; mystery novels for the chemistry experiments that

had to be babysat overnight; snow boots from the big snowstorm . . . how many years ago?

And of course there are pictures. One in particular: sweat-stained and grubby. Small enough that I'd carried it in my purse for years. I'm not sure how it got here and have no idea what to do with it now, so I stuff it randomly in a drawer, an emotional land mine I'll stumble over again some time, but out of sight for the moment.

* * * *

Every day I asked about Europe. By then, I knew the people were no taller, that the sky was still blue and the grass still green. In my history classes people crossed the ocean in sailing ships and returned in less time than Dad had been gone.

I was eight when I found out the truth.

By then, I knew people went to Europe in airplanes, so I decided to skip school and walk to the airport, which had to be on the south side of town, since that was the only direction I'd never been. Mom was still sad and whatever Dad was doing couldn't be as important as she was. As I was. The picture was to show people so they could help me find him once I got there. It was of him and my mother on a camping trip, smiling, sitting on a log. It was the first picture I'd ever snapped, something magical I could hold forever.

I passed Benjamin Kendall's white picket fence, then waved at Ralph, Mrs. Jergin's old basset hound. I walked by the municipal pool and the park with the yellow swing set. I went up on the hill and looked for them, all those planes

flying to Europe. But there weren't any. No runways, no shiny jets, no tall traffic towers. Nothing but wheat fields and distant mountains.

I sat down, buried my head in my arms, and cried.

I woke to crickets and frogs, the moon, full and bright in the east. I picked my way home, through branches and gloom, and found my mother crying at her table. She looked up and was suddenly furious.

"Where have you *been*?"

I couldn't answer; there was no excuse good enough.

"Not you, too, Julie. I can't lose you, too."

* * * *

I'm still trying to regain my composure when I hear a knock at the lab door.

"Are you Julie Rasmussen?"

I look up and see a man with clear blue eyes and sandy, shoulder-length hair.

"You're the researcher, right? Sorry; I didn't mean to—"

I stand, shoving my hair out of my face. "Yes. I'm Dr. Rasmussen—Julie. Just call me Julie. Jules, if you want . . ." I stammer, take a breath. "Sorry. Yes—you've come to the right place." He reminds me of the perfect son or husband or father, soft-spoken, smart. "Do you have a girlfriend?"

He laughs. "You don't beat around the bush, do you?"

"No, I mean . . . what category?" I grab my clipboard, hold it up. "I need to put you in a category."

"Oh . . ." He grins. "Single."

I feel something in my gut. Apprehension. Sadness. Hope. I imagine my neurons firing, producing the color my scanner would see.

"How about you, Doctor? Boyfriend?"

"Not exactly."

He walks over to the machine. "What is it you're looking for? Love?"

"Sort of."

He moves closer. "What does love look like?"

I imagine it. Dendrites and neuro-pathways lighting up. Snowflakes building . . . melting.

He is too close, looking at me now, not the machine. "You think maybe you've found it?"

I turn away, embarrassed. "Please leave."

"*What?* What'd I do?"

"I'm not a test subject."

"What the hell does that mean?"

"It means I'm not interested."

* * * *

She comes in with black hair tangled around her shoulders and an attitude to match. The first thing I hear is her gum.

"You pay?"

"No."

"Why not?"

"They didn't renew my grant."

"Don't you know that's what separates us from them? People get paid. Guinea pigs don't."

I feel myself smile. "You're in it for love *and* money, huh?"

She shakes her head. "Nope. Just money."

Sadness swells through me as I notice a butterfly tattoo on her left ankle, the wings green, blue, and purple—colors that, on a scan, would mean inactivity.

"How do you know it's not just lust?" she adds.

"I take both single people and people who are in committed—"

"Bring in a john."

I stand there with my mouth open, like an idiot.

"You think of that?" She comes closer. "Did it ever occur to you that maybe the variable you think you're measuring isn't there at all?"

I feel my face redden. She is not stupid, not uneducated. "Where do you go to school?"

She snaps her gum. "Here." Her gaze is hard, accentuated by black liner circling two piercingly blue eyes. "I'm going for my Ph.D. in physical education." She grins. "Get it?"

"Huh?"

"*Physical* education?" She raises a wry brow. "*Nevermind*. You professor types think you're smart, but really—"

"I want you as a part of my study."

"*Your* study? If I participate, wouldn't it be *our* study?"

"Okay. Whatever you say. Are you in or out?"

She smiles. "In. This ought to be entertaining."

* * * *

"You want tongue or no tongue?"

I turn and there she is with a man, green-eyed and quiet.

"This is John." She giggles. "Get it?" Then she kisses him, open-mouthed, gum and all.

"Uh..."

She turns and smiles. "Want to catch it on that machine of yours?"

"You know, this isn't exactly—"

She walks up to me. "It is *exactly*." She grins. "You want to know what love is, I'll show you."

My gut tightens. This isn't love. "What's your name again?"

"Karla."

"Karla, I don't think this is such a good—"

"Wait." She winks, a dare, climbing into the machine. "Turn it on."

I do, and I watch. Their brains, like twin stars, each pulling on the other, light up. My heart sinks. So it all looks the same.

She climbs out, still grinning. "What'd you think?"

"You looked happy."

"Happy?"

I print the image, hand it to her. "All that yellow . . ." I catch her gaze, want to say *that's* love, only it isn't.

"So, that's us." She looks at me. "What's it mean?"

"It means you like each other."

"Just like?" She raises an eyebrow.

I catch his gaze, his eyes sea-foam green. "You're . . . stimulated."

She snorts.

"Thank you for your cooperation, Karla and . . ." Whatever his real name might be. I look at him and can't stop looking.

"Trevor," he says, taking my hand. His grip is firm, confident.

"You two are free to go."

"So that's it?"

I catch the dumbstruck expression on Karla's face. "Yeah, that's it."

"I thought this was a study on love."

"It is."

She stands there, momentarily taken aback. "No wonder you didn't get your grant."

* * * *

I dream about him. Ocean Eyes. I wonder what it might be like to be in Karla's place. In the dream, he has a slightly European accent—German, maybe. Or Dutch. But my father's eyes were blue. Blue, flecked with gold. Eyes of sky, not of sea. Trevor is the same age my father was when he left, but he isn't my father. Maybe that's the appeal.

Is he really a john? And why is it that her brain lights up when he's nothing more than a stranger?

As soon as I'm fully awake, I call her.

She answers, groggily. "Yeah?"

"Karla?"

"Yeah? Who the hell's this?"

"This is Dr.—"

"Julie? You wanted me to call you Julie, remember?" Her voice gets harder, louder. "Do you know what time it is?"

I glance at my watch, the digital numerals reading 5:24. "I, I'm sorry, look, I just need you to come back in—you and . . . Trevor."

"I thought you were done with love." But her voice is no longer harsh.

"Not yet."

"Well, then . . ." I imagine her bounding out of bed. "What are we waiting for?"

* * * *

She doesn't bring Trevor. This time she arrives with a different guy, younger, with wild, unruly hair a generation out of date. "This one's really John," she says. "Yesterday, Trevor filled in. John had a gig."

John meets my stare. He's clad in stained blue jeans and a black tee. Karla matches. They are casual, sloppy, love all that seems to matter. But how is it possible? And why the hell, after bringing Trevor in yesterday, is she flaunting it to John?

The machine gives strange readings. There's heat, but not in the right places. They're going at each other with apparent passion, and the pleasure centers of their brains are nicely lit up, but there's way too much going on in the cortex, and something else I haven't even begun to figure out by the time they unclench.

I let her see the new scan, with its bursts of yellow, red, green, and blue. To her, it must look like yesterday's. "See," she says to John. "I told you you'd be good."

"Huh?" Something about Karla always reduces me to monosyllables. "How'd you two meet?"

She glances at him sidelong, grinning wickedly. "You mean, am I really a working girl? Sure, who isn't? But not that kind."

"What kind are you?"

"Student. Pre-med for a while. These days I'm more into theater. That's how I know John, though he's mostly a musician."

"What about Trevor?"

"Nosy, aren't you?"

I reach for my clipboard. "Background."

"Yeah, right." She unwraps a wad of Bazooka, pops it in her mouth and works her jaws. Dramatically, I now realize. I should be angry, but mostly I'm remembering the dream.

"Trevor's a playwright," she says eventually. "He and I were an item a year or so ago, but he's a bit too traditional." She pops the gum, loudly, with authority. "He's one hell of a kisser, though. *That* was never a problem."

By this time, she's out of the machine, heading for the door. They're already in the hallway when she turns, and with perfect timing, drops a parting shot. "By the way, John's gay."

* * * *

For an hour after they've left, I seethe. I don't like being played for a fool. But eventually I pull up the scan and study it. All that activity in the cerebral cortex? I bet that's the part of their brains they use when acting. It's stronger in John,

maybe because he had the tougher role. His performance was certainly good enough to fool me. The other stuff? Maybe that's what you get when you're secretly laughing at someone.

I flick the scan off again. I really don't like being played for a fool.

But I remember Karla's enthusiasm when I called her back. Deep inside, she's curious. Maybe it's just about the scanner; over the years, most of my subjects have been fascinated by it. That's why I give them printouts as souvenirs. But maybe she too is curious about love. She'd never admit it, but she's wounded too, or she'd never have played out this little charade of Johns and Trevors. Unless, of course, she's practicing a role. Hooker with a heart of . . . well, not gold. More like diamonds in the rough.

Not that it matters. I think back on the waiver I make all my study participants sign. There's not much risk to the scanner, but I'd written the thing pretty broadly. Maybe it's time to take this to the next step.

* * * *

Getting her back in is as easy as I'd hoped it would be. "Can you bring in both John and Trevor?" I ask.

"Ooh, getting kinky, aren't we?"

I sigh. "Not at the same time."

"Aw, what's the fun in that? Who do you want first?"

"Doesn't matter."

* * * *

It turns out to be John. She'd wanted to come right away but I'd stalled because I needed a few days to prepare.

"Good," I say when they arrive. "This time I'm going to want you to kiss three times."

"Only three?"

"You can have as long as you want on each."

Karla's grin is wolfish.

"Within reason."

The first is a baseline. Similar results as before, though with less of the odd stuff I presume to be humor. Maybe the joke is wearing thin.

"Great," I say and let them climb out. "Let's let you catch your breaths a bit. "Want anything to eat? Coffee? Sandwich?"

For once she doesn't have gum. "Nah. Got a big audition next week. Gotta starve."

I poured myself a cup of coffee. If my nerves show, I can blame it on the caffeine. "Okay, now we're going to test the effect of personal hygiene."

"Excuse me?"

"Well, if you'd eaten the lunch, you'd have found it full of onions, pepperoni, garlic, and stuff like that. Since you didn't, we'll have to try it this way." I opened the refrigerator and pulled out a couple of small glasses, capped with Saran Wrap.

Karla peeled off the lid and took a sniff. "Ew! What's that?"

"Juice." Straight from Carl's old health-food juicer, which he'd never bothered to retrieve and I'd never gotten around to taking to Goodwill. The lab's not the only place that accumulates junk. "No calories. Just the good stuff." The two

concoctions are slightly different so they'll each get the full impact of the other's breath. "Bottoms up."

When they're done, I have them kiss again. Not surprisingly, the starburst is less intense, with some previously unnoticed activity, largely in the olfactory centers. It isn't a truly legitimate test because, other than the olfactory stuff, it might just mean the novelty is wearing off. But the next step is the one that matters.

"Now, let's see what happens when you freshen up a bit." I hand them each a small spray bottle. "Breath freshener." Which is partly true. Nice minty taste and all that. But the real show is in the chemicals behind the mint. Oxytocin. Testosterone. Estrogen. Epinephrine. A few others I suspect might play roles: excitement, stimulation, pair bonding—the whole shebang.

They'd never climbed out of the machine, and the scanner is quick enough to catch an image, even though they're not holding all that still. A bit blurry, but enough to see their brains light up like firecrackers. The epinephrine hits first, then there's a petal-like unfolding as the others kick in behind it. You can feel it happen—I tried it at home—but it's mild enough I was sure they'd put it down to the mint. How do they describe mouthwash in ads? Bracing, or something like that. Some of the rush I'm seeing is simply that. But hopefully, I've also primed them enough for the next kiss to be . . . interesting.

And from the looks of the scanner, it appears to have worked. John pulls back, startled, but Karla's the type who lives for the moment, so she won't let him go. This time the

kiss lasts five minutes, and I don't intervene, as the starburst blossoms then fades.

"Wow," Karla says. "What was that stuff?"

I hold up a bottle of Scope. "Mouthwash."

"Huh. Guess I don't know everything after all." She's oddly subdued and for a moment I feel guilty. Then I remind myself that they fooled me first. I feel a bit more guilty about John; if the kiss was as potent as the scanner indicated, he might be having a crisis of sexual identity. But like Karla, he brought it on himself. Whatever he's feeling will be short lived, anyway.

They climb out of the machine, holding hands. But Karla is already reverting to her old self. "That was fun," she says.

"When's the encore?"

"Excuse me?"

"When do I come back? With Trevor? Or anyone else? I know a lot of guys."

But suddenly, I'm remembering my father. Before he left, back in the good years, he dabbled in magic. Even then I knew he wasn't very good, but the first time he did a card trick he was good enough to fool me. But he could never resist doing it over, and by the second or third time, I always got him. It was a bit of a game, where from his point of view losing was also winning. *I saw that Daddy! You can't fool me!* But it wouldn't be the same for Karla. She'd bring her own mouthwash or maybe some kind of breath-freshening gum and when that didn't have the same impact, it would be like me spotting my father's badly palmed card.

"I don't think that's necessary," I say.

"Why not?"

"I found what I was looking for." It's probably the biggest lie I've ever told in my life. In addition to my father's magic, I've also remembered that Karla and Trevor were once an "item." John will figure out soon enough that today was an aberration. But Karla and Trevor must once have shared kisses that were the real thing. Rekindle that, and they might decide to replay the relationship that hadn't worked a year ago. I wasn't sure which bothered me more, the fact I had no right to do this to them or the fear that this time it might work out.

Karla drops John's hand, approaches me. She's close enough for me to see flecks of darker blue in her light-blue eyes. "You're scared, aren't you? Why?"

For every step I take back, she takes another forward. "I'm not scared."

"Sure you are."

"No I'm not."

She snorts and turns to leave "Liar."

"Wait." My words surprise me. "I need Trevor's contact information. I'm not sure I know how to reach him except through you."

She snorts again. "Yeah. Gotta have the background." But she rattles off a phone number and I write it down without knowing what I'm writing, as though my fingers, my brain, have gone numb. I imagine it on a scanner. Blues and greens. Ocean hues.

* * * *

I dream about him again that night. Every time I drift off, I see those sea-green eyes. The next day, I power up the scanner. Climb in and think about him. But the scan tells me nothing. Lots of activity, but no pattern I've seen before. Confusion, in other words, which is pretty much what I'm feeling.

I finger the spray bottle, then figure what the heck and give it a whirl. Everything sparks up, but it's not like Karla and John. Not like anything. Just me and a fantasy. A man who might as well be in Europe.

On the third day, I call him. My hands shake. My mouth is dry. I hear it ring on his end, anticipate his voice.

"Hello?"

"Trevor?"

"Speaking."

"It's Dr.—Julie."

"Dr. Julie?"

"Sorry. It's Julie."

"Uh . . . hi."

"Can you come back in?" I swallow. "Alone?"

"Why?"

"I have some questions for you. I sometimes need to interview subjects separately."

"Oh."

"Does this afternoon work?"

"Sure."

"How's one o'clock?"

"Fine by me. See you then."

I set down the phone, trembling again. I've got enough spray for one more test. Then, if I want more, it'll be another week in the chemistry lab.

* * * *

He arrives ten minutes early, in dirty khakis and a green polo that matches his eyes. I see his shadow first, lingering in the hall, not wanting to interrupt.

I swallow. "Trevor?"

The shadow turns into a man. In the dim light, his face seems young, unlined. I think of my mother and the way she aged, the way her hurt stole the softness from her face and made her sadder, so I could see it even when she tried to forget.

He walks in, smiles. If there's hurt there, I can't see it. "So..."

I take a breath. "I made some coffee. Would you like a cup?"

"Thanks, but I don't drink coffee."

"Me, I live on the stuff." The corner market, in fact, makes a brew they call Ultra-Extreme Super Jolt. I don't think they sell much: it tastes like reagent-grade caffeine mixed with burned cork. It does the job, but I know better than to offer it to others. At the moment, I've got a thermos of Kenya's best.

I pour myself a cup, and try to get to the point—try to pretend there really *is* a point. "Karla can be a bit . . . enigmatic."

"You don't say?" The smile touches his eyes and it's all I can do to keep my train of thought.

"Is she really an actress?"

"Yes. And I'm really a playwright. Though that's not my only job. I'm also a sail maker."

"A what?"

"I make sails. For boats. Down near Shilshole Bay. It's what, in my field, they call a day job."

"And the two of you?"

"We gave it a go, but she's a long way from being ready to settle down. I'm not sure why I let her talk me into this. She gets these goofy ideas, and then you're in, up to your eyebrows, wondering what you're doing."

I check my clipboard, trying to figure out how, earlier, I'd gotten so rattled I never even asked him the most basic questions. "How old are you?"

"Older than I look. I still get carded all the time. I actually collected a degree in mechanical engineering before I quit the corporate rat race. Some of it comes in handy, though, working with boats." He's looking at me oddly. "I'm forty-one. And you?"

"Thirty-seven."

"This isn't about science, is it?"

It hadn't been about science since I'd lost my grant. Maybe for some time before that. If it had been, I'd have remembered to have him fill out the damn intake form before we'd started. If it had been, I'd have had no excuse to call him back.

"Didn't think so," he says. "Can we go to dinner?"

I almost say no because I'm afraid of what it is that draws me to him: those eyes, so much like my father's. Kind and

confident in the good years . . . and then, gone, like the snowflake you can never hold. I want the good years, but can't stand another round of bad ones. "Let me think about it."

* * * *

I can't concentrate, and there's nothing I need to be doing for the rest of the afternoon. Without conscious plan, I find myself drawn to the same park bench where weeks before I'd watched the children play. It's summer now, and the park is crowded.

I know now that there really is a neurochemistry to love—or at least to the attraction that's fueled a million sonnets. It's potent stuff, mediated by chemicals strong enough even to blast through years of sexual orientation, at least temporarily. I may not have identified them all, but I've found a few dandies. And I've used them to create a love potion. Chemists can create diamonds in the lab, real in every way but for the fact they don't come from the earth. Soon perhaps, anyone can buy them. How much does that matter? Is there a clear distinction between that which comes naturally and that which is forced, even when what's forced looks like the real thing?

More than just the seasons have changed since my last visit to the park. Then, everything seemed magical; now, a little boy is screaming, throwing himself on the ground and flailing his limbs, pounding fists too small to do damage except to himself. "No!" He screams. "No home! Want stay. Not all done!"

What is it that I want? True love that can't be lost? Or just a man to call me beautiful even though I'm not and to let me gaze in his eyes and pretend I see . . . what? Someone worthy of his love?

A little girl runs after a ball. She's laughing, no thought but for the ball. But she's running fast, on a sidewalk. I can see it coming; she's running too fast for those little legs. I see her tip forward, try to catch herself, and go down, hands and knees on rough concrete.

On the other side of the playground, two boys are tugging at a tricycle. "Mine," one yells. "Mine!"

From a hundred feet away, I can hear the frustration in the mother's voice. "We have to share, Jackson. Let Tyler have a turn."

"No, mine!"

Where have all the daydreams gone? What happened to the magic?

I remember Alice and Victor, the retired couple, still capable of generating neurochemical flares just by talking to each other. They'd been married for fifty-one years. Back then, I'd been doing real research: I'd spent an hour collecting their bios. "We met at a sock hop," she'd said. "I bet you don't even know what that is." Which was right; I had to look it up.

That kind of love is rare. I try not to think how rare. I'd rather believe one in a thousand than one in a million. My father's face flashes again through my mind—that grin, buoyant and heartbreaking. There and then gone.

I have a concoction that might not only generate love, but bring it back on demand. The good years, forever.

* * * *

Trevor and I meet at an outdoor café. It's still sunny and warm, a slight breeze riffing the blue umbrella above us.

I've dressed up, the first time in years.

"You look beautiful," he says.

I feel myself smile. "Thank you."

We talk comfortably and a bit randomly. About academia, the weather, sailmaking.

"Do you have a boat?"

"Yes. A thirty-two foot trimaran. I keep her at Shilshole. Maybe you can join me sometime."

I like this quiet man. But will he go the way of my father? Even Carl and I generated sparks at first.

In my pocket is the bottle that can, if not hand me my dreams, at least bring them closer. I don't have to spray both of our breaths; he'll pick up enough from mine. The old love song about kisses sweeter than wine: that'll be me. This time there's not even any mouthwash to give it away. Tasteless and odorless, that's the potion in my purse.

But if it works, all he'll see is me. There will be no memories to ignite the blaze. No squash or petunias. No summer barbecues or Christmas Eves cuddling by firelight. No vacations basking on faraway shores or camping beneath the Milky Way. My potion will bypass all of that. An instant sun, created from nothing.

The café isn't far from my home, so Trevor offers to walk. Time to use the spray soon, if I'm going to. But my mind is on fried squash and petunias.

One of the things that made Alice and Victor different was that they had four decades of shared memories. You can't get those from a bottle. It wasn't just the squash and flowers: it was what they signified. Alice and Victor were attentive. Carl was an okay kisser, but he was never attentive—always more wrapped up in his astrophysics than in me. As I, to be honest, had been more wrapped up in chemistry. Chasing tenure is an all-consuming goal—too much attention divided by too little time. Neurotransmitters are both causes and effects. Maybe what I'd created was a drug, masquerading as love.

Trevor is talking, but I'm not catching much of it.

"You okay?" he asks.

"Yeah. Just a little . . ." What? Confused, but that's not what I want to say. On a scan, my cerebral cortex would be lighting up in spots and flickers all over the place. ". . . out of practice," I finally say, because that too is true.

Then my apartment is in view. Ground floor in a nice old Victorian. Ground zero for my moment of truth. A block away, I open my purse, fumbling as though for keys. Pull out the sprayer.

Whatever love is, it doesn't reside in the cerebral cortex. It shouldn't take a Ph.D. to know that. Nor is it something you strive for like tenure. Alice and Victor had been attentive, but they'd also been relaxed, comfortable not only with each other, but also with themselves.

I veer into an alley and throw the spray bottle into a dumpster.

"What was that?"

"Nothing." Nothing and everything. In a distant corner of my mind, my father's eyes twinkle at me. I never asked my mother what happened; just assumed that somehow he changed. But maybe it had been at least partly her fault. Maybe she'd tried too hard, like she had with the porcelain doll and the snowflake box. Like she had with the story of Europe. I'll continue my work, but this time I'll do real science. This time, I'll look at how our brains work . . . and not try to force them.

I'm suddenly aware of Trevor beside me.

"Thanks for saying yes tonight," he says.

"I didn't."

He grins.

"I said okay."

"Semantics." He moves closer and I realize we're about to have our first kiss in the alley behind Wong's Chinese Buffet. He's not the artificially created diamond I'd been trying to perfect, but a diamond pulled from the earth, mammalian and primal. Whatever else this will be, it will be real.

Every neurotransmitter in the book must be playing in my brain, plus a few never seen by science. I suppress them all. Brains have will, not just chemicals. I don't need an instant supernova or flare. Even stars take millions of years to ignite, and suddenly, they don't seem so rare. He leans in, and so do I....

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Novelette: **A SOUND BASIS FOR MISUNDERSTANDING** by
Carl Frederick

* * * *



Illustrated by John Allemand

* * * *

So you think music is a universal language,
huh?

* * * *

At each hop in his journey from Earth to Choff, Roger observed that the alien to human ratio had gone up exponentially—even though the hops were between planets where the sentient inhabitants were oxygen-breathers. And now, as he walked through the long, flexible airlock from the quantum-tunneling ship to the Choff Spaceport Terminal, Roger saw that *he* was the alien while everyone else was presumably a Chuff.

He began to observe his fellow passengers clinically. As the new Anglo-Terran cultural liaison, he had to know and understand these people, but until now he'd never even *seen* a Chuff. And he'd not had any time at all to study up. Not that there was much *to* study. Distant Choff was beneath Earth's radar—until the Nrrilgan language team reported that the planet virtually bulged with the purest lutetium ore in the known galaxy. *And now everyone's running around like frenzied ferrets.*

His boss had ordered him to come immediately to help negotiate a lutetium-mining contract. Thinking about it now, Roger gave a soft sigh. He'd hardly had time to pack a small travel bag and make sure he had a spare reed in his bassoon case. He'd set off knowing nothing about the natives, and all he'd been told about their planet was that the surface gravity was 0.8 g, the atmosphere was remarkably similar to Earth's, and the climate was well within the capabilities of his temperature-adaptive clothing. In short, he could survive there—at least as long as he stuck to embassy-provided food and drink.

Out of the corner of his eye, Roger observed the nearest Chuff. He—if it was a he—stood about seven feet tall and was very powerfully built, and, like most oxygen breathers in this part of the galaxy, was bilaterally symmetric: head on top with recognizable very large eyes, ears, but with what looked like breathing noses beneath the ears. They had legs and arms each with an extra joint, and hands with four fingers. *Sort of like cartoon animal hands.*

He, like all the other Chuff in the terminal, wore a tight-fitting headset over his ears. *To block out noise, I guess. Odd though since the ship wasn't particularly noisy. These guys must have really acute hearing.* Having made a logical deduction, Roger felt his confidence returning. *These aliens aren't all that alien. I should be able to figure them out without much trouble.*

Roger watched as a uniformed spaceport official opened the door to the terminal—and a gush of sound flowed through the airlock like a physical force. Quickly, Roger set down his two items of luggage and covered his ears. Then he saw the Chuff taking *off* their headsets, and he realized his deduction had been completely wrong. *Jeez! What kind of a planet is this?* Roger slowly slid his hands down from his ears. The sound was tolerable, just barely, but he could hardly think. *Oh my gosh! I thought it was chewing gum the stewardess handed out. Could it have been earplugs?* Roger followed the crowd into the terminal. *That gum did taste funny, now that I think of it. Earplugs? Maybe that's why the Chuff were staring at me.*

Roger hefted his luggage—*I wonder if I could tear up some underwear and make earplugs*—and, as he followed the stream of Chuff toward what was passport control or something of the sort, he gazed around the terminal looking for his boss. But Duncan wasn't there—nor was any Terran, for that matter. As his walk slowed to standing-on-line speed, Roger examined the signage on the walls.

A large, rectangular sign with moving characters seemingly floated over the presumed passport control area. *It seems that the Chuff are a technologically advanced species.* The characters were complex. *Must be a non-alphabetic writing system. Strange!* And the contrast of the characters was low. Roger had to look hard to actually see them. *Maybe Chuff eyes are sensitive to a different spectrum—UV, maybe.* But what was not hard to see was a flickering disk at the upper left corner of the sign. *Wonder what that's about.*

When Roger reached the counter, the Chuff in charge looked at him for a moment, and then the Chuff's eyes flickered just the way the sign had. Roger drew back. With its glowing eyes, the Chuff looked like something out of a horror movie. Then the Chuff's eyes went dark and after a few seconds he or she said something in a booming monotone. But the background noise was too high to hear anything distinctly. Roger wouldn't have thought speech was possible at all in that din. Setting down his luggage, Roger held forward his pass card and, hoping in Chuff it wasn't an obscene gesture or something, gave an "I don't understand" spread of the hands.

The Chuff took the pass card, inserted it into a reader, and then made what *was* an obscene gesture in Terran. Roger flushed, then forced a smile as he realized the gesture might just mean, "wait." The Chuff looked away and upward, and following the gaze, Roger saw what looked like a ceiling mounted convex mirror. In it he saw the reflected image of the Chuff, whose eyes had begun to flash again.

Almost immediately, another Chuff, smaller and very energetic, ran up to Roger and handed him a book-sized package. There was writing on it—Terran writing—from Duncan. Ripping open the package, Roger found a note and a headset. *A Nrrilgan translator!* Quickly, he slipped the cushions over his ears and pulled down the microphone, turning on the unit. Abruptly, the horrendous background noise ceased—but not completely. *Noise-canceling earphones. Thank you, Duncan!* Now he heard only something like a single blurred tone, textured and rich with harmonics—like the constant drone of a bagpipe. *Duncan would like that—the dour Scot.* Roger estimated the range to be between a 98hz G and A or maybe A-sharp. Roger scrunched his nose in puzzlement and turned to Duncan's note for enlightenment. But as he began to unfold the paper, he was distracted by the Chuff pass card official.

"Are you going," said the Chuff, "to visit the Big Building for Between the Stars Buying and Selling?"

"What?" said Roger, startled. "Um. Yes. I think so."

"Sweet!" The Chuff handed back Roger's pass card. "Have lots of fun on our nice planet!"

Roger, now able to communicate, had questions. But before he could frame one, the Chuff said, "Pretty please go ahead through the door to the big room where people wait—so the people behind you can get their turn."

"Yes, of course," said Roger. "But do you know if Mr. Duncan Frye is here in the terminal? He's the Anglo-Terran trade commissioner and was going to—"

From behind, came a voice. "You are making everyone wait, poopthead. Move!"

Poopthead? Roger stuffed the note in his jacket pocket, picked up his travel bag and bassoon case, and hurried forward toward the door.

Walking through into the waiting room, Roger saw seats that could accommodate Terrans. In one of them, Duncan lounged. As Roger approached, the man rolled languidly to his feet.

Roger saw Duncan move his lips. But from the earphones, he heard only a beep. He'd used Nrrilgan translators enough to know it meant Duncan wasn't speaking recognizable Chuff. *Damn!* Roger set down his luggage, then reached to his microphone boom and pushed it up, switching off the translator. He winced under the returning din. *Maybe if we shout, we can hear each other.*

Duncan leaned forward and moved the microphone boom on Roger's headset halfway down. Roger sighed in relief as the gentle bagpipe drone returned.

"This way," said Duncan, "the translator is off, but the noise canceling stays on." He smiled. "So, Roger, my boy. Welcome to Choff—planet of perpetual noise." He looked

down at Roger's luggage. "Oh dear. You brought your bassoon."

Roger shrugged.

"Well, if you'd planned to serenade the Chuff," said Duncan with some annoyance in his voice, "I'm afraid you'll be disappointed. Their hearing range is very narrow—the only way they're able to survive with the full-spectrum thunder noise on this planet."

"Then I assume Chuff all sound the same," said Roger, keen to impress with his deductive abilities. "All basses—no tenors, no sopranos."

"Exactly."

"How boring," said Roger.

"Perhaps." Duncan urged Roger toward the door. "But the Chuff are very civilized. They have taxicabs. I have one waiting." He pointed upward.

Roger picked up his luggage and followed Duncan to a staircase with steps a little too far apart and high for human comfort.

"We're the guests of honor at an art show," Duncan called over his shoulder. "And we must not be late." He glanced up at the sky. "Not that you can tell, but it's already dawn."

"It looks like rain."

"It always looks like rain here," said Duncan with a sigh, "at least in this region of the planet. Goes with the constant thunder, I suppose."

"I wonder how anything grows here without sunlight." Then Duncan's words registered. "Dawn? Did you say there's an art show at *dawn*?"

"The Chuff are a refined species." Duncan nodded, as if to himself. "Even in the early morning," he added softly, "unfortunately."

Roger laughed. "Refined? The Chuff on line behind me called me poopyhead."

"Yes. I've noticed that."

"Excuse me?"

"Not your head," said Duncan with a chuckle. "I mean that the Nrrilgan translators convert Chuff into Terran . . . well, baby talk."

They clambered into the taxi. Duncan pulled down his microphone and gave directions to the driver, then raised it again and turned to Roger. "I'd almost think the Nrrilgan language team had a strange sense of humor. The translators for Chuff are, after all, only alpha-test units."

The cab rose smoothly into the air.

"Maybe it's an artifact," said Roger. "I mean the translators convert from Chuff to Nrrilgan, and then from Nrrilgan to English. A lot can happen."

"Haven't seen this in any of the other Nrrilgan language translators."

"Well, alpha-test or not," said Roger, "the Nrrilgan are not noted for a sense of humor—especially about their translators." He bit his lip. "Why baby talk, I wonder."

"Baby talk or kid talk." Duncan shrugged. "Don't know why. You're the cultural liaison. You tell me."

Roger made a noncommittal grunt. Duncan had often made a point of telling him that cultural liaisons were only minimally useful in trade negotiations, and he didn't want to

give the man a chance to tell him so again. He'd worked with Duncan before, and every time he had to prove himself anew.

Roger turned away and glanced out the window. "Big city."
"The capital," said Duncan.

Roger nodded. It *did* look the work of a civilized culture: an abundance of what looked like parks, no mechanized surface transport—walkways rather than roadways. Yet it was bustling—clearly a center of commerce.

Roger glanced back at Duncan. "What do art shows have to do with negotiating a lutetium contract?"

"Well," said Duncan, "it seems they won't trade with us unless they actually like us—are *simpatico* with us." He threw a glance upward, toward the gray dreariness of the Choff sky. "Or unless we can convince them that there is some product of Earth that they absolutely can't live without." He smiled, sweetly. "And, of course, that's why you are here."

"I guess we can't sell them music players, can we?"

"This is serious," said Duncan.

Roger nodded. "Art show," he said, more to himself than to Duncan. "I guess that makes sense. With their limited range of hearing, I'd assume the visual arts would play a disproportionately large part in their culture. Who knows? Maybe we could sell them art reproductions?"

"Who knows?"

As Roger and Duncan walked into the art reception, a Chuff ran up to them. "Hi, Duncan," he said. "Oh, man, it's nice to see you again." Then the Chuff turned to Roger. "Hi. My ear-name is Fwem. I'm the just-for-now explainer for how we Chuff do things."

Duncan made a momentary adjustment to Roger's microphone boom. "That means Acting Cultural liaison, as far as I can make out." Duncan gave a tolerant smile. "Your counterpart."

Roger wondered how Duncan could tell the Chuff apart. *I guess diplomats have to be good at that kind of stuff.*

"If you have questions," said Fwem, "just ask me. I know stuff."

"Thank you. And my name's Roger."

"You can eat and drink," said Fwem. "The cook says he thinks everything is safe for Terrans."

"I'm . . . I'm not very hungry," said Roger.

"Okay," said Fwem, turning away. "Well, bye-bye, then. Have fun."

Roger, following Fwem with his eyes, widened his gaze to take in the reception as a whole. The gathering looked like just about any haute culture reception on Earth—if that look was suitably blurred by alcohol. Unnatural looking people in unnatural looking clothes milled about, snagged hors d'oeuvres and drinks from passing trays, and occasionally looked at things hung on the walls.

As he wandered, Roger's attention was drawn to two Chuff glaring at each other, their eyes flashing. By their bearing, Roger could tell they were important personages. One of them caught Roger staring at him, and he stared back with flickering eyes. After a couple of seconds, he pointed to the other Chuff and said, "He started it. He said my review was stinky."

"No I didn't," said the other. "*You* started it. You said my story was really dumb and yucky. You're just mean."

The first Chuff drew himself to his full height. "*You're* mean!" he said. "And you started it. Just because I loved that picture, you had to hate it."

"Liar!"

"Stinky face!"

Just then, a Chuff came by carrying a tray of finger food. "Eat some of these," he said to the two angry Chuff. "They'll make your tummies happy."

Roger threw a "help me" glance to his boss halfway across the room. Duncan came over. "We're going to look at some of the pretty pictures," he said, dragging Roger off toward a wall.

"They are a childlike people," said Duncan.

"I wonder," said Roger. "Can they really be childish and sophisticated at the same time?" He stared up at a painting that seemed to be just a featureless rectangle painted in some dull, uniform color.

"Apparently." Duncan peered in at the painting. "Can you see *anything* in this painting?" he said with an all but imperceptible shake of his head. "Or for that matter, in any of the paintings?"

"I'm surmising the hues are mostly in the ultraviolet."

"Indeed," said Duncan, coolly. "I wonder if that explains Terran modern art as well."

A Chuff meandered up to them. "Do you like this painting?" he asked.

"It's . . . interesting," said Duncan.

"Yes," said Roger. "Very . . . interesting."

"Oh, goody," said the Chuff. "I'm happy you think so." He wandered away.

"I wonder," said Roger. "Are they really childlike, or is it just an artifact of the translators?"

"What do you mean?"

"Maybe we think of them as children because of the translator baby talk," said Roger. "And maybe they think of us the same way for the same reason."

Duncan gave a mirthless chuckle. "An interstellar trade summit with toddlers doing the translations. God, I hope not."

Roger looked away at a Chuff. "Boy, I wish I knew what those flickering eyes were all about."

"The instructions with the translator say voice is the primary mode of information transfer and the eyes are the secondary method." Duncan nodded across the room. "It looks as if the just-for-now explainer is coming our way—to explain something, perhaps."

"Good," said Roger with a smile. "I could do with some explanations."

Fwem approached. "Because you are our important guests," he said, "it is time for you to paint a picture now."

"Excuse me?" said Duncan.

The Chuff put one trisectioned arm closely around Duncan's shoulder and another around Roger's. "Come on." He maneuvered the Terrans toward a large canvas, as featureless as were most of the others. A crowd awaited them. Another Chuff stepped forward and, with a show of ceremony, held forth a small, rectangular box, opened it, and

presented Duncan with something like a thick artist's brush, but with sliders on it. Fwem sidled up and explained that the sliders controlled the brush-tip thickness, and selected the colors.

"Thank you," said Duncan to the Chuff holding the box, "but my associate here is the artist." He handed the brush to Roger.

"What? Me?" said Roger as Duncan forced the brush into his hand. "I haven't any idea how—"

"Paint!" said Duncan.

"Okay, okay." Roger regarded the brush. One of the sliders clearly indicated hue. Next to that slider was a band of color starting at green and merging to blue and then dark blue. Most of the slider seemed to be black. "Must be ultraviolet," said Roger. "This confirms it: most of their vision has to be in the UV." *Well, that rules out our selling them vid-players.*

Roger looked up. The Chuff were staring at him with expressions that seemed to be eager anticipation.

"Paint," said Duncan, this time softly but with a sense of urgency.

"Why?"

"To understand us," said Fwem, "you have to understand our—beep!"

Damn translators! Roger smiled sweetly. "I should very much like to," he said. Then he made a few pseudo-random movements of the sliders and, at the lower left corner of the screen, made a kid's simple drawing of a bunny rabbit in deep blue.

"Sweet!" said a Chuff.

"Pretty!" said another.

"Do more!" said yet another.

Roger exchanged a glance with Duncan and then, with a flourish and the brush set wide, he made a bold, diagonal blue gash of color across the canvas.

Gasps came from the assembled Chuff, and one of them said "Aw, man!"

Roger smiled to himself and raised his arm for another stroke of artistry. But before the brush contacted the canvas, Fwem grabbed his wrist.

"No!" cried Fwem. "You have made doo-doo on the painting of one of our best and most expensive picture-painters. Pretty please don't paint any more."

"What? Wait a minute. I didn't know." Roger glanced to Duncan for moral support but didn't receive any. "I mean, I just thought—"

"I think you'd better go now." Fwem glanced around. "It looks like some of the painter's friends might want to beat you up."

"Look. I can explain. Let me think." Roger realized he really couldn't explain—not without admitting that all the paintings looked essentially featureless.

"Tell me tonight at the music doing," said Fwem. "Not now. Please go away now."

"Wait," said Roger as Duncan pulled him away toward the door. "I'm sorry."

"Yeah, right," said one of the nearby Chuff.

As they waited on the roof for a taxi, Duncan let out a sigh. "I'm afraid we blew it," he said. "We'll get one more

chance tonight. If we can't impress them with our basic wonderfulness, then I shudder to think where the Agency'll post us next."

Roger did shudder. "I don't understand it. After I drew the rabbit, I thought—"

"Don't think about it. Concentrate on tonight's mission."

Suddenly Fwem's words registered. "Did he say *music* doing?"

"Fwem invited us—more like a command, actually." Duncan glanced up at the arriving air-cab. "Here. At sunset. A concert, I think."

"Concert? But they have a hearing range of one note." Roger gave a frenzied little laugh. "They say music is the universal language, but not in this part of the universe." Roger pulled himself together and tried to sound professional. "I doubt if it'll be music. I'd expect something more like cadenced poetry."

"The translator used the word music," said Duncan.

"Nrrilgan translators have been known to be wrong." Roger smiled. "Music. What will it be—a lot of Chuff humming their single note for an hour or so?"

"You've got the rest of the day to find out what it will be—and to come up with a plan to impress them." The taxi's side irised open and Duncan climbed in. "We've *got* to get that lutetium contract."

"Sure. Great. Fine." Roger followed his boss into the taxi. "Coming up to speed on an alien culture from a standing start—in the *rest of the day*."

"The *good* news is that you have more time than you might think. The Chuff day is about thirty-eight hours long."

* * * *

Roger unpacked his travel bag in the compartment provided for him in the Jupiter-class spaceship, which served as the Terran Embassy. Then he went for a walk. Maybe if he observed some Chuff doing what Chuff do, he might be able to come up with an idea or two. And his presence shouldn't skew his observations; it was a capital city. Aliens probably wouldn't be a rarity.

Strolling the broad walkways of the city, Roger noted the similarity to many other capital cities he'd been posted to: alive and crowded, groups of humanoids walking quickly in and out of high-rise buildings, a profusion of surface-level stores and eating places.

Aside from the monotone from his headphones, it was eerily quiet. During his walk, he'd heard only a few isolated words spoken. But there were a lot of flickering eyes to be seen. *I wonder if the Nrrilgans were actually right. Is voice really the primary mode of communication?*

As he meandered, he began to realize that the Chuff were indeed technologically advanced—perhaps even as advanced as Earth. *What could we possibly sell them that they couldn't produce more efficiently themselves?* He shook his head. Selling wasn't the primary issue—being *simpatico* was.

The absence of voices began to wear on him. Silence. He'd become almost oblivious to the pervasive monotone. He

doubted if the Chuff heard it at all anymore. But then, as his amble took him to the periphery of a park, he did hear voices.

Roger stopped short and wrinkled his nose in confusion. The voices were higher pitched than the Chuff he'd heard. *That's impossible!* Then he noted that the voices were an octave higher. He rushed into the park and saw a group of small Chuff playing on a sort of jungle gym. Roger smiled. It was beginning to make sense. Chuff heard sound only in a narrow range of fundamental frequencies. But they also could hear the harmonics of those frequencies. Roger looked at the Chuff at play. *These must be Chuff kids.* And at some point in their growth, their voices must change—by dropping exactly a full octave.

Roger marveled at the great variety of what must be toys—and he speculated that novelty might be important to the Chuff. *Just like Earth, where toy technology is only second to military technology.* Roger bit his lip and thought. *Maybe that's the beginning of an idea.*

Many of the alien kids were swinging on the gym, while others were engaged in a game—and those Chuff were chanting in cadence as they skipped and cavorted. *Hey! I wonder.* Roger got an idea. *Maybe Chuff music is made up of one note on the scale, but played at differing octaves.*

Roger felt pleased with himself and turned to leave, eager to tell Duncan his idea. But then again . . . he stood stock-still. The chanting: the pitch wasn't constant. The kids were chanting in perfect unison, but the pitch changed, though not by much: less than two semi-tones spread over a dozen or more distinct pitches. *Could it actually be singing?* Roger

walked to a park bench, sat, and observed. There were bigger Chuff sitting on benches. *Parents, probably.* After a few minutes of listening, Roger was convinced that the small Chuff were actually singing—and the 'singing' was actually beginning to sound to him like music.

Then a Chuff child ran up to a big Chuff. Roger was pleased to hear actual conversation between the two.

"Can I have a—beep?" asked the child.

"Not now," said the bigger Chuff. "Dinner is soon."

"But . . . but I want it."

"I said no."

Roger noticed that there was no flickering of eyes. He glanced at the kids playing. They talked, but their eyes didn't flicker. Then Roger looked at the parents. *Lots of flickering eyes.*

Then came the revelation. The instructions with the Nrrilgan translators were wrong—a mistranslation. Speech wasn't the *primary* mode of communication. "Primary" should have been primal—or maybe basic. Roger gave a small nod of his head. It seemed so obvious now. Kids learned speech first, and only later learned how to flicker. And that meant that adults used speech only to speak to kids or to get someone's attention. *Poopyhead was the clue—and I missed it.*

Roger jumped from the bench and, with the help of enthusiasm as well as a relatively low surface gravity, sprinted back toward the embassy to tell Duncan. *And that also explains why their writing system isn't alphabet-based.*

* * * *

"Very interesting, I'm sure." Duncan, sitting in a plush chair in the embassy lounge, looked up at Roger with a blasé expression. "But how will this help us at the concert tonight?"

"Well . . ." Roger, feeling suddenly deflated, plopped down on the facing chair. "I don't know. Maybe I'm totally wrong. I'm not really even sure the Chuff kids *were* making music. Maybe it was as much music as a bee dance is a dance. Maybe it was just some ritual of shared humanity, alienality, whatever."

"Focus!" Duncan moved forward in his chair and looked hard at Roger. Then he chuckled. "A shared ritual of alienality. Fine. We'll take that as a provisional definition of music—Chuff music. Now, how can we use that to our advantage tonight?"

Roger, elbows on knees, cupped his head in his hands. After a few seconds, he looked up. "If we were expected to paint at an art show, maybe we'll be expected to make music at the concert. Maybe the concert'll be something like a jam session."

"Can we?" said Duncan. "Make music, I mean."

"The translator stored the last few hours of source sound, of course," said Roger, thinking as he talked. "So I can listen to the Chuff singing. But there's no way I'd be able to actually sing those microtones myself, not without months of practice, if then."

"Perhaps we could cobble together an audio file of the microtones, somehow," said Duncan with an eager, hopeful expression. "And play it for the Chuff at the concert."

"That would take days." Roger looked off into space. "You know," he said in a distant voice, "bassoons have thick walls."
"What?"

"Low bassoon notes would require fingering holes that are too far apart for fingers to cover them. So holes are drilled at an angle—closer together on the outside and wider apart at the inside of the instrument."

"Have you lost your mind?" said Duncan.

"I was just thinking. You could drill holes angled the other way—close together at the inside—to produce microtones."

"Ah." Duncan narrowed his eyes. "Do you really think you could make a bassoon play those tones?"

"Yeah. It would be pretty simple to calculate where to drill the holes."

"Then do it." Duncan snapped to his feet. "It's our last chance. And maybe the Chuff will give us an A for effort."

"Hey, wait a minute." Roger rolled to his feet. "I was only hypothesizing. My bassoon is a valuable and rare instrument."

"The agency will buy you a new one."

Roger scowled. "I rather imagine bassoons are very scarce in this part of the galaxy."

"So are jobs for Anglo-Terran junior cultural liaison officers."

* * * *

Smiling in spite of his suppressed anger, Roger stalked into the music-playing place. He carried his once beautiful bassoon, now disfigured by a slew of new holes and duct tape covering the old holes as well as some of the keys.

Roger had expected to see musicians up front and listeners sitting in rows of seats. But it was rather more like the art reception. There were no rows of seats, and Roger saw no objects that could have been musical instruments. It seemed a safe assumption that he was about to hear adult Chuff singing the type of music he'd heard from kids in the park. Again Roger smiled, this time in anticipation. Bassoons, even mangled ones, made awesome sounds. He was sure the Chuff would be impressed.

A Chuff announced the start of the music-making, and a group of a dozen or so gathered at the front of the room while the rest congregated at the back, standing. *Chuff seem to do a lot of standing.* Now it looked something more like a concert to Roger—a conductor and a choir.

The "singing" began and within moments, Roger stood spellbound. The music was not the simple microtonal sounds of the playground. Instead, the singing consisted of one note and many harmonics of that note. Roger was sure he couldn't even hear some of those harmonics. One-note polyphony: the note stayed the same, but the timbre changed. And the rhythms were incomprehensibly complex. At several points, each chorister sang a different rhythm pattern, which resulted in syncopations that spread like a wave through the chorus.

Roger found the sound very interesting and even musical, though beyond his comprehension. He felt about it the way he felt about Chinese classical music: impressive but not something he'd like to listen to for long stretches of time. Roger realized he'd guessed wrong, horribly wrong, about the nature of Chuff music. It was more harmonic than microtonal.

He suddenly felt embarrassed about his bassoon—about how the Chuff would take his microtonal imitations of Chuff kid sounds. *But maybe here, unlike at the art show, the audience won't be expected to participate.*

The music stopped and the choir director faced the audience. "Before the second half of the music starts," he said, looking at Duncan, "I invite our guest of honor to do some music."

"Thank you for the privilege." Duncan put an avuncular arm around Roger's shoulder. "But my colleague Roger has asked that he be allowed to, uh, do music." Duncan smiled, genially. "That is, if it is acceptable to you."

"Cool!" said the choir director.

Roger forced a smile and picked up his bassoon. *At least they should appreciate the rich harmonic structure of this prince of the woodwinds.* Roger closed his eyes and, as his hands caressed his familiar instrument, his fingers sought the unfamiliar holes. Tentatively, he began to play. Then, basking in the rich reedy woodwind tones, his playing grew more assured. *This is actually pretty good. The Chuff should appreciate this.* Roger's confidence rose. *Even though microtonal, this is real music.*

While playing, he eased open his eyes and stole a glance at the listeners. The Chuff showed expressions much like those he'd seen when he'd savaged the painting. He knew now it bespoke intense emotion, but in this case it certainly had to be one of intense pleasure. *No one could possibly call this kid stuff.*

As Roger put down his bassoon, a Chuff ran up to him. "That was very childish," he said.

"Hey!" That was it. Roger had taken enough. "Who you calling childish?" he said, clenching his fists.

"Roger!" Duncan admonished. "Remember the lutetium."
"What? Oh, yeah."

The Chuff glanced around and then leaned in toward Roger. "Let's go and talk where there are no other people around," he said at a loud whisper.

"I'll come with you," said Fwem.

"Mine!" said the other Chuff. He put an arm around Roger's shoulder. "Take your music maker."

Roger hefted his bassoon, then looked imploringly at his boss. "Duncan. I don't like this."

"Don't worry," said Duncan, making calming motions with his hands. "I've never seen the Chuff to be violent."

"Yeah. Right. That's probably why they're taking me somewhere out of sight."

"Don't be silly," said Duncan with a smile. "And anyway, fear not. The agency is protecting you with a very generous insurance policy."

"Thanks much."

"Look," said Fwem. "I think I should come too."

"Neener-neener-foo-foo," said the other Chuff as he maneuvered Roger toward the door."

* * * *

With a pasted smile covering his disquiet, Duncan watched as Roger and the unknown Chuff went through the door. Then

he noticed the other Chuff at the concert. Their eyes were flickering wildly. Something had happened—clearly something major. Duncan leaned in toward Fwem. "Who was that taking Roger away?"

"Big chief music judge," said Fwem, his eyes on the just closed door.

"A . . . a judge?"

"Yes." Fwem looked far from happy.

Oh, dear. Duncan blew out a breath. He'd never really believed in the usefulness of cultural liaisons. They always seemed to cause more problems than they solved. *Especially this cultural liaison.* And now it was his problem. Duncan realized he had no idea how the Chuff justice system worked. Could this chief music judge do bad things to Roger? Maybe he'd just confiscate Roger's bassoon and have it chopped up for firewood. *That wouldn't be too bad—not too bad at all.* He looked hard at Fwem. "Why did the judge take Roger away?"

"Why?" said Fwem. "Because the music was wicked . . . awesome wicked."

Wicked. Duncan worried. Roger might have gotten himself into serious trouble and it might take the ambassador himself to get him out of it. *The ambassador will not be happy.* Duncan turned to ask Fwem more questions but just then the second half of the concert started. He'd have to wait.

Throughout the second half, Duncan's trepidation steadily grew. *What a civilization considers wicked can be very strange—and beyond logic.* Duncan kept his eyes on the door. *Roger might be in very serious trouble indeed.*

Then, when the music finally ended, Duncan saw the door open. And through it came Roger and the Chuff who'd abducted him. Arm in arm, they walked up to Duncan.

"This," said Roger, "is Churbek."

"And," said Churbek, "this Roger kid here is my new best friend."

"Best friend?" said Duncan weakly, struggling with the revelation that Roger was *not* in trouble.

"Churbek is a music producer," said Roger. He turned to Fwem. "Churbek tells me you are one, too."

"Churbek got to you before I did," said Fwem.

Duncan's worry had turned to relief—and now to annoyance. "What's this about?" he demanded.

"Churbek has offered me a recording contract," said Roger.

"What?"

"The Chuff have a taste for the exotic," said Roger. "We can sell them novelty—as long as they can use it and comprehend it. Anyway, they say that my music should be very appealing to children."

Duncan felt the situation slipping away from him. "I'm not sure that's appropriate for an Anglo-Terran government employee."

"If he couldn't do it," said Churbek, "that would be awful."

"It's a great opportunity," said Roger.

"Still," said Duncan with a smile covering his irritation, "the Agency frowns on moonlighting."

"I really think I should do it," said Roger. "For the sake of the Agency, of course."

"That's just it," said Duncan, his irritation turning to anger. "You *are* a government employee. You can't—"

"They've offered to pay me in lutetium—lots of it."

"Oh." Then, because he felt he had to, Duncan added, "Good work." Inwardly, he winced as he saw Roger, Fwem, and Churbek looking at him as if he were an idiot—as if he were a poopyhead.

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(EDITOR'S NOTE: Roger had different problems in "Misunderstanding Twelve" [April 2004] and "A Higher Level of Misunderstanding" [May 2007].)

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Reader's Department: **THE ALTERNATE VIEW: TAKEN ON
FAITH** by Jeffery D. Kooistra

I bought this book a few years ago: *What We Believe But Cannot Prove: Today's Leading Thinkers on Science in the Age of Certainty*. It is edited by John Brockman and available from Harper Perennial (ISBN-10: 0-06-084181-8, copyright 2006). I don't recall exactly why I bought it, although I am fairly certain that I thought I might discuss it in an Alternate View. Otherwise, any subtitle that tells me the book contains the musings of "today's leading thinkers" puts up a big red flag. Our leading thinkers? Who selected these people and why are they considered "leading thinkers"? There being no formal, recognized operational definition of the breed, it is simply a matter of opinion as to which people qualify. And you all know how fond I am of other people's opinions.

That having been said, I do recognize the need for rhetorical flourish in subtitles. The book contains musings from 109 contributors, one of whom also wrote the introduction, and the editor. I was pretty confident I'd find something inside that I'd have an alternate view about, or that one of the writers would have an alternate view of his own that I could present.

Just flipping through the pages, of which there are about 260, one finds that the typical contributor took about a page and a half to tell us what he believed but could not prove. Some took a few more, and several took much less. Personally, I have a bit of a problem with accepting someone

as a "leading thinker" when he can't conjure up even one page on the subject at hand.

I confess that most of the names were completely unfamiliar to me. No offense Terrence Sejnowski, but I've never heard of you. I can see in the little bio that precedes each contribution that you're a computational neuroscientist and the coauthor of a book called *The Computational Brain*, but I must have missed that one. Christine Finn, archaeologist and journalist, author of two books, same deal.

However, there are plenty of names that I did recognize, among them genuinely famous scientists (leading thinkers or not) that I'm sure most of the *Analog* audience has heard of, and several science fiction writers as well, some of whom have appeared in these very pages. There are names like Ray Kurzweil, Richard Dawkins, P. C. W. Davies, Michael Shermer, Bruce Stirling, Freeman Dyson (a leading thinker in anyone's book!), Daniel C. Dennett, Lawrence M. Krauss (*The Physics of Star Trek* author), Lee Smolin (I wrote about his book a few columns ago), Gregory Benford, Rudy Rucker, and Mihaly Csikszentmihalyi. (Okay, I admit it, I had never heard of Mihaly Csikszentmihalyi, but I liked his contribution and thought it made for a fitting concluding essay.)

I've selected a few of the essays to discuss below. This should give you a good feel for what you'll find in the book, but I'll tell you right now that I think it is worth a read. I've certainly wasted more money than this book will set you back on thicker, highly-touted tomes by leading authorities that were crap from preface to index. If you run into crap in this book, the next essay may very well be a gem.

In the preface, editor John Brockman explains the specific motivations that lay behind asking eminent minds what they believed but cannot prove. I found them naive, but explaining why would require more than an Alternate View column. Suffice to say that if I had only read the preface prior to buying the book, I would not have bought it. But if I had also read the introduction written by Ian McEwan, a non-scientist but a well-respected British author, in addition to the preface, I would have changed my mind and purchased it.

McEwan's intro is marvelous. He echoes several themes that are near and dear to my heart, and is clearly aware that, path to truth or not, science is performed by scientists, who are people first. In my experience, progress in a field is often not made until someone comes along who can rub the noses of the accepted experts in the dog waste of their dogma. Or, as happens more often, when those authorities with a vested interest in the status quo—financial, intellectual, or both—die. McEwan understands this.

First up is the contribution by Michael Shermer, publisher of *Skeptic* magazine, someone who would never make it on my list of leading thinkers. He is skeptical about things almost everyone is already skeptical about, and famous for it. That qualifies him? But he is a competent writer and states clearly what it is he believes but can't prove. It's actually a bunch of things, and not succinctly put. But he starts with this one: "I believe, but cannot prove, that reality exists independent of its human and social constructions." (p. 37)

Even I believe *that*, but Shermer's reality has no room for the supernatural or paranormal, especially God, and mine

does. He says: "After thousands of years of attempts by the world's greatest minds to prove or disprove the divine existence or nonexistence, with little agreement among scholars (as to whether He is or isn't) one's belief, disbelief, or skepticism finally rests on a nonrational basis." (p. 38) True, you can't prove God exists from His creation, but you also can't prove the existence of Henry Ford from a Model T. Bringing up those greatest minds seems a bit beside the point, but since he did, he should have noticed that most of those greatest minds believed in God anyway, lack of proof notwithstanding. Maybe they knew something Shermer doesn't.

At least Shermer gave the readers three pages of his well-presented thoughts. Next we turn to the contribution from Bruce Sterling, novelist, journalist, and futurist. Here is his bit: "I can sum up my intuition in five words: We're in for climatic mayhem." (p. 75) He goes on to say . . . well, nothing. That's it. That's his entire contribution. Seems to be a leading thinker who keeps his thoughts to himself. Perhaps that's just as well since believing we are in for climatic mayhem hardly counts as an intuition when headlines routinely claim exactly the same thing.

Freeman Dyson is the guy who thought up Dyson Spheres, worked on the Orion space drive, and showed that Schwinger's and Feynman's "competing" approaches to quantum electrodynamics were equivalent. (He's also a global warming skeptic, by the way.) His piece is a bit over a page long, not at all concerned with "weighty" matters, but very

interesting and so deftly written I'm impressed with the style even apart from the content.

Here is his belief: "Given any number, such as 131,072 (which happens to be a power of two), the reverse of it is 270,131, with the same digits taken in the opposite order. Now, my statement is: It never happens that the reverse of a power of two is a power of five." (p. 82) In Dyson's preceding paragraph he says, "Thanks to Kurt Godel, we know that there are true mathematical statements that cannot be proved." He believes his statement is an example of such.

Haim Harari, theoretical physicist, begins his essay with an interesting question. He says we've known about the electron for over a century, and that it "is believed to be a pointlike, elementary, and indivisible particle. Is it?" (p. 181) He goes on to ask the same question about the assumed indivisibility of the neutrino and quarks, and he wants the reader to consider whether or not the accepted "fundamental" particles actually are, or if they may be made up of something smaller.

Haim admits that there "is absolutely no experimental evidence for a further substructure within all of these particles." (p. 182) That isn't strictly true, since interpretation of observations is theory dependent. If substructure were to be found, many earlier observations would be reinterpreted as having actually pointed to it.

So Haim's unprovable belief is that the fundamental particles are not so fundamental after all. He feels they may be made up of smaller particles in the same way the atom was found to consist of subnuclear particles. Made of

something smaller? I agree. But I think it's in the same way a tornado is made up of air molecules.

Perhaps my favorite essay is that of physicist Lee Smolin. (I discussed his book *The Problem With Physics* back in my September, '09 column.) He opens with these two sentences: "I am convinced that quantum mechanics is not a final theory. I believe this because I have never encountered an interpretation of the present formulation of quantum mechanics that makes sense to me." (p. 220) Smolin knows much more about QM than I do, he being a theorist who has spent much of his professional life working on quantum gravity. So for me it is nice to read that his highly informed opinion is the same as my almost gut level "what the hell does *that* mean?" opinion.

Given his belief, it follows that QM is an approximate theory, and that there must be hidden variables. In his view, "the hidden variables represent relationships between the particles we do see—relationships that are hidden because they are nonlocal and connect widely separated particles." (p. 221) You'll have to make of that what you will; his essay is pretty succinct and I'd just wind up quoting the whole thing if I explained further.

Smolin also mentions that he (and I agree) doesn't think the Big Bang represents the beginning of time. His last sentence is heartening for an experimentalist to read when it comes from a theorist: "Finally, I believe that in the near future we will be able to make predictions based on these ideas which will be tested in real experiments." (p. 222)

The last essay I'll discuss is also the last essay in the book. It is by Mihaly Csikszentmihalyi, and seems clearly to have been picked to be last. He is a professor at the Drucker School of Management at Claremont Graduate University, and has written several books. He gained my approval with his first sentence: "I can prove almost nothing I believe in." (p. 251) Among such things are the roundness of the Earth, quarks, and the Big Bang. He notes that his beliefs "are based on faith in a community of knowledge whose proofs I am willing to accept . . ." (p. 251) This is a notion it is always wise to keep in mind, for faith in things we believe but cannot prove is as necessary to science as it is to religion, politics, and friendship.

If I had been asked to contribute to this book, I would have said that what I believe but cannot prove is that the Universe cannot be mathematically inconsistent with itself. I think it follows from this belief that mathematically inconsistent theories, like classical electromagnetism, need to be put on a mathematically rigorous basis. It works too well over too huge a scale for us to be complacent in leaving it unfinished. I believe the mathematically consistent theory will be in the form of a perfect fluid model of space-time (the aether) that will naturally eliminate the distinction between particle and field, revealing, finally, the Theory of Everything.

Excepting, of course, the origin of the aetheric fluid in the first place. God made that.

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Novelette: **NOTHIN' BUT BLUE SKIES** by Stephen L. Burns

Some professions enjoy little public trust. But how sleazy can they be, really?

Ten minutes to closing on a cold, rainy Thursday night, and Kent Green was thinking it wouldn't be the end of the world if no other customers came in before he closed the sales office and locked up. It had been so dead since late afternoon he'd sent the other salesmen home to their families. Divorced and owner of the place, he stayed.

Dreading the arrival of possible customers was not a standard powertrain of thought for the owner of a used car lot. But it had been a long miserable day, and Kent was willing to pass on the chance to go get soaking wet once again only to hear someone tell him they were "just looking."

Some tin had moved during the day, in spite of the foul weather: a four-year-old hybrid and a three-year-old pure electric, both reasonably clean units with average miles on them; stock in trade for Blue Sky Motors. When his father started the lot in the Sixties he'd chosen that name because of a conviction he'd soon be selling the flying cars he saw touted in magazines like *Popular Science* and *Popular Mechanics*. The name ended up working as the place came to specialize in eco-friendly used vehicles. Fate, maybe.

Eight minutes to closing. Kent closed down his computer and hauled his feet off the desk. Drained the tepid dregs of

his coffee, no more eager for a long drive home to an empty house than more waiting for nothing to happen.

That was when the short guy in the long gray robe came through the door.

Kent's welcoming smile was automatic, if not entirely heartfelt. Smiling was a reflex so deeply wired into him that he'd once smiled all the way through a holdup. Hey, you never knew, the guy might come back looking for a getaway car.

The robe's hood hid the customer's face, which could be a warning sign of bad intent, but this part of town saw all sorts of strange types. Then there was that New Age monastery up in the hills. Twice now he'd sold heaps to monks from the place.

"Welcome to Blue Sky Motors," he called. "I'm Kent Green. Can I help you?"

The hood moved so it was pointed at him. "Perhaps."

The more specific that first answer, the more serious the buyer tended to be. Perhaps was something a be-back might say.

But the smile stayed, and Kent came out from behind his desk. "I bet we can help. What's your name?"

"Moto."

"So, Moto, are you looking for a good, clean used car? One that's kind to the environment—and the wallet?"

"We may be able to enter a business relationship. If we can work out certain details regarding trade-in."

The guy—he was pretty sure it was a guy—had an odd, hard-to-place accent. Usually he could peg accents. He heard a lot of them in this part of the state. This one, no idea.

"What have you got? I can give better terms on eco-cars for trade." Not strictly true—there was a substantial government buy-back bounty on certain gas-guzzlers—but no sense bringing up confusing details until he knew what the guy was driving.

"My trade-in is rather unusual."

That usually meant a retrofit or a home-brew. Tricky market. Most people wanted pure stock. But there was a certain segment of the car-buying public that cherished the one-off because of the air of individuality it imparted.

"Is it outside?" He hadn't seen anyone pull into the lot, but playing a few hands of computer solitaire when he should have been stapling himself to some overdue paperwork might have kept him from noticing.

"Yes, it is."

Kent peered past the guy in the robe, and out through the plate glass window. Pouring harder now, and a wind had kicked up. Lovely.

But his smile never faltered as he reached for his jacket and hat, both emblazoned with the Blue Sky Motors logo.

"Well, let's go take a look."

* * * *

A lot of tin merchants fall into the habit of playing mental games because those games could sometimes give an edge. Trying to guess what a customer might be driving, or be

inclined to drive away. Picking the decision maker in a couple, spotting hagglers.

Kent was figuring that the monk would have something practical, maybe a pickup or a sedan. A van. With luck an old Mercedes, but more likely an old gas-sucking station wagon.

The good news was that the car was parked out under one part of the lot covered with a canopy. The bad news was that the car was a—

—Corvair. A bright banana-yellow Corvair.

Kent kept his smile as he walked toward it. A used car dealer has to be able to make lemonade out of lemons. Corvairs were somewhat collectible. At least it wasn't a Yugo or a Gremlin.

"Don't see many of those anymore," he said with a bemused chuckle.

"Not like this one," Moto agreed. "It is a most exceptional vehicle."

"What year is it?" He was no expert, but there seemed to be something subtly off about the car. The lines weren't quite right, the overall shape slightly distorted in a way he couldn't put his finger on.

"2018."

Kent gave the monk the eye. "Can't be. They quit making these back in the '60s or '70s. Or is it a reproduction?" He reached the side of the car, and did have to admit that it looked either showroom-new or cherry-rebuilt. That would also explain the sense of oddness about it.

"Reproduction. Yes, in a sense. Of one of the most beautiful vehicles ever produced."

"Huh." You might call it cute, but beautiful? Putting a value on it was going to be a bitch. Usually he had Julio take potential trades out for a drive. Five minutes behind the wheel and his service manager could give chapter and verse about everything from the front end to the tranny to the condition of the batteries or exhaust, and nail down the value to within a hundred bucks.

"You must take this vehicle for a drive," Moto said.

"I'm not sure that's necessary." It was late. It would take both Julio and net-searching to evaluate it. His driving it would count for little.

"Please. Only in this way can you understand what an exceptional trade this vehicle would be."

Kent glanced at his watch. After nine now. No way there was going to be a sale tonight. But maybe if he agreed to a quick spin the guy would come back in the morning. He wanted Julio to see it, if for no reason other than the novelty of the thing.

He shrugged. "Sure. Why not?"

As he opened the driver's side door and slid into the seat, the monk went around and got in the passenger seat.

The first thing he had to do was fumble for the lever under the seat so he could shove it back, not surprising since he was a foot taller than Moto. He left the door open so the dome light stayed on, helping him see what he was doing.

The dash wasn't like any he'd ever seen before, blank black plates where the gauges should have been. Maybe it had looked like that on the original, but he doubted it. No seat belt. But the shift lever was easily enough located, as

were the steering wheel, brake, and gas pedal. After a bit of searching he found the key, turned it.

"Sure runs quiet," he observed. The car only made a soft hum. That suggested some form of electric or hybrid drive system. The original Corvairs had, if he recalled correctly, a noisy rear engine.

"Yes, this vehicle is very quiet. If you would please pick a destination for the test drive."

"I was just going to take a quick ride around the lot. My service manager would be the one to take it for a real test drive."

The hood moved from side to side. "That is not sufficient. Please pick a destination. A place five miles away would serve our purposes."

"Really, I don't need to drive it that far." Nor did he want to go out on the highway without seat belts.

"Please, I must insist. Pick a destination."

Kent was too much of a pro to sigh. "Okay, there's a truck stop at the intersection of this highway and Route 215. Mack's." That was a drive-to spot he and his sales force gave test drivers fairly often.

"Excellent. Please put the car in drive so we may commence the test drive."

Kent did as he was asked. The car rolled forward, out from under the canopy. Rain immediately lashed the windshield. Before he could ask where the switch for the wipers were, they came on automatically.

"Nice touch. The lights came on by themselves, too."

"This is, as you will see, an exceptional vehicle. Now please put your foot more robustly on the accelerator pedal so we may proceed."

"Sure." He fed it only a little gas. Corvairs were reputedly one of the least safe, least road-worthy vehicles Detroit had ever churned out. He didn't know if they—or this reproduction—would live up to that reputation, but he was willing to bet it wouldn't handle like a Porsche.

"What the—" he shouted as the car shot not forward, but straight up, acceleration shoving him into the seat. In a second the lot was a small bright square far below him, and the car was still blasting skyward like there were rocket engines bolted to all four wheels.

Actually they weren't going straight up, but following the sort of curve made by a mortar shell, a curve that was already topping out, and sending the car plummeting down as only a couple thousand pounds of wingless steel can plummet from a height of over a mile, the ground rushing up in a blur—

There was a slight jarring sensation, and they were parked in a slot in the back corner of Mack's Truck Stop.

"—*hell?*" Kent whispered, looking around and surprised to still be alive.

"Ten seconds," Moto said. "Greater performance is available, certainly for longer trips, but it is always prudent to exercise caution when in control of an unfamiliar vehicle."

Kent pried his fingers loose from the steering wheel. Turned to stare at the monk. "What," he whispered hoarsely, "*is* this thing?" In the back of his head numbers were running.

Car sales run on numbers: book and trade values, APR, payments; a good salesman can reflexively crunch numbers quickly. He was thinking five miles—okay, call it three miles as the Corvair flies—in ten seconds comes out to somewhere in the neighborhood of a thousand miles per hour.

"We call it the Turble."

Which sounded like a supercharged turtle. Detroit had done worse, though not lately. At least in the name game.

"And you want to trade this car for one of mine?"

"That is the desired arrangement."

"Any one in particular?"

"Let us return to your place of business so that I may determine which vehicle would be desired. Is that acceptable?"

"Sure." He gingerly took hold of the steering wheel. "So what do I do?"

"Simply step on the gas."

* * * *

Ten seconds later they were back at Blue Sky Motors. Kent cautiously guided the Turble back under the canopy, then with a peculiar mixture of relief and regret, turned off the key.

They had barely stopped when Moto hopped out of the car and started toward the nearest line of cars. He watched in growing bewilderment as the monk opened the driver's side door of each car, leaned inside, and sniffed the seats.

Moto lingered over an '08 Escape hybrid, finally closing the door carefully, almost reverentially.

Kent couldn't see Moto's face, but didn't need to.
He knew he'd just made a sale.

* * * *

It was only when they were back inside that Kent realized that, in spite of his time in the lot seat-sniffing, Moto wasn't wet. That wasn't true for him, when he hung up his soggy coat and hat both began to drip.

Kent went back behind his desk and sat down, ready to do some serious business. "So what kind of deal are you looking for?" He had to work at keeping any trace of eagerness out of his voice and off his face. Having had some time to think about it, he knew he wanted that Turble, and wanted it badly. If only for himself.

"I seek a direct trade, vehicle for vehicle," Moto answered. "There would be some minor restrictions, but none that should preclude agreeable commerce."

"We can probably work something out, sure. You have a title for the Turble?"

"I have the creator's certificate."

"So who built it?"

"We did."

"Who's we?"

"Us."

Kent decided to let that detail remain unresolved for the moment, knowing he'd circle back to it later. "So what does your Turble run on?"

"Water."

"Fuel cell?"

"Not precisely." The monk sat slightly forward. "There are deeper implications to this deal than I have yet mentioned. I am proposing an ongoing business relationship. More Turbles in trade for selected vehicles from your lot."

It hurt to keep a poker face, hurt like biting back any reaction to being offered a Rolls Royce in trade for a tricycle.

"That . . . might be possible," Kent allowed, sounding reluctant to move too fast on such an idea.

"We would hope so. For each vehicle we select we would provide a Turble, subject to contractual limitations pursuant to our forged agreement."

Warning flags went up in Kent's head. The monk was talking like a lawyer, and it was a truism that selling a car to a lawyer was riskier than buying ones whose paperwork was done in crayon or riding a gassed-up Pinto through a car crusher.

He steeped his fingers, face solemn. "What kind of limitations are we talking here?"

Moto was silent a moment, as if considering which cards to lay on the table.

"I am what you would call a sales representative," he said at last. "The interests I speak for have an appetite for certain vehicles. As a medium of exchange we have created a vehicle of our own, the Turble. If over time transactions prove satisfactory, we may provide other models—other vehicles—to widen the base of exchange. Our contacting you is a means of testing the market since we have reason to believe we could not successfully enter into direct commerce with potential customers for the Turble."

"So who do you represent?" Moto's confession that he was a sales rep meant that the gloves could come off. Customers had to be treated carefully. Sales reps were made to be squeezed and abused. "Is it some place like North Korea? Libya? Some place we would normally refuse to do business with?"

"I represent the Koomban Empire."

"The who?"

"The Koomban Empire." Moto stood up and took off his robe.

"Whoa," Kent said. He didn't shove his chair back in shock, but his eyebrows did go up almost to his hairline.

Moto was, under the robe, a five-foot-tall red devil straight from a '50s tattoo. Red skin, potbelly, forked beard, pointy tail, horns, and all.

"Please do not jump to conclusions," Moto said.

"Such as?" Kent asked in a voice that hardly shook at all.

"I am not a demon or devil, imp, or other manifestation of evil."

"You *are* a sales rep," Kent pointed out.

Moto sat down. "Point taken." He crossed his legs, showing off bristly goat feet. "I am an alien. A Koomban. Marketing studies quickly apprehended our unfortunate resemblance to supernatural beings held in ill favor. We concluded that we would not be judged kindly, or be particularly successful, were we to enter direct trade with your kind."

"Probably not," Kent said agreeably, though he had a feeling that some people would gladly trade their souls for Turble. And the difference between some bottom-feeder car

dealers and the forces of Hades wasn't that great, mostly coming down to less brimstone and more deceptive contracts.

"Our requirements for assaying trade vehicles are, by your habits, somewhat unusual."

"You mean telling what you want by sniffing the seats?"

Moto shrugged. "Ownership and use of a vehicle imbues it with traces that we can sense. For my kind, sitting in such a vehicle is similar to your sitting in a theater seat and watching a play or movie. We are choosy. Some movies have greater depth and interest than others. Still, we understand how the root of our desire for your vehicles might be misunderstood."

"I believe you're right." Actually most people wouldn't care if they ate the seats and screwed the airbags if it meant getting a car that went a thousand miles per hour. But this wasn't the time to disagree with the man . . . or whatever.

"There is one point in our contractual agreement that may present some difficulty."

"And that is?"

"Buyers must swear loyalty to the Koomban Empire."

Kent sat up straight and scowled, as if just hearing about a delinquent lien or an admission that the car spent a few days at the bottom of a river.

"Now wait one minute, Moto. What do you mean by loyalty?"

The Koomban held up his hands. "It is nothing, really. Verbal boilerplate."

"Swearing loyalty to an alien empire is hardly nothing."

"Really, it is. The oath is strictly pro forma, not that dissimilar to the EULAs you agree to when commencing to use software."

"But you're an *empire*. You want us to swear *loyalty*. Are you guys at war or something? You want us to agree to pay tribute, or provide troops, or something like that?"

"Most certainly not!" Moto said, sounding offended.

"Then what does it mean?"

"Were we to become part of some conflict, and I assure you that is most unlikely, then your loyalty oath would bind you to being on our side. The best comparison I can make would be to the manner in which you are on the side of various sports teams."

"So . . . we'd have to root for you?"

"Yes. We would even issue you pennants and noisemakers. But we have not required such contracted enthusiasm in centuries."

"So . . . I'd have to swear this oath? Or would it be sworn by the buyer?"

"The buyer."

"Would a written declaration count?"

Moto's faint smile was devilish. "Am I correct in understanding a proposal to hide the declaration in the fine print of the sales contract?"

Kent looked him in the eyes. Yellow, slit-pupilled eyes. "You have a problem with that?"

After a moment Moto shook his head. "No, that would suffice."

Kent sat back, staring at the creature across from him and thinking hard. "So how many units are we talking about?"

"As many as you want. You provide suitable vehicles for us, we can provide Turbles—or at some point other models—in trade."

"How much should I sell the things for?"

Moto showed pointed teeth. "For what the market will bear, of course."

"What about the dangers of flying cars?"

"There are none. Our vehicles will automatically avoid other objects. Their inertial damping systems allow for evasive maneuvers that would destroy anything you can build and kill anyone riding inside. That system is robust enough that, were you to somehow fly one into the side of a mountain, the vehicle would be undamaged and the passengers would feel no more than a mild bump. There is no safer vehicle to be had anywhere."

"And they run on water."

A nod. "About one gallon for every ten thousand miles."

"How about repairs?"

"They are largely self-repairing. Only tires and wiper blades would need to be replaced. We are not certain that the eight-track will be viewed positively by many, and it may have to be replaced."

"Warranty?"

"Ten years, bumper to bumper, with generous terms for trade-backs."

There had to be other questions—important questions—but Kent couldn't think of them. Only one left: "So how would we seal a deal?"

"A simple handshake for now, followed by a one page contract. So you find our offer interesting?"

"I guess." Kent sounded unsure, still slightly reluctant. Pure salesmanship.

Moto peered at him for several seconds, stroking his forked beard, then said, "Did I mention that you would get to keep the Turble you just tested? A second one would be provided as payment for any vehicle you might take."

"Like that Escape? You seemed to take a shine to it."

Moto ducked his head. "It too is an exceptional vehicle."

Kent leaned forward. "What say I give that car to you? Personally."

"That would be . . . most kind and generous."

"So would Blue Sky Motors becoming your exclusive dealer."

Moto stared at him. After a moment he smiled.

Kent smiled back.

Alien to one another, but each understanding the other perfectly.

* * * *

Kent walked Moto—once again robed—out into the lot. In Moto's hand were the keys to the Escape, and in his hand were the keys to the Turble. The rain had let up to a light but steady drizzle.

"I shall return in two nights," Moto said as he opened the small SUV's door. "We can then commence the exchange of more vehicles."

"Works for me. Come after closing. Nine thirty or so."

"That is agreeable." Moto climbed inside, closed his eyes a moment, sighed. "Remarkable vehicle." He removed an object about the size of a cell phone from inside his robe, placed it on the dash.

"Drive happy," Kent said cheerily, closing the car door.

The Escape rolled forward a few feet, then suddenly leapt straight up, and was gone from sight in just a couple seconds.

Kent stood there, staring up into the sky for almost a minute, then went back inside.

First thing in the morning he'd turn Julio loose on the Turble, trying to find out what made it tick. If the tech was beyond him, he knew of two people, regular customers, who might be able to help. One was a retired rocket scientist, the other an unemployed physicist.

The list of bases to be covered was daunting. He had to figure out what to charge for a Turble, who to offer it to, and how best to make that offer. He had to find out what made that Escape so irresistible so he could start acquiring tradeworthy tin. He was going to need new security, new advertising, more lot space, and a plan for dealing with media and government attention when news of his new line broke.

But for now, it was time to lock up and head home. Maybe take a detour or two for some more Turble drive time.

He was whistling the theme song for their commercials, *Nothing But Blue Skies*, as he crossed the lot.

Back inside the Turble he inserted the key, turned it on, took hold of the wheel.

"All hail the Koomban Empire," he said with a laugh, then put the vehicle in drive and rocketed merrily into the night.

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Novelette: **WHEN WE WERE FAB** by Jerry Oltion

The Latest Thing may not be what you think....

The tinkle of the bell caught Rick by surprise. It had been hours since anyone had come into his store. He'd cleaned and dusted the shelves so many times in the last few weeks that there was nothing left to do, so he had settled in behind the cash register with a *Discover* magazine and had happily lost himself in an article about nanofabrication units. Apparently they were the wave of the future in retail.

His customer was a gray-haired man in his late fifties or so, round-nosed and red-cheeked from the cold. Five-eleven by the measure on the doorframe. Rick didn't know why he still checked; the police would look at the video rather than trust his estimate if the guy turned out to be a robber. Old habits were hard to break, though.

The gray-haired man looked over at Rick, then around at the shop. What does he see? Rick wondered. A neighborhood convenience store with character or a cluttered mess of outdated junk?

The customer headed for the personal hygiene aisle. Probably staying at the Holiday Inn just down the block, forgot his toothbrush or deodorant, and didn't want to pay the hotel shop's outrageous prices.

Rick turned back to his magazine. Nanofabs. A single unit could churn out anything from electronics to a two-by-four.

Anything that had a digital template, anyway, but practically every new product was being introduced digitally as well as traditionally. The process hadn't been certified for food yet, but that was sure to come. Manufactured products were identical to the original template right down to the molecular level. A block of cheese was a block of cheese, whether the carbon and the hydrogen went through a cow or a fab.

Rick wondered if this technology could make small stores competitive again. If he could buy templates and pay the same royalty as Wal-Mart, then he could sell products for the same price and reap the same profit. No shipping costs or price gouging for low volume. And no inventory sitting idle on shelves for months at a stretch. One guy with a nanofab could sell every product in the world out of a store no bigger than his largest item.

Well, okay, you'd need a raw materials tank. You could get carbon and oxygen out of the air—and help cut global warming in the process—and hydrogen and more oxygen from the water tap, but you'd need iron and silicon and who knew what else. That's where the small shop owner would still be at a disadvantage, but it was a much smaller disadvantage than what he faced now. Or maybe it would be no problem at all. There was, after all, a dumpster in back.

He looked up as the customer approached. Toothbrush. Make that toothbrushes. The guy must be buying for an entire family. And he was definitely from the hotel: he still wore a badge on his jacket that said, "Hi, my name is:" with "Gary" written in bold Sharpie in the white box.

"Find everything you need?" Rick asked.

"Did I!" said Gary. "You have any idea how hard these are to find anymore?"

Rick took a brush from his outstretched hand. *Reach*, medium, compact head. It had purple rubber grippy lines running up the handle. "Looks like the same thing I've been carrying for years," he said.

"Better stock up, then," Gary said. "Because I haven't seen one in a store for quite a while. I think the company's quit makin' 'em. Toothbrushes nowadays are all fancy, with wear indicators and bristles sticking out every which way. And twice as big. Ever notice how everything has gotten fatter in the last few years?"

"Tell me about it," Rick said. "I've had to change my shelving to accommodate it."

Gary set his hoard of toothbrushes on the counter. Four of them. Rick rang them up and the guy paid cash, which Rick ran through the counterfeit scanner before counting out his change. He wondered what would happen if you used a nanofab to make money? It would be the same as the original right down to the molecular level. His scanner wouldn't be able to tell the difference. Except for the serial number. The scanner already checked those against an online database. You'd have to be pretty clever to assign each bill a new number that wasn't in service somewhere else. Rick wondered if it was even possible to modify a template to that degree, assuming you could get a template for a hundred-dollar bill in the first place. Was there some kind of scanner for solid objects? And maybe a 3D Photoshop program to tweak them after you'd scanned them?

Gary thanked him and headed out the door with his prizes. Rick settled in to read the rest of the article. He got through the whole thing without another interruption.

* * * *

Six months later a gleaming new nanofabrication unit filled the front half of his store. The racks of magazines and shampoo and toothbrushes had all gone into the back, soon to wind up in the raw materials hopper if things went according to plan. It was a gamble, but with business down so much, he hadn't really had much choice. Now he could sell a pair of shoes or a TV or a case of paper for the same price as anybody else. His corner shop wasn't just a convenience store anymore, it was a *convenient* store, right downtown but offering the same deals as the box stores out in the boonies.

All that remained of the old store were the food and beverages. Those still weren't approved for duplication. Apparently it had something to do with farm subsidies and milk price supports, though Rick suspected those would go the way of the dodo soon enough.

In the meantime he was doing a brisk business in, well, just about everything. The novelty of it probably accounted for the first few weeks of sales, but the convenience and the bargains brought people back. Business grew until the fab was running nonstop, pouring out products as fast as people could punch the buttons and Rick could fill the hopper with raw materials. He couldn't quite bring himself to toss everything into the bin, so he saved one of each old product, more as a memento than with any hope of selling any of it.

Maybe he could put them in a museum someday: the last macro-manufactured products ever made.

He was just about to buy a second fabricator when the first hint of black cloud drifted around his silver lining. A teenage girl keyed in a request for a new phone and hit the "make" button, but instead of the whir of machinery and the hiss of the spray heads, the machine went "ding!" and displayed a message on the control panel: "Template not in database."

"Er?" Rick said when she showed him the problem. He checked to see if he was connected to the 'net. If this was the first time anyone had ordered this particular model, then the machine would have to go find the template, which it couldn't do if the connection was down. But that wasn't the problem. The machine simply wasn't able to retrieve the template. Rick spent a frustrating few minutes trying to puzzle out why it couldn't, eventually losing the teenager out the door before he learned anything.

He stood aside and let the next customer build a wrist TV while he called customer support. It took thirty minutes to get through to someone live, who told him the news: "Your rights package doesn't include special editions."

"What do you mean, 'special editions?'" Rick asked.

"Special editions are custom releases of new product variants that are keyed to exclusive markets," the service rep said in a voice that had clearly repeated the same phrase hundreds of times already.

"How do I become one of those markets?" Rick asked.

The answer was just what he expected: "Pay a premium."

Brilliant. Rick checked his contract, and then he called a lawyer, only to learn that the distributors had him by the short hairs. He had the legal right to sell any "standard" product in the database, but nothing required a company to put new products in that database.

"It's planned obsolescence," the lawyer explained. "You didn't really think new technology would change that, did you?"

"I did," Rick admitted. "Because the advertising for the nanofab made it sound like it would." He felt himself blush as he said it.

"Caveat vendor," said the lawyer.

Over the next few months, it seemed like every product had a "New!" and "Improved!" variant that was available only at Wal-Mart or Freddie's or Costco. Rick watched his clientele dwindle and debated subscribing to a premium service, but he couldn't afford the top tier and nothing less would keep him competitive.

He had a moment of temptation when he caught a group of teenagers using the fab to build a music player that he knew wasn't in the database. He suspected something the moment they came in, six boys who went into a huddle around the control panel to hide what they were doing. Rick let them get far enough into it for the machine to start up, then walked over and said, "Hi, guys. What'cha making?"

"MiPod," one of the kids said.

"I didn't know the old ones were still popular," Rick said.

About then the machine spit out the player. Rick picked it up before any of the kids could. It was a tiny rectangle of

iridescent purple metal with swirls of green and silver across the face. Two bright orange ear buds stuck out the top, smaller than a baby's little finger. The only lettering anywhere on the player simply said "Aiden."

"Odd brand name," Rick said. "I haven't seen that one before."

One of the kids snickered, and another one punched him quickly in the side.

Rick tapped the power button and the face lit up with a menu. The lettering was too small for him to read easily, but he could see that the player was already filled with song categories. He picked one at random and expanded it. Titles scrolled by for screen after screen.

"Man, preloaded, too," he said. "The royalties on all those songs must really add up." He looked at the nanofab's control panel. The item register said "Aiden MiPod, \$24.95."

"Okay," Rick said, "Pretty clever, but I can't let you have this. There must be five hundred bucks worth of music in here alone. I get caught selling stuff like this and I lose my license to fab *anything*."

The kids looked at one another nervously. None of them looked at Rick.

"Which one of you is Aiden?"

The one nearest the door bolted for it. The rest of them took off after him, the bell dingling madly in their wake.

Rick pressed the "No sale" tab on the nanofab screen and carried the MiPod back to the checkout counter. He set it there while he called up the last ten minutes of surveillance video and saved it to his off-site backup, then he pulled the

ear buds out of their sockets, popped them in his ears, and pressed "Play." The deafening blast of electric guitar that assaulted him was all the proof he needed: the knock-off player actually worked.

He would bet money that the original was right there in one of those kids' pockets. They must have figured out how to scan it and upload its template to a product database somewhere and then direct his nanofab to that database. For a moment Rick considered tracking it down in the nanofab's records and seeing what else was in there, but he quickly sent that notion out the door with the kids.

No, tempting as it might be, he wasn't going to start pirating stuff just to stay in business.

* * * *

He was reading *Discover* behind the counter again—a magazine he'd had to buy with his own money in order to fabricate—when the bell startled him. He looked up to see a guy with gray hair, round nose and red cheeks on a slender, late-fiftyish frame. Five eleven. The man looked vaguely familiar, but Rick couldn't place him. He looked to the side of the store where the personal items used to be, then back at Rick.

"Got any more of those toothbrushes?" he asked.

Toothbrushes. Right. "I probably have one, if you didn't buy me out last time," Rick said.

"I didn't," the man said. "Although I wanted to. Didn't seem right, though, to be greedy."

Rick laughed. "You might be the last person left in America who feels that way. Come on back." He led the man into the stockroom, now the raw materials room, and over to the shelves of stuff that he hadn't recycled. He blew the dust off the toothbrush rack and said, "Have at it."

The man—still wearing a "Gary" name tag—happily dug through them until he found his favorite brand and style. "Last one," he said, holding it up for Rick to see. "Could be the last one anywhere as far as I know. Seems a shame to use it."

Rick shrugged. "Better than lettin' it gather dust."

"Maybe. I'll have to wrestle my wife for it, though. We're both on our last ones from the batch I bought before."

"You want to stay married, let her win," Rick said.

Gary laughed. "Smart man."

Rick waved at the dusty shelves. "Need anything else off the bargain rack?"

He meant it as a joke, but Gary turned back and poked through things for five minutes or so, selecting a package of Bic shavers, some Suave shampoo, and a pack of Handi-wipes. "Can't get any of this stuff anymore," he said.

Rick looked through the doorway into the shop where his nanofabrication unit idled, waiting for customers who only wanted the latest thing. "Hold on a second," he said, and led the way back to the front of the store. "The bastard distributors screwed me on the new products, but I never thought to check about old stuff. What if they packed the database with old products to pad it out so it looked like everything in the world was in there?"

Gary grinned conspiratorially. "Wouldn't that be too cool!"

It would have been, but alas, when Rick navigated the menu into toothbrushes, all that came up on the screen were the fancy ones with the bells and whistles. One even had a separate "uvula wand," whatever the heck that was. On the off chance that there was more in the memory bank than showed in the menu, Rick keyed in the make and model of the toothbrush his customer liked, but he only got the now-too-familiar response: "Template not in database."

"I guess that would have been too easy," Gary said.

"Yeah, I guess." Rick looked at the nearly useless—and only partially paid-off—nanofab humming quietly there in his shop and wondered how he could turn this one customer into the horde that had crowded in here just a few months earlier. Or even just the steady trickle that he'd enjoyed years ago, before the big box stores had cut into his customer base so badly.

Well, this guy liked old toothbrushes. There must be more people like him.

"So how do you make a template?" Rick asked.

"I have no idea," Gary said.

"Me either," said Rick, "But it can't be too tough." He told Gary about the kids who had duplicated the MiPod. "If we can figure out how to do it for other stuff, you'd never have to scrounge in storage rooms for toothbrushes again."

"Or nice-looking digital watches," Gary said. "Or toilet paper on regular-sized rolls. Or—"

"Digital watches?" Rick asked.

"You remember when they first came out? They were the coolest things you could get. Timex and Bulova made the most elegant styles, with braided-metal bands and fancy numbers and the whole shebang. Then somebody decided digital was uncool except for sports, so the only decent watch you can buy now is analog. It's like that with everything. Once the patent runs out, manufacturers drop it like a hot potato and push something else on us. And the only versions of the old stuff you can get afterward are cheap knockoffs that often as not don't even work."

"What about trademarks?" Rick asked. "Those don't expire, do they?"

"Probably not," Gary said. "So you file off the serial numbers and the brand name before you scan it, and sell it as generic. Or put on the package, 'Compare to the Reach Advanced Model with Compact Head.' That not only tells people what it is, but it states straight out that you're not trying to pawn it off as the original brand, so there's nothing they can do to stop you."

Rick laughed. "What do you do for a living?"

"I run seminars on investment strategies. Why?"

"Because you seem to know a lot about patent law."

Gary shrugged. "I know when a company is vulnerable. And when it's strong. If you can bring back a bunch of old stuff that people used to like but can't get anymore, I'll be buying stock in *you*."

Would he really? That was the most encouraging thing Rick had heard for months. Especially because he had a suspicion how he might accomplish it. He nodded toward the

toothbrush and razors and shampoo and dishcloths that Gary held in his hands. "If you want to make an investment, then those would be a good place to start."

"What do you mean?"

"I mean leave them with me for a few days. I may be able to get 'em scanned for you."

Gary looked at his treasures, then at Rick. Slowly, he laid them down on the counter, then took out his wallet and extracted a business card. "That's my cell number," he said. "I'm at the Hilton until Friday. Call me if you get 'em in time. Call me at home if you don't, but *call me*."

"Will do," Rick said, hoping he would have something positive to report. He only had one lead, and a tenuous one to boot, but at least it was a lead.

* * * *

After Gary left, Rick printed a still from the surveillance movie of the kids who had made the knock-off MiPod, posted it on the front door with a sign that said, "Aiden, call me, no questions asked," and waited for the grapevine to do its thing. He expected it to take a day or two for word to spread, but within an hour he noticed a girl pause at the door on her way in to buy a pack of gum, and about ten minutes later his phone rang.

"What do you want?" a boy's voice said, trying to sound tough.

"I want to offer you a job," Rick said.

"I got one."

"This is a better one." Rick explained the deal.

"You want me to scan toothbrushes and shit?" Aiden asked contemptuously.

"That's right. Anything that's in the public domain. You get a royalty on every one I sell."

That got his attention. "How much?"

Rick laughed. "Hell, I don't know. We're breaking new ground here. You're the computer genius, or you must know someone who is. Set up a website for public-domain products and charge what you think the market will bear."

Aiden took a minute to think it over. "Toothbrushes," he said.

"And anything else you used to like but can't get anymore," Rick said. He took a shot in the dark and added, "Your first iPhone. A classic Game Boy. A skateboard with wheels."

"Oh," said Aiden.

Rick smiled. Oh, yeah.

He looked up when the bell rang. Gary. And half a dozen other people from his convention, by the name tags. They all started talking at once. "Can you get me an incandescent light bulb?" ". . . slide film?" ". . . a Mac Cube?" ". . . a real Coke?"

Rick held up his hands. "Not yet. But if we can find an original anywhere, then yes, I can."

They left business cards with him. Promised to send their last remaining treasures to him for scanning. Offered to pay up front. The list of items they wanted topped 100 by the time they stopped brainstorming and went back to the convention.

After they had gone, Rick went to his computer and printed out a sign for the front window: "Old and Unimproved. Whatever you can't get anymore, Coming Soon!"

Then he sat back to wait for the tide to turn.

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Novelette: **THE PLANET HUNTERS** by S.L. Nickerson

The best—and worst—parts of research are surprises.

I had instructed him to only wake me up for a hot Jupiter, and even then it had to be a real sizzler.

The phone rang at eleven a.m. and into it I managed to grumble a single syllable: "Yeah?"

"Your spectra were perfect." The happiness in Shakir's voice sickened me. No one should be happy at this early hour. "I've been analyzing your old observations myself and discovered more exoplanets."

"How big are they?"

"Rocky, Earth-sized, pairs at a time..."

"What'd I tell you? First, it must be around the size of Jupiter," I said, speaking as I would to a child, "and then it has to be close to its sun. That makes it a hot Jupiter. Everything else, I don't want to hear about."

"But every team from here to Beijing is scrambling to find extrasolar Earths. More ESEs, they cry!"

"Yeah, everyone's doing it. I have six months to finish my thesis and stand out enough to land a postdoc. How am I supposed to do that ogling bloody ESEs?"

"Even Wertzberg is, and you know how it is to get the Germans to—"

"Great. You've still got two years left. Go away."

I was more pleasant by afternoon, probably because of Shakir's unconscious state. When I wheeled my bike into our office at four p.m. he was face down on his keyboard, while at her desk in the corner, our other officemate, Ingrid, played chess with the incrediblecomputer.

Suddenly, Ingrid turned to me. "This is an event."

"What do you mean?" I asked her, hanging up my helmet and unwinding the scarf that had protected my lungs from Toronto's pollution. It was easy to be paranoid when sitting next to an atmospheric physicist like her all day.

"This is the first time you two've been in the same room for a very long while. Everyone was starting to think that you and Shakir had merged into the same person."

I was not sure how to respond to that, and so instead I grunted. "Almost done for the day?"

"Yep," she said. Ingrid was a theorist, most of her work being in the fictional realm that took place somewhere inside of a computer.

I plopped down into my seat to prod my computer from its slumber. "What job are you on now?"

"I'm tweaking a new model of Earth's atmosphere, fixing our pollution rates to be constant with contemporary values and running it a few hundred timesteps into the future." The theorists always remotely logged onto the incrediblecomputer, a machine I had never seen. None of their clique would divulge its location. It could have been shoved away in a closet in Iqaluit for all I knew.

"Crystal ball physics, then," I said. "The future never gets old."

"But it's a slow day on the incredible computer," she added. "Damn cosmologists with their space-curvature calculations. They're such resource hogs."

My computer awakened, I logged on, and the first thing that greeted me was the giant doomsday clock, red letters flashing across my desktop. It was counting down to when the Behemoth Space Telescope—BST, informally referred to as "Beast"—would be operational. Ten days, four hours, sixteen minutes, and five seconds. With a mirror large enough to satisfy the combined vanities of all the celebrities in Hollywood and Bollywood, the BST was to fill the void felt in infrared astronomy since the James Webb Space Telescope got put down. It was calculated that the BST would be good enough to directly resolve the spectrum of electromagnetic radiation emitted by an exoplanet. The only problem with it was that the gatekeepers who controlled it, deciding in advance which astronomers would be able to use the BST, had rejected all my proposals for observational runs on it.

To further my study of hot Jupiters I needed a spectrum that only the BST could provide. Electromagnetic radiation of a source could be represented as a plot of intensity versus wavelength of radiation, called a blackbody spectrum. An ideal blackbody spectrum was smooth and hill-shaped. Our sun peaked in the visual, and Earth, being cooler, peaked in the infrared. Because stars and planets were not perfect, their blackbody "hills" had chunks eaten out of them from molecules in their atmospheres that had absorbed radiation at particular wavelengths. From such spectra, one could piece together the composition of the object's atmosphere.

"Fuck," I said after checking my email.

Ingrid raised a brow.

"Sydney and Cape Town have just rejected my applications. There goes them. What am I going to do if I don't land a postdoc?"

"Get a real job." She shrugged.

I returned a glare.

For the next while I typed away at a paper I was supposed to write last week on my newest hot Jupiter discovery, and every few minutes I switched back to my desktop to stare at the doomsday clock as if expecting it to go faster. If I got time on the BST, I could point at my postdoc of choice. I scanned the new papers online at arXiv, wrestled with the office printer, made some coffee, and typed a bit more of my paper.

By six p.m. Shakir stirred, peered around the office as if he did not know where he was, blinked, and then saw me. "Did you look at them?" he demanded.

"Look at what?" I asked.

"The spectra, the radial velocities, my calculations."

"There's an eraser stuck to your forehead."

He groped at it. "Did you check them over?"

"No. How could I, when you didn't give them to me?"

"I put the printouts on your desk."

I eyed the stack of papers for the first time and discreetly pulled a folder over it. "Didn't see them."

"I suppose you did that too when you first analyzed the spectra. Kept the hot Jupiter and discarded the rest."

"Yeah, the interesting parts, the ones no one else is doing, the exoplanets that will get me my postdoc. All you're looking for are things like our solar system, boring rubbish. We already live in one."

He started packing his palmtop and notebooks away. "What I do isn't rubbish, and I need a second opinion. I found five pairs of extrasolar Earths from your observations of seventeen solar systems, as opposed to your two hot Jupiters. If you can confirm this and I did find enough extrasolar Earths, I might be able to squeeze in some time myself on the Beast for follow up."

I sucked air through my teeth. "You would never get to use the Beast!"

"I would before you! Hot Jupiters are no longer so 'hot.'"

"It's all early universe high-redshift this, and extrasolar Earths that. Well, no one ever got any science done doing whatever is fashionable." I used to be like Shakir that way, hopping onto whatever astronomy boat was popular at the time, making my research conform to the norm like a good sheep. It was only now, when I broke my own path, that I resented what I had been.

"Searching for extraterrestrial life is more than a trend," he said.

"You should stop polluting your brain with science-fiction crap and aliens. It never comes true."

"I'll enjoy the look on your face when I do find them, and no less on one of these extrasolar Earths."

"On that day I'll be too busy checking you into the mental hospital."

"But aliens aren't nearly as insane as some of *your* pet theories," he said. "What was that one you had, about the magnetic fields of mini-Earths? Then it was the mercury core of Gamma Cephei E. And hopefully you've ditched your hypothesis on the polar atmospheres of hot Jupiters."

Ingrid snorted. "Stick to observations."

"Shut up. Better to dream and fall a thousand times than . . . be like the pair of you." And then something suddenly occurred to me. "Ohhh, Shakir," I said, trying to sound kind.

"Mei, you know I hate it when you say that." He was standing now, zipping up his backpack.

"If I check over your work, I'll get first billing on the papers."

He groaned. "Fine."

"And, if in the unlikely event, which is about as likely as you finding aliens, you get time on the Beast, might you squeeze in a few directions to call on some of my hot Jupiters?"

"I'll consider it."

"I can check over some of your older data too."

"And if I do find aliens, you won't put me in white?"

"Done."

I worked through the night, stopping only once to give a tutorial at eight p.m. It was a general astronomy course meant for undergraduates of the artistic persuasion who did not know a black hole from their own navels and were still under the impression that winter happened when the Earth was farther away from the Sun. They were there for the

distribution credit, I was there for the cash, and so generally we had an understanding.

* * * *

Shakir had outdone himself. I could not find a single blasted mistake in his calculations, for once, which meant that I could be making a mistake. I arrived in my apartment at two a.m., with curry and naan from the only Indian place open past midnight. I pushed aside clothes, books, and electronics from my couch to make a seat and dug in.

With two exceptions, the Cabal was relatively quiet tonight. In a poster beside the light fixture on my ceiling, Lisa Randall wrote out calculations on her blackboard. From his desk on the wall above my monitor, Subrahmanyan Chandrasekhar read a book. One of his corners was starting to curl from the heat. On my fridge Richard Feynman was playing his bongo drums again, while above him, on my freezer door with a magnet over his forehead, Galileo Galilei was shushing him. Richard grinned impishly and made a lewd comment about Galileo's frock.

On the wall across from me, Annie Cannon turned away from her photographic plate to give me a good squinting. "Found any more hot Jupiters today?" she asked.

"Shakir sucked me into that extrasolar Earth garbage," I said and stuffed a large slop of curry on naan into my mouth. "But just for a while, until I can hijack some time on the Beast. Then, if I have one success they'll give me more time, even for something different. At least, that's how it has worked for the space telescopes in the past. So then I'll apply

for use a second time without the ESE-baggage, and have it all to myself. I hate these politics, this paperwork, this kissing ass for resources. I just want to do science with my life."

"Hear hear!" Richard said, and gave his bongo drum a particularly vigorous whack.

"At least you didn't have to worry about politics or funding in your day," I said to Galileo. "You could just go out and discover stuff, since almost everything remained undiscovered."

"Don't talk to me about politics," Galileo said. "I had to deal with the Catholic Church."

I curled up and did some marking, and only spilled curry on two papers. The spectra fared better: only one drop of curry. I really started to question myself when still I failed to see anything Shakir did wrong, especially given the statistical anomaly of this sample. But there was little doubt, even within error, that those five solar systems had Earth-sized planets, two at once. I checked my watch. Seven a.m., time for bed.

I slept very little that morning and awoke early, just after one p.m., drawn to my computer. Still in pajamas, unwashed and unfed, I remotely logged into my work account and called up the data, needing greater detail than the printouts Shakir had supplied me with. There had to be more planets in these five systems that all seemed to have exactly two extrasolar Earths. Just as he only focused on the signatures of Earth-sized planets and I only focused on those belonging to Jupiter-sized planets; the rest got discarded.

The easiest to find were pairs of Jupiter-sized ones in all five, them being the largest. Of course, none of these were hot Jupiters—they were too far away from their suns for that—but neither were they so far from their suns as to be cold Jupiters. In fact, they might be considered just-right Jupiters like Baby Bear's porridge, at a distance from their suns comparable to our Jupiter. The planets that were Saturn-sized were the second easiest to pick out in the five systems. Next came the extrasolar Neptunes in pairs, and last the hardest to spot, being the smallest, extrasolar Marses. All these planets lined up in the same order from their sun: closest the two extrasolar Earths, the Mars, the Jupiter, the Saturn, and farthest the two Neptunes.

I rolled my chair back and did not want to touch my keyboard again, very disturbed by what I had just seen.

"Are you well?" Subrahmanyan asked me from above my monitor, putting his book down.

"I thought first, perhaps I had observed the same solar system five times by accident? But that can't be. The solar systems all have different coordinates in our sky, I remember doing different levels of correction for reddening from varying amounts of interstellar gas between us and them. And their suns are known to be at different ages. These five solar systems have to be different, and yet they're the same."

"Why must they be different?" he asked.

"Because the exoplanets in every solar system observed have a random distribution, various sizes and distances from their suns. It's like a box of chocolates," I said, stammering. "Here, though, all at once I've discovered five systems that

follow some correlation. What does this mean? Will this revolutionize planet-formation theory, favor one of those theories over the other, or destroy them all? Are solar systems predisposed to form their planets in a certain order?"

I turned my head sideways and looked at my monitor another way. "They're just like our solar system! My methods can't see something the size of Mercury, but I bet that the Mercuries would be out there too. One of each of Shakir's extrasolar Earths is a Venus, and one in the Neptune pairs is a Uranus. Those planets have similar masses. You should know that, Subra." Venus was Earth's twin planet, a rock similar in size, radius and distance from our sun, only where Earth had been perfect for life, on Venus a runaway greenhouse gas effect reigned, making its atmosphere thick, clouded, and uninhabitable. Ingrid had once told me that Venus was like a prophecy, a warning of what Earth would soon become.

"I have the key to the Beast!" I cried.

From my kitchen, I could hear Richard smacking a victory jam on his bongo drums.

In ten minutes I wrote up my new proposal for the gatekeepers of the BST and emailed copies to Shakir and our supervisor, Dr. Onishi. Investigating this strange pattern we had stumbled upon would be far more satisfying than pairs of extrasolar Earths alone.

Dr. Onishi summoned me to her office in the tower that afternoon. The giant clock on her wall ticked the seconds by. Nine days. I had nine days left before the BST became available and I would not suffer to be left out of the first

round. A hazy sunset spilled across the horizon from behind the Toronto skyline, leaching its glare into Dr. Onishi's office. She ran a finger down her window, and the glass darkened.

"I dislike west-facing offices," she said, rolling back into her desk. She passed me a printout of my report, bleeding red from her old-fashioned penned corrections. "Did you do a statistical significance test?" she asked, picking up a fork and fishing around in a bucket of poutine that was as big as her head. "Do you know the probability of this happening spontaneously? Five identical systems out of the seventeen you observed?"

"Well, with dozens of exoplanets being discovered every day between hundreds of astronomers, you'd think that a coincidence would have happened to *someone*. Do I even need the test?"

"I did it. You've less than a thousandth of a percent of seeing the exoplanets you got from your spectra, which means there's a bias in your data taking or processing. Now that lovely hot Jupiter you were writing up about? Wrong, all wrong. I've called the observatory to get them to test their equipment's calibration." Dr. Onishi was always efficient and quick, a publisher, not a perisher. As a graduate student alone she had refined two methods of detecting exoplanets. I would sleep easier if only I could accomplish half as much.

"There's nothing wrong with my data," I said, voice rising. "I've checked it over; I'm careful, always."

She pointed a fry-speared, plastic fork at me. It dripped a lump of gravy-drenched cheese onto her desk, which she ignored. "But clearly you can't have seen so many solar

systems identical to ours from a random sample. It's an impossibility. Go over it again from the beginning, and then I'll consider sending it off to the Beast. You have a day."

"A day?" I asked. "I'm already late for my hot Jupiter paper."

Dr. Onishi pointed the fork to her clock. "Time's ticking. If you would rather write a paper, I could pass this on..."

It was not the giant clock that told the time she had pointed to, but a smaller one on her other wall I noticed only now. Instead of counting up, it counted down to a time very familiar to me. It seemed I was not the only one with a doomsday clock centered on the BST.

"I'll do it." I turned to leave.

"One more thing, Mei," she said. "Next time you've data, look at the whole of it and not just your hot Jupiters."

For the rest of the night, I feverishly reprocessed my raw spectra. The Moon crossed the sky, a pizza delivery came for me, everyone else on the floor went home, and still I worked, fingers flying from keyboard to mouse, and my gaze ran across my monitor.

I did not know I had fallen asleep until I woke up near noon to a pencil jab in my ribs. I wrenched the pencil from the poking hand.

"Hey!" Shakir said.

I held the pencil tip to his neck. "You don't think I'm crazy, do you?"

"It's a great stunt, you have me there. Imagine, saying there are many solar systems like ours out there. This might be the pet theory of yours that's actually convincing."

"It is not a stunt!" I said, standing. "It's the truth. I know what I see. Look at it for yourself."

He scrambled back to his desk. "If these five systems are so similar to ours then they too may be the perfect storms to create life."

"This isn't about finding your little green aliens! This is about overthrowing fucking planetary formation theory!" I tossed him his pencil and furiously started commanding print runs of my past day's work. "Read it!"

"Okay, okay."

"No one asked my opinion." Ingrid was marking undergraduates' tests. Her lips moved while she read the papers, circling her pen in the air as she decided the destinies of her disciples. "I think you're crazy."

"Thanks," I said.

After adding my recalculations, Shakir's proofing, and Dr. Onishi's input, I had a spruced-up proposal that would be irresistible to the BST's gatekeepers. I sent it to them with eight days to go, pointing out other weaker proposals that others had submitted and how I was much more deserving of their time. They responded to me in six days.

* * * *

"I hate them!" I said, spinning in circles, kicking up the clothes and books that covered my living room floor. "When I'm professor, I'll build my own space telescope, twice as big and shiny with a bow on it, and I'll reject them all. Then they'll know what it feels like." I sank down into my couch

and snapped open a beer bottle. My headphones were jutting into my butt. I ignored them, having much bigger problems.

Shakir had come as soon as he heard the news. He was still standing by my door, eyeing the piles of junk that surrounded him as if he was Zheng He and they the Indian Ocean. I could see the calculation in his eyes as he tried to determine the optimal route to my couch.

"Just step on it," I said.

"But you never do your laundry," he said. "I'm afraid if I put my footprint on your clothes it'll be there for a year."

"I hope you like Thai. Here in ten minutes or it's free."

He held up a data-neb. "I brought some entertainment. The complete seasons of *Red Dwarf*, *Battlestar Gallactica*, *Dollhouse*."

"You're still obsessed with classic television, then?"

He stepped across the mess of the floor, one foot at a time, seeking the maximum number of gaps possible. I shoved stuff off my couch to give him a place next to the beer packs.

We clicked our bottles together.

"To the rejects," I said.

"The rejects!"

I chugged down half the bottle. A while ago I had discovered a one-to-one monotonically increasing correlation between the quantity of alcohol I consumed and how tolerable Shakir became to me.

"If it helps," he said, swallowing, "I had a peek at the order lined up for the very moment the Beast goes into operation. They just released it an hour ago. First, they are

looking at Andromeda, then the Eagle Nebula, then solar system EPH1889."

"That's one of our five," I said.

"Guess what?" he asked. "A team from Victoria found two extrasolar Earths on it, like we did. They'll look at the larger one first, and then the smaller one."

"Damn it. I told you I wasn't crazy," I said. "Even other people have verified at least one of these systems! So we got rejected on basis of overlap."

"Exactly."

The Thai came in eleven minutes and twelve seconds. We had to take our victories where we could. The thing with the Thai food was it was spicy, and the thing with beer was that it tended to dull the heat on one's tongue, and the thing with memory was that it tended to run away when beer knocked on the door.

So I awoke upside down some time in late morning, feet pressed to wall, legs diagonally across couch, shoulders on floor, mouth dry, head throbbing with pain. I turned my head left to see my headphones in my face. I turned my head right to see my bike wheel, having been driven across the floor over my books. The advantage of a messy apartment was that it was invariant under trashing. I carefully eased myself upright.

Shakir lounged back in my desk chair, slumbering in the embrace of someone familiar.

"You are wrapped up in Galileo!"

"Ugg," Shakir replied, still asleep.

I kicked through empty beer bottles to reach him, unwound the poster off of Shakir carefully so as not to rip it, and frantically tried to smooth Galileo out and reattach him to the freezer. "So sorry," I told him.

Galileo returned a scowl. Richard winked.

"Who were you talking to?" Shakir asked. He now sat upright, fully awake.

"No one!"

Beside Subrahmanyam's place over my monitor hung a poster of the Hertzsprung-Russell diagram that mapped out the temperature and brightness of stars. They tended to clot together in groups. The most prominent clots were the white dwarfs, small star-corpses that no longer underwent nuclear fusion; then the supergiants, unusually bright stars in the prime of life; and the largest clot, more of a stream really, the main sequence where most stars spent the majority of their cycle. Our sun was a main-sequence star, would fatten into a red giant in a couple billion years, and later retire as a white dwarf.

Five pins protruded from my diagram. Three were at the main sequence, the fourth was on the verge of the red giant branch, while the fifth sat amongst the T Tauris, a short phase of young stars whose group hardly made an impact on the diagram.

"I don't believe it. First you abuse Galileo, and now you deface my Hertzsprung-Russell diagram?" I asked. "Fracking smeghead."

Shakir turned around to see what I was staring at. "Pin the tail on the star?" he asked with a shrug. "Who's to say that you didn't do that?"

I walked toward it and tripped over Ingrid, who had been sleeping on my floor. She grunted and began to stir. An empty beer can fell off her forehead. I could not recall at which point in the night she had joined us.

"Did *you* do this?" I asked, and ripped the pins from the poster.

* * * *

I attended the department's BST launch party with a Big Byte chocolate bar in one hand and a giant Pinkberry smoothie in the other. It was six p.m. Around me my fellow astronomers and a number of physicists and mathematicians chattered, the words all going over my head. We filled a lecture hall. There were balloons thrown around, streamers, a snack cart. At the front they were having difficulties navigating the controls of a super-definition projector. I watched them blankly, unmoving, willing it to work. We had already missed the launch of the BST itself into orbit.

"The big day," Ingrid said, taking the seat beside me. "Cheer up."

"Big for them." I took a noisy sip from my smoothie.

"You're such a grump."

Shakir sat to my other side. At least *he* looked as upset as I felt. When one was miserable there was nothing more infuriating than the sight of happy people, the inverse of schadenfreude. I did not want to suffer alone.

"Chocolate?" I asked, offering him the bar.

He responded by raising his Big Byte Double Precision.

"You win," I said.

A balloon bopped me on the head. I seized it with a scowl and popped it with my nails.

The projector's blue screen flickered into a scene at the BST's control room in Vancouver, rows of people at their computer terminals wearing headsets, typing, talking, turning knobs, and flipping switches on their circuit boards.

Cheers erupted in our lecture hall at the sight, and then everyone quieted to watch the projection.

The gray control room suddenly flashed to a red and white scene. Some knowledgeable-looking scientist stood at a podium with our flag behind him. The caption told us that he was Dr. Arnold Masamba, Vice Director of the BST. He adjusted his horn-rimmed glasses, cleared his throat, patted the microphone clipped to his suit collar, and started speaking.

"Initial inspections of the Behemoth Space Telescope have all proven to be positive. The telescope is fully functional. It is receiving directions from headquarters now and in a few moments shall be focusing on the M31 galaxy to take its very first images."

Cut to the control room, once stale but now full of life as its people rose from their seats and started clapping. Cut to a few politicians, smiling as photographers snapped their pictures. Cut to an image of the Beast, freefalling in Earth's orbit. Cut to Dr. Masamba again, taking questions from reporters.

I threw my empty smoothie bottle to the floor.

They showed us infrared Andromeda. It was beautiful, and after a delay we saw the Eagle Nebula and it was glorious, but I hardly paid attention. I was awaiting one thing: EPH1889's turn.

Because planets at the distance of solar system EPH1889 were still point sources to us, we would not see an image in terms of space like the images for Andromeda and the Eagle Nebula, which were larger objects in the sky. Instead what the BST was doing now was gathering the intensity of electromagnetic radiation from this particular point source planet in each wavelength to produce my sought-after blackbody spectrum.

When this came up on the screen it was less impressive than the imagery of the galaxy and nebula. This was rough, for the scientific processing would take days, but the distinctive blackbody-hill was there, along with the absorption lines from materials in the planet's atmosphere. I noticed lines in the spectrum from carbon dioxide, water vapor, and ozone. The rest of the mess I was unfamiliar with, but I knew enough to see that even in atmosphere this exoplanet was similar to Earths.

"Chlorofluorocarbons!" Ingrid cried.

"Ow, my ear," I said. "What . . . chloroflablah?"

"CFCs—chlorofluorocarbons," she said, trying to speak up over the erupting chatter around us as others got excited. People were leaping out their chairs, screaming. "I recognize their signature in the absorption lines. They're a group of

anthropogenic compounds from the twentieth century used for refrigeration, cleaners, aerosols; huge ozone gobblers."

I could feel my heart pound faster. "Truly?"

"That got them banned in the 1980s Montreal Protocol."

"Let me backtrack for a moment. So when you said they were anthropogenic..."

"CFCs don't occur naturally. Synthetic."

"Intelligent life," Shakir shouted. "They just discovered extraterrestrials!"

"It should have been us," I whispered with a sigh.

* * * *

News spreads fast. This was the sort of news you call all your friends and family for in the middle of the night. This was the sort of news everyone checked for on the Internet every minute to seize every last drop of updates, while getting hammered with their friends. Aliens were on par with the discovery of the wheel; only there had been no media in ancient Mesopotamia.

I never bought newspapers, since they were sensationalized lies, but on my bike waiting at the traffic lights on my way to work the following afternoon, I caught glimpses of the headlines in people's hands or sitting in the newspaper boxes, when I was not coughing from the smog.

Aliens! Aliens! Aliens!

Behemoth Space Telescope Finds Extraterrestrials

We Are Not Alone

E.T. Phones Earth

First Evidence For Life on Other Worlds

*Aliens Better Not Be Protestant: Pope
Extraterrestrial and the Beast
Will They Come in Peace?
New Space Telescope Takes Shocking Images of Life in
Distant Solar System
Beast Sniffs Out Aliens*

* * * *

In the office, Ingrid had some familiar plots up on her monitors.

"Aren't those the spectra from the Beast last night?" I asked, leaning on her chair. "They released them to just any scientist?"

"I'm not just any scientist!" Ingrid said indignantly, tapping a pen on her monitor. "After the traces of several synthetic chemicals were confirmed on the first, larger of the two extrasolar Earths in the EPH1889 system, everyone ignored the blackbody spectra of the smaller one. Here it is. See those large gaps? That comes from absorption in an atmosphere composed mostly of carbon dioxide, with a copious concentration of sulphuric acid."

"An extrasolar Venus," I said, which confirmed my suspicions.

"Indeed. I subtracted the blackbody spectra of this planet from that of our Venus. Within experimental error they match. It's incredible."

"But what about the extrasolar Earth and our Earth?" I asked.

"Ah." She clicked a few things on her dock and pulled up the appropriate windows. "They're similar, but don't match. For example, we have more carbon dioxide and methane by several factors, but they seem to have more CFCs, nitrous oxides, and ozone. Our planet is warmer than theirs by a few degrees, nudging our blackbody spectrum down a little."

"The aliens are destroying their atmosphere too! Maybe we should send them warning signals."

"The Beast is now taking the blackbody spectra in more detail for every planet in EPH1889," she said. "I'll soon do this analysis for them too! This is so juicy."

I returned to my desk with a grunt and found that the doomsday clock had gone into the negative. I clicked it shut furiously. My inbox was full of emails from people bursting to share the news or asking me to verify it. I ignored them, not wanting to deal with emotional non-scientists at the moment, and pulled up arXiv instead. There was something comforting in the crisp, clinical prose of research papers. Like my inbox, arXiv was flooded with everyone and their gerbil's theories on the BST's discovery. I cut out all the planetary stuff and instead skimmed the observational cosmology. It was guaranteed to be exo-planet-free and a topic I had long ignored, but now I needed escape.

Cosmologists enjoyed exploiting the likes of supernovae and other standard candles to probe every nook, wrinkle, and blip of space's curvature to map out the shape of our universe as far back in time as light could travel. Apparently there were extra spatial dimensions out there that astronomers had to account for when taking measurements at long distances. I

had the luxury of treating space as flat because my observations only took me as far as the Milky Way and the rest of the Local Group.

Someone rapped on our door and I jumped. It was Dr. Onishi. She waved a piece of paper and said, "Good news, everyone. It seems that a certain two of my grad students will get time on the BST after all."

Ingrid turned to me with a grin. "It's your time to dream, Mei."

* * * *

"We won't be here long," I told the Cabal just as I finished unrolling Lisa and sticking her to the ceiling. Beside her, directly over my bed, was my mutilated Hertzprung-Russell diagram, still with the holes. The room they had given me at the BST headquarters in Vancouver could have been more accurately described as a cell: cold, gray, and metallic. A Spartan would have been at home here.

It was too clean. I could not sleep in clean places, no matter how tightly I closed my eyes to pretend otherwise. I saw the bookshelf I had just spent several minutes sliding my books onto, considered it for a moment, and then threw all the books to the ground. I opened my suitcase and sprinkled my clothes everywhere, over the floor, on my bed, and tossed a few socks onto the bookshelves. Better.

Annie and Richard were arguing over solar interiors, but went quiet when my door was pushed open.

"What're you doing?" Shakir asked.

"Decorating," I said.

He took a bottle from his pocket and held it toward me.
"Anti-jetlag pills, calibrated for Pacific Time."

"Obeying time zones is for the weak."

He took it back. "They did give us the nine p.m. shift tomorrow."

"Do you think the food here is any good?"

By heading to the cafeteria, we experimentally verified that this was not the case. I had grabbed a heap of cardboard-flavored chili and a quivering tower of blue jelly, while Shakir did not fare so well with his lo mein and piece of guava pie. Perhaps when designing the meals, the chefs thought the Beast was not the telescope, but who they were supposed to be feeding.

We sat alone at our table while another group of astronomers were gathered around something I could not see. Shakir and I pulled out our papers, discussing the order in which we would view our four systems.

"You know," he said at last, "this is the first time we've worked together on something."

"Keep that between us," I said. "I don't want my reputation ruined."

He smiled. "I told you extrasolar Earths were more interesting than hot Jupiters."

"Shut up."

Groans erupted from the group. I rose from my seat and tapped the tall one on the shoulder. She turned to me, and I saw the source of their attention: the very small monitor of a palmtop displaying zigzag lines of black and white static.

"Catching the latest cosmic microwave background radiation?" I asked.

The astronomer stared at me down her long nose and flipped a length of curls over her shoulder. "You're the ones from *Toronto*, aren't you?" From the tone in her voice, she might as well have been asking if we were from a pigsty.

I glanced at her nametag. "At least we're not from *Newfoundland*. What're you watching?"

A few of them moved back so that Shakir and I could join in and get a good look at the palmtop.

"Every telescope in working order on Earth, around Earth, on the Moon and Mars is now pointed toward the alien-inhabited exoplanet in the EPH1889 system, naturally," she said. "And I've clearance with several of those." She put emphasis on this as if this made her more important than all the other astronomers around her. "We're watching live images as the Shirt tries to pick up signals in the television frequency from that very planet."

The Shirt was the SHRT—Sawyer Hogg Radio Telescope.

I stared at the static. Nothing was happening, and just as I turned to leave, someone gasped and was shushed.

The static had become an image of two aliens in conversation. I held my breath and absorbed everything before my eyes. The aliens were brown-skinned humanoids, with all the appropriate limbs and features and eyes etcetera that we had; only their foreheads were high and ridged. Both aliens had mangy black hair to their shoulders. Black suits were their chosen attire, with some sort of chain mail belt slung diagonally across their shoulders and torsos. They stood

in a beige, well-lit room in front of metallic panels on which several yellow and red LEDs flashed.

"Turn it up," one of the astronomers said.

The aliens spoke to one another in a harsh, halting language that I did not recognize as any on Earth. A pair of doors slid open then, and in walked a third humanoid. He was shorter, bald and might have resembled any ordinary white-skinned human wearing a red and black spandex bodysuit. A triangular swoosh-shaped metal pin was fastened over his left breast. In fact, except for the peculiar clothing I saw nothing alien about him.

Static overcame the scene and everyone in the cafeteria started cursing the palmtop.

"Hey!" Shakir said. "That's the best part of the episode. The Klingons were just about to capture Patrick Stewart."

"Who is Patrick Stewart and what do they want to cling on to him?" I asked.

"He was the star of a late-twentieth-century series called *Star Trek: The Next Generation*, in which he played the captain of a spaceship that explores the galaxy. Those 'aliens' were just humans in makeup."

"So the extraterrestrials are pirating our campy science fiction shows."

"It isn't campy."

"A prank." The Newfie sniffed with distaste. "It has to be. I cannot accept that was truly the Shirt's transmission."

Eleven a.m.: Despite the complete mess in my cell, I was unable to sleep that morning. I tossed and threw my blankets off the bed, staring up at the Hertzsprung-Russell diagram

stuck to the ceiling, feeling that somehow I had missed something. The pinholes nagged at me. I needed to get a new poster when I returned to Toronto.

Eight p.m.: Shakir and I went over our plan of attack once more together, and decided to look at our four exoplanets in order of the age of their stars, starting with the youngest. We would only take the spectra of the larger of the two extrasolar Earths, not having time for much else. Those were the ones most likely to have life. I was tired from little sleep, but the sheer adrenalin pushed me through. The hour of the BST was almost upon us.

Nine p.m.: "You have the coordinates, the information, everything ready?" I asked him as we took our seats at the BST's control computer. Our area, for visiting astronomers, was sectioned off from the main control room. Though we could see it from the glass, they would not be able to overhear us.

"Of course I do," he said.

"I got the reading material." I set down my pile of Post-It-note-marked textbooks on atmospheric physics and astronomy. I had come prepared to reference anything that might come up. Who knew what other chemicals aliens might produce?

"All right," I said, "first the system TOB1546 with the T Tauri-type star. I don't expect aliens on this one." T Tauris were young and violent stars, known for ejecting spurts of radiation into their systems. Both the youth of the system and the radiation were good reasons to doubt that they harbored life. "Well, aliens like us, anyway."

Shakir handed me the keyboard. "You take this one."

The BST's control program was familiar to me because I had been given practice sessions since we arrived at the Beast's headquarters yesterday. It was a simple matter of giving the Beast the proper coordinates and deciding on what type of exposures to take. I typed in the orders quickly. Though the coordinates required some adjustment and the first spectra did not turn out so well, in a matter of a few minutes I got it working.

With Ingrid's help before I left Toronto, we had been sure to verse ourselves well in the signatures of certain anthropogenic compounds in the blackbody spectra, and I saw none in TOB1546's extrasolar Earth.

"Mostly hydrogen and helium, two to one ratio," I said. "Pretty pedestrian stuff. Makes sense that the primordial atmosphere of a terrestrial planet would resemble that of its sun. Next." I passed him the keyboard.

The second system was that of a main sequence star, though one a few billion years younger than our sun. Calmer and older than the T Tauri, but still too young to support evolution as we knew it.

I was correct. This planet's atmosphere was mainly water vapor, carbon, and sulphur dioxide.

"Like the composition of volcano vomit," I said, turning open the appropriate page in an atmospheric text.

"Bu no life still," he said. "Your turn."

"No, you take this one too." I thumbed through the book a little more to be sure.

"I can't believe this," he said. "Mei giving up a turn at the controls?"

"I'll just take the last one," I said, "the system with the main sequence star that's about to go red giant, SWH1942. Now that'll be interesting."

Our third solar system had a star that was just a hundred million years younger than our sun.

"If any of our four systems have aliens," he said, "it should be this one."

He took the blackbody spectra, and we immediately began to flip through my atmospheric books to do a quick in situ analysis of the absorption lines. We saw water vapor and carbon dioxide and tantalizing traces of ozone, but nothing that could be described as anthropogenic.

Earth's atmosphere was composed mostly of diatomic oxygen and nitrogen, both of which were unreactive species and hard to see in absorption lines. Ozone, however, was the product of ultraviolet rays striking diatomic oxygen. Where there was ozone there was probably diatomic oxygen, and where there was diatomic oxygen there were probably:

"Plants," Shakir said.

"We can't be sure," I said. "I need to show these to Ingrid, maybe even a biologist or two."

"Earth's is the only stable atmosphere in our solar system that has more oxygen than carbon dioxide," he said. "Why is that? Because of plants." He grinned widely. "We've found our own aliens. Not industrialized, intelligent aliens. Brainless, plantlike things, but we have them!"

"Or they're smarter than us," I said. "Perhaps they're industrialized, but don't crap in their atmosphere like we do. Great, so now you and I will go down in history as the second people to discover extraterrestrial life."

"But our aliens are better than the CFC makers on EPH1889. Our aliens are environmentally conscious *and* they don't pirate our television."

Suddenly, I remembered the pinholes in the Hertzsprung-Russell diagram over my bed and it all made sense. "Many theories say that our sun was once a T Tauri star in its youth," I found myself saying, pulse quickening, "and during that period the Earth's primordial atmosphere was made of hydrogen and helium before it all got blown away by the young sun's radiation. Then it was replaced by a second atmosphere spewed out from the Earth's interior. The suns in our five systems trace the evolution of our sun." I seized his shoulder. "Shit. The aliens are us."

"How?"

"Those aren't other planets, but ours in the past, somehow, snapshots in time. They watch our classic television, pollute with our old chemicals, and their sun's younger." I pointed to the T Tauri system TOB1546 with a shaking finger. "Primordial Earth, I'm sure of it." I move my finger over the second system. "Earth before life begins." And the third. "Time of the dinosaurs. As for EPH1889? Late twentieth century, maybe early twenty-first depending on how long your cling-on show aired."

"Are you sure?" His eyes widened. "This defies everything: string theory, high-energy physics, the whole of astrophysics! Is this from exotic worm holes, cosmic mirrors, what?"

"Yeah, something like that." Reading over those cosmological papers before I had left Toronto was turning out to be useful after all. "You know how the universe is folded in on itself, that it isn't flat in space? Well, what if time isn't flat either? We could be observing the echoes of warped time that turn all of space into a crystal ball. It'd return images of ourselves at certain points in space."

"But we're no Einsteins," he said.

"No, we're Michelson and Morley. Damn! There could be more systems out there than these five. There could be thousands, mapping out the entire course of our history to us like insects trapped in amber."

"We've seen the past," he said, drawing back. "Just SWH1942 left. Their star is about to inflate into a red giant. That solar system, *our* solar system, is dying."

"Humans mightn't even be left on Earth!" I cried. "They could've moved to the dwarf planets to prepare for the doom, or escaped to another solar system. It's billions of years from now; we better have mastered interstellar travel. Maybe there're still stragglers left on Earth, and the Sun's about to eat them."

"Should we even dare to peek into the future and see what it holds for humanity?" he asked.

"Sure," I said, punching in the coordinates. "Let's take a look."

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Novelette: **THE ROBOTS' GIRL** by Brenda Cooper

Technology can satisfy many human needs,
but can it satisfy all?

The door's silent slide still surprised me, even after Aliss and I'd been moving boxes into our new garage and piling them in unruly heaps for two days. Hair stuck to my neck as sweat ran down the small of my back and the backs of my knees. Our real estate agent had told me it never got hot here, but apparently she lied about the weather as easily as she lied about the closing costs. So we were too broke for household help and hot from humping boxes. But we were here.

Home.

And done working for the evening.

I gathered up a cold beer from the gleaming fridge, which opened and closed for me the same way the front door did, eerily quiet and efficient. I'd grown up with doors you opened and closed with human muscle. My last house had been built green when that meant saving energy instead of producing it. Trust humanity not to waste anything free when you can use a lot of it.

The high ceilings and three tall stories made the house seem like it yearned to join the cedar and fir forest. It made me feel like a pretender. We'd bought here, across the lake from Seattle, with returns from a few good investments and a

dead aunt. The sliding door opened for me (of course). It allowed me outside onto a deck that glowed honey-colored in a late afternoon sunbath. No matter how pretty the deck and the house and the forest around us, the woman on the deck was prettier than all of it. Aliss'd caught her dark hair up in a ponytail that cascaded almost to her waist, thick as my wrist both top and bottom. Sweat shined her olive skin, and she smelled like work and coffee and the rich red syrah she held in her right hand. She pointed at the neighbors, a good three house-lengths away from us. "In five minutes, I've seen two humanoid bots over there."

"So they're rich. Maybe we can borrow one for gardening." Not that I minded gardening; dirty nails felt good.

"There's another one."

The curiosity in her voice demanded I stop and look. A silver-skinned female form bent over a row of bright yellow ceramic flowerpots on the deck outside the three-story house, plucking dead pink and purple flower-heads from a profusion of living color, dropping her finds into a bucket as silver as her hands. I sucked down half the beer, watching. Counting. Three bots. One outside. Two or three little ones moving around the house, the ones that didn't look like people. Families in our newly acquired income bracket might have one of the big humanoid ones, but only if they needed a nanny more than flashy cars or designer clothes. Maybe a handful of robovacs and robodisposers and robowashers, like the ones sitting on a pallet in our garage right now.

"I haven't seen any people," Aliss mused.

"Maybe they work."

Her eyes stayed narrow, her jaw tight and jumping a little back by her ear, and she rocked back and forth on the balls of her feet. I knew what that meant. "Guess we're taking a walk."

"Got to meet the neighbors, right?"

I'd actually been thinking about sliding into the hot tub naked and having another beer. But this was our first house together, and I wanted her to be happy. "Let's go introduce ourselves."

Our driveway gave under our feet, the heat drawing up a hint of its origin as old tires, but not so much it overwhelmed the loamy forest dirt spiced with cedar. Aliss and I turned onto the road, hand in hand. Meeting the neighbors started to feel like a picket fence, like something my mom would do. We turned off the road onto their driveway.

Red light lasered across our bare shins. "Stop now."

Aliss drew in a sharp breath and squeezed my hand before letting it go and freezing in place.

"State your business." I followed the voice to a spot about fifteen feet in front of me and about knee-high. The guardbot was the same pebbly dark color as the driveway, cylindrical, with more than two feet, and not standing still, which is what kept me from counting feet. This bot was neither pretty nor humanoid. In fact, a bright blue circle with a red target stickered in its side screamed weapons.

I talked soft to it. "We're the new neighbors. We came to introduce ourselves."

Its voice sounded cheerfully forced, like a slightly tinny villain in a superhero movie. "Aliss Johnson and Paul Dina.

Twenty-seven and twenty-eight, respectively. You have been here for precisely sixty-seven hours..."

I waved it silent before it got around to checking our bank balance and running us off entirely. "So, then you know we're harmless. We'd like to meet your owners."

"They are not home."

Aliss still hadn't moved, but she asked it, "When will they come back?"

It turned a full 360, as if someone else might have snuck up behind it, and then said, "Please back up until you are off the property line."

We backed, all the nice warm fuzziness of being in a new home turned sideways. After we'd turned away from the house and the bot, my back itched behind my heart. I whispered in Aliss's ear, "Not very nice neighbors."

She grunted, her brow furrowed.

"Maybe we should jump in the hot tub."

She gave me a pouty, unhappy look. "They were watching us."

I didn't remind her she'd been watching them. I just hugged her close, still whispering, "This is our first night here. Let's enjoy it."

She stopped me right there in the middle of the road, at the edge of our own property line, and nuzzled my neck. When she looked up at me, the slight distraction in her gaze told me I wouldn't have all of her attention easily. I made a silent vow to figure out a way to get it all and started my devious plot by sliding my hand down the small of her back

and pulling her close into me. We walked home with our hips brushing each other.

The next morning, warmth from her attention still lingered in the relaxed set of my shoulders and the way my limbs splayed across the bed like rubber. Birds sang so loudly they might have been recorded. I tried to separate them, figure out how many species must be outside.

"Honey?" she called. With some reluctance I opened my eyes to find Aliss standing on the small deck outside the bedroom, one of my shirts her only clothing. Fog enveloped the treetops outside our third-story window, tinting the morning ghostly white and gray. "Will you come here?"

Since she was wearing my shirt, I pulled on my jeans and joined her, drinking in a deep whiff of us smelling like each other. Although we couldn't see the house from any of our windows, the deck had a nearly direct view into the robot-house's kitchen, the fog and one thin tree-trunk the only obstructions. Three silvery figures moved about inside a square of light that shone all the more brightly for the fog.

I put a hand on Aliss's shoulder, leaning into her. "Since robots don't need food, there must be people there."

"Don't you see her?"

I squinted. At the table, a girl sat sideways to us, spooning something from her bowl into her mouth. She wore a white polo shirt and brown shorts, and her blond hair was curled back artfully behind her ears and tied with a gold bow. She belonged in a commercial. Across from her, one of the robots appeared to be holding an animated conversation with her.

"How old do you think she is?" Aliss asked.

She still had a child's lankiness and a flat chest, but she was probably near as tall as Aliss.

"Ten? Twelve?"

"She's alone."

"You don't know that." Although her observations were often uncanny.

"It explains the nasty bots. They were protecting her. But it's not right."

"Her mom or dad will show up any second."

Aliss crossed her arms over her chest and gave me the look. "No cars, still. No movement except the girl. No other lights on. She's alone. It's a crime to leave a girl that age alone."

I glanced back at the window, where one robot was clearly conversing with the girl and another was bringing her a fresh glass of juice. "She's not alone."

All I got for that was the look again. I tugged her close to me. "Come on, let's eat. She must have parents."

"I hope so." Aliss let me pull her gaze away from the bright square of window and its even brighter occupants.

* * * *

Days later, we sat on new recycled-sawdust Adirondack chairs we'd ordered for the bedroom deck. The table between us held two coffee cups and two pairs of binoculars and a camera. Aliss hadn't moved from her chair for two hours. She worried at her beautiful lower lip. "No parents. No people. Not for five days."

"They'll come." Not that I believed it any more. "Maybe there's someone living there who never comes into the kitchen."

"That's lame."

"I'm reaching. I want my girl back."

"Don't be selfish."

At least she had a little tease in her voice when she said it.

We met the neighbors—not at the robot house, but across the street. William and Wilma Woods. Really. They were at least eighty. Their kids hired bot-swarms to clean up their yard for them, but obviously did nothing for the inside of the house. The Wood's probably couldn't see well enough to tell if there was a purple people eater living in the robot house, and when we asked about it, William pulled his lips up into his hollow cheeks and said, "The new house? I dunno who lives there. We don't get out much."

He meant us. We lived in the new house.

The house on the other side of us from the robot house stood empty-eyed and vacant, with a traditional security system that included signs and warnings of proximity detectors. Forest took over for half a mile on the far side of the robot house before it yielded a barn-shaped house next to a barn with a corral and three swaybacked horses. The offbeat collection of direct neighbors made me wonder if we'd picked the right house to buy. The robot house was clearly our problem, at least in the world according to Aliss. And since she was my world, it mattered to me. In fact, after days of watching the little girl play ball with robots and eat with robots and study at the kitchen table with the help of robots,

I was beginning to worry all on my own. Surely the kid needed a mom or a brother or a dog or something. Something warm.

I have some skill with the nets, but all that got me was frustrated. A holding company owned the house. A public company owned that company and a few hundred more. It spread wealth—a lot more than this house—through thousands of shareholders. Not a very unique tax dodge for second or third homes. All it told me was the girl or her family—or the freaking robots—had money. Which I already knew. I gritted my teeth and kept plugging while Aliss brought me coffee and rubbed my neck. We saw the girl bent over the table studying every day, but I couldn't find her in public school, online or offline. No kids of her description had been reported missing anywhere in the country.

We unpacked the house, all except the pallet of robostuff, which Aliss steadfastly ignored, and two boxes of art too lame for the new house.

The third week, I woke up in the middle of the dark and texted a friend in the reserves, who brought his night vision goggles. She was warm—and alone. Human.

Satellite shots from the city never showed a car, although they did show the girl out playing robot ball twice.

Aliss made up names for her (Colette, Annie, Lisa, Barbie) and drew her picture. Not that we didn't do our jobs (me, investing advice; her, marketing), or make dinner, or make love. But the spare time that might have been nights out or movies all went to the robots' girl.

It wasn't like we wanted kids. But she started to haunt our dreams for no good reason except that we were human and she was surrounded by beings that weren't. We walked by the house at least once a day. Always we saw the guardbots. There were three of them. One too many for the two of us. Or maybe three too many. We hadn't degenerated into breaking and entering. After all, the robots' girl laughed and played. Her hair was neat and her clothes ironed.

We walked and watched almost every day. Delivery trucks came and went from time to time, but no regular cars stayed, no friends, no family. Just groceries and occasionally bags or boxes that might hold shoes or clothes or books.

* * * *

Fall began to cool and shorten the nights. We were on our lunch break, walking out with the first yellow and orange leaves scrunching under our feet, the sky a nearly purple blue above us. After we passed the house and entered the stretch of forest on the far side, Aliss was silent for a long time before she said, "She's too good. A kid her age should play tricks and make faces and all that stuff. She doesn't do that."

"Do robots have a sense of humor?"

"Shit. She's been like this forever." Her voice rose. "I keep hoping her mom is on vacation, and she's coming back. She's not. The robots really are raising her."

She fell silent, her feet making soft sliding steps on the road, her breathing faster than it should be for our pace, her lips a tight line in her face. "I'm going in."

"A little melodramatic, aren't we? You sound like a TV cop show."

She swung around in front of me and stopped, blocking my way, head tilted up toward me. "It's like she's in jail. But she doesn't know it. What if they've raised her forever? What if that little girl doesn't know what a human hug feels like? What if . . . what if she thinks she's inferior to those robots? What are they teaching her?"

"Shhhhhh." I took her shoulders lightly. She felt like a bird. "We have to keep perspective. Not get thrown in jail for breaking and entering. The cops won't even go in—you called them."

She stared at me, eyes wide, then snapped her mouth shut.

"I'm sorry, we can't. There's nothing illegal about robot babysitters."

"They're not babysitters." She thumped her fists against my chest and her breath overtook her ability to speak and she actually quivered.

I pulled her in and stoked her hair. "We have to find another way."

She leaned back and smacked me again with her fists, hard enough it stung a little, might leave a little bruise. "You just don't care!" Now she was hissing at me. Not screaming in case the damned robos heard, but she wanted to, the sound building up in her and coming out in shakes and deep out-breaths. She looked deep in my eyes, probing me, looking for something.

Whatever it was, she didn't find it. She turned and stalked up the street, stiff-backed, unbound hair flying behind her, her shirt the only yellow in the green and gray and black and brown of the forest.

I should have chased her. But I was trying not to laugh; Aliss seeing me laugh would have been worse than me standing there holding it in. Not that it was funny. She'd just overreacted so much it didn't seem real. Two minutes before, we'd been walking happily beside each other.

I didn't move until she was opposite the house. I should have chased her, should have run as fast as two feet can go. I should have known she meant exactly what she said.

While she hurried up the road, arms-swinging, I stood still, trying for emotional control. She turned sharp left at the driveway and kept stalking, heading for the front door. She was small then, far enough away I could see her but couldn't expect to run up and catch her. She looked beautiful and terrible, brave in the face of her stupidity.

One bot moved in front of her, the line of its squat body hard to make out except when movement gave it ghostlike visibility. Another one seemed to float toward her, its body easier to see as it moved between me and a green hedge starred with small white flowers.

I shook myself loose and bounded toward her, waving my hands over my head as if the guardbots would decide I was more threatening even though I stood on a public road and Aliss was doing a full frontal assault.

They ignored me.

Red lines illuminated her jeans, bisected her knees, her calf, above her ankles.

I raced all-out, finally driven to ignore the property line.

She stepped onto the front stoop and jerked, then collapsed, her long hair a curtain across her face. I almost made it to her side when I felt the sharp jolt of a stun gun and my mouth was too busy being stiff to let out my curse. I went to jelly, crumpling just too far away to touch her. I didn't lose consciousness, but my head had a muzzy shockiness and my body didn't really want to move right away, even though my heart was willing.

The guardbots withdrew a respectful distance.

The door opened.

A silver form in Dockers and an Izod t-shirt bent down and gazed at Aliss, an inquisitive expression on its face.

The guardbots whirred off, surely going back to watch for more nosy neighbors.

Aliss sat up, looking the robot in the eyes, which were like tiny camera-irises set inside lids with no lashes. From the distance of our third-story porch, their eyes had looked nearly human, but here the emotion came from subtle changes in the shape of the smooth, silver face. Robos can come with human-colored skins and rose lips, and blond or dark or even gray hair, but whoever chose the bots for this house liked them to look like science-fictional beings. I'd seen similar models up close at home shows, except they'd looked even less real, maybe because people in bad suits were selling them like refrigerators.

This one had an air of authority.

"You were trespassing," it stated convincingly. It glanced at me, as if making sure I knew I was trespassing too.

I nodded at it. "Sorry. We're the neighbors."

"Yes." It looked back at Aliss. "We have been watching you watch us. That's why Jilly told the bots not to kill you."

Good for Jilly. I struggled to sit up, pulled my hands under me, folded my legs, and noticed my back hurt.

"Is Jilly your little girl?" Aliss asked.

For just a moment, it looked like the robot couldn't decide what expression to wear. "Jilly is our head of security. I am Roberto."

I managed not to laugh. I stood up, happy to be above him. "Glad to meet you." In spite of the fact that he was a machine, his authority felt absolute. "We came to visit. The girl who lives here, she must need friends."

I was rewarded with a sweet look from Aliss, who took my hand, and also took the half step or so necessary to keep it naturally. A man and his girlfriend, standing together on borrowed ground on a quest for warmth and humanity for a single little girl.

Roberto stood, too, half a head taller than me, a full head taller than Aliss, and a lot shinier. Roberto seemed to gather himself up, or maybe align was the right word, like coming to perfect parade rest, making every bit balance just right. There was no blame in his smooth voice as he said, "I presume you mean human friends?"

I was clearly out of my league. "We see she's taken care of," I stammered.

Aliss put some serious pressure on my foot. "Can we meet her? Please?"

"She will be finished with her classes in three hours. Would you like to come back after that and join us for afternoon tea?"

"Uh, sure."

Aliss let up on my foot. "Thank you, Roberto. We appreciate the offer."

As we walked hand in hand up the driveway, the guardbot ignored us, a dark rock-colored splotch the size of small dog, turning around and around softly at the base of a deep green rhododendron bush.

We went in through the garage door. I eyed the pallet of robowhaters in various states of repair. Aliss pecked me on the cheek. "I'm going to go get ready. Why don't you see if you can find a good vac?"

I blinked at her, startled. "Sure." It took me almost an hour to free three robovacs, test them, and decide which one had a prayer of actually cleaning the floor. The one I eventually chose wasn't silver, but rather a rounded bump of burnished wood with rubber edges and a long scratch from one time when it slammed a wall hard enough to knock a glass vase down on its back. I squatted and rubbed its familiar top, talking to the damned thing as if it were a dog or something. "You're sure a whole five or six generations removed from the neighbor's bots, aren't you? That silver thing over there might be the brightest crayon in the box, but I kinda like you."

It made no reply.

I carried it up the steps from the garage, fifteen pounds of robot tucked under my arm. When I opened the door, the scent of warm molasses lifted my spirits. I put the bot down carefully, noting that it looked even more beat up in the gleaming kitchen than it had in the garage. I patted its back, then stood and curled my arm around Aliss's lovely stomach and kissed the top of her head. "Thank god Jilly let us live so you could make cookies for me."

She swatted me with a kitchen towel. "The cookies are for the girl. I wasn't worried about the guards. They knew we were neighbors. I mean, we might have been borrowing a cup of sugar, right? It wasn't like they were going to shoot us."

I decided to take the high road and ignore the fact that they had shot us, changing the subject by stealing a cookie. The cookie became a rock in my stomach. We were returning to the place that had tasered us on purpose. No matter what the rest of me thought, my body didn't like it.

Aliss freshened her makeup and pulled on a clean blue shirt before we walked over, carrying her offering of cookies carefully.

The silver gardenbot I'd often watched tending the flowers was outside raking up the few leaves that had dared to fall on the perfectly square lawn in front of the house and depositing them in a red plastic bucket. She straightened as we approached, clearly the sentry designed to watch for us. One of the guardbots sat at her feet like a dog. The other two were nowhere to be seen. When the door opened, I expected Roberto.

Instead, the girl herself opened the door. She was a head shorter than Aliss, and thin, but with muscle on her arms and legs. She was dressed in a schoolgirl uniform; Dockers and a white shirt, green tennis shoes, and green socks. The bow in her honey wheat hair was green this morning. Her wide-set eyes were a startling blue flecked with gold and black. She looked poised for her age, which was probably eleven or twelve. She had the barest hint of hips and breasts, but was still more a promise of a woman than a real one. What mostly struck me, though, was that she had almost as much emotion as the robots.

No kidding.

The silver female holding the broom had on a welcoming smile and stood in a relaxed posture, one arm leaning on her rake. The girl at the door looked blank. If I had to define a look on her face, I'd have said fear. But it was a ghost of fear, governed by control. The kind of look you see in executive's eyes during a stock fall, or a politician's eyes on a tense election night.

Aliss didn't react to the fear, but held out the plate of cookies and she smiled. "Hi! I made you cookies. Can we come in?"

The girl didn't take the cookies. "Roberto asked me to guide you in." With that, she turned lightly, pivoting on the balls of her feet, and led us through an open entryway lined with pictures of humans and up a wide set of wooden stairs to the kitchen. She didn't look at us again until she sat at the kitchen table and tipped her hand toward us, as if asking us to sit. The kitchen felt warm and inviting in spite of her cool

appraisal and the silver beings hovering by the sink. The walls were peach and brown with light charcoal accents, and the table was a polished cherry with small woven cream mats at each place. Our seats were obvious: there were three places with silverware and glasses already full of water, and the girl was already in one of them with her hands folded in her lap. Everything—the house, the girl, the robots—it all belonged in an upscale 'zine, and it all made me feel a bit like a visitor in a museum.

Aliss set her tray of cookies down in the middle of the table, still fresh enough to give off a strong scent that made my mouth water. She looked at the girl, clearly yearning to say something to her, but she managed to hold off and just sit beside me, the two of us assigned to be opposite the girl and able to look up at our deck.

A fembot handed Roberto a wooden tray with a sage-green clay pot and three small Japanese-style teacups on it. She wore a white sundress and blue sweater that probably came from a Nordstrom catalog. Roberto nodded at her, said, "Thanks, Ruby," and delivered tea and a small plate of pale, thin cookies to the table. He glanced at Aliss's offering, her cookies fat and homey next to the robots' cookies, and simply said, "Thank you."

The combination of feeling so out of place and the absurd thought that Roberto looked like a protocol droid from old movies almost made me burst out laughing, stopped really only by the sheer earnestness of the girl and her green bow.

I curled my fingers around the teacup and sipped slowly. Warm, but not too hot. Minty.

Aliss succumbed to the girl's silence and said, "Thank you for having us over. We're pleased to meet you. My name is Aliss, and this is Paul."

"I know." She swallowed, as if unsure how to talk to us.

The silence stretched until Aliss filled it. "How was school? What are you studying?"

One side of the girl's mouth rose in a quirky grin. "Today's physics topic was gauged supergravity."

It didn't faze Aliss, who probably recognized the term about as much as I did—which was zero. She plowed forward. "What about English or art? Do you study those, too?"

The robots' girl nodded. "Of course." Then she stopped, and the fear came over her features again for a minute and was gone. "We didn't invite you here to talk about me. I would like you to stop watching me."

I blinked and Aliss flinched.

The girl continued. "I can see you from here. I am not happy there is a house there, or that you can see me from your deck. It makes me uncomfortable and I want you to stop."

She looked directly at us, her tea untouched. She hadn't taken either kind of cookie.

Aliss licked her lips and the ear end of her jaw muscle jumped, but otherwise she looked smooth and unruffled, a trait she'd learned from dealing with irascible marketing clients. Probably that wasn't much different than dealing with irascible preteens. She leaned forward. "We're only watching you because you seem to be very alone. We don't need to

keep watching. But would you like to come over and see us some afternoon? We'd love to show someone our new house."

Roberto stiffened, if a robot can be said to stiffen. Emotion doesn't really exist for them; they're programmed to pretend. But he became a bit taller, and a bit more imperious.

The girl glanced back at him as if asking for advice, and he inclined his head ever so much as if to say, *Go on, you're doing fine.*

She looked back and Aliss and shook her head. "I really just want you to stop. Will you promise me?"

Alice chewed on her bottom lip.

I couldn't take it anymore, myself. The very air in the room had become awkward. This was a kid who didn't want to be watched, and I got that, understood that maybe we'd seemed like voyeurs. Heat bloomed on my cheeks. I wanted to make her more comfortable. "All right. I'll stop watching you."

Aliss shot me a look that said she wished I'd let her handle this, and I reached for one of the pale cookies and nibbled at the edges. Vanilla and sugar, with a touch of flour and egg to keep it all together. It melted in my mouth.

I looked back at the girl, who nodded at me, her humorless eyes fixed on my face. She reminded me of a doll. I wanted—needed—to see her smile. "I'm sorry if we upset you. We didn't mean to." I paused, and when she didn't say anything, I asked, "Would you tell us your name?"

She closed her mouth and glanced back at Roberto and then at Ruby.

Apparently neither of the robots were willing or able to guide her here. She looked down at the table and mumbled, "Caroline."

"Pleased to meet you, Caroline. Would you like to try one of Aliss's cookies? They are my favorites."

She shook her head. "I can't eat things that strangers make." She stood up, raising her voice for the first time. "Go now, please. Please go."

Aliss flinched, as if Caroline's words were little darts.

I stood and took her hand, whispering, "It's okay." Then I looked at Caroline and said, "We would very much like to talk with you again soon. We don't mean any harm, we're just used to knowing our neighbors." A flat-out lie, but how would she know?

Caroline nodded and spoke to Roberto in a quite commanding voice. "Please see them out." She turned again, her back to us, gliding gracefully out of the room and down the stairs, while Aliss and I watched her, openmouthed.

Ruby followed her.

Roberto nodded at us. "I will lead you to the door."

Aliss picked up her teacup and mine and walked to the sink very deliberately, setting the cups down. She turned and said, "Thank you for your hospitality." Then she smiled very sweetly at Roberto and winked at me. "Can I leave her a few cookies? I can leave an extra one so you can test it for poison."

"That really won't be necessary."

Aliss sounded human and hurt, a little snitty, and Roberto sounded even and quite sane; not human at all. I picked up

the plate of cookies, shocked silent and deep in thought. As Roberto opened the door and stood to the side, clearly waiting for us to pass through, I asked him, "Were you hoping we would be good for her, or that she would chase us off herself?"

His silver mouth stayed in a tight, firm line, but then he winked at me. Because he had seen Alice wink? Because he meant yes to one of my questions? Because he had something in his eye? I didn't think we'd get back here easily, but I also clearly didn't speak robot, so I led Aliss out and we walked carefully down the stairs. Even though I turned to look at the banisters and the corners, to get one more glimpse of the art and the too-perfect warmth of the place, there was no evidence of Caroline at all. Outside, we passed all three of the ugly little gray guardbots with too many feet. I finally got a count—seven legs each. Not quite spiderlike.

As soon as we returned safely to our own property, Aliss sagged against me. I had expected her to be spitting mad, but instead she had tears on her cheeks and she whispered, "Poor kid" a few times before letting me kiss the tears away and lead her up to the house. We stayed in our room that night, polishing off two bottles of Syrah and then making rather intense and distracted love that left us tangled in a sweaty mess on the big bed.

Near dawn, I woke up to find her sitting upright and naked, with her back to me, staring out the dark window, the only light a thin sliver of moon that hung between two tree branches. Her chest and shoulders heaved as she sobbed softly. When I reached for her, she wouldn't turn over and

face me. I rubbed my thumb and forefinger along the sides of her spine, making small circles on her back until I fell asleep again.

* * * *

The next morning, I woke to the smell of fresh coffee. Aliss sat at the kitchen table scowling. "Now I feel like I can't even go out on our own deck, and like I need to—to make sure Caroline's all right."

I poured my own cup of dark delight and stared out the window. We couldn't see the robots' house from here, but there were three fat squirrels jumping about in the trees. "She wasn't very nice," I said.

"It's just the age—I know—my sisters both went through it."

I was an only child and didn't remember being very surly at all. "Did you?"

"Probably." She sipped her coffee. "But I don't think you remember your own stupid years as much as the ones you get to watch. I thought my sisters had lost their minds. My mom used to say we needed her the most when we were teenagers. I think she was right."

"I don't see what we can do about it," I muttered.

"Caroline didn't say anything about parents. She must have some."

I walked up to the fridge, waited for the door to slide open, and rummaged for some bread to toast. "I have an idea."

She raised an eyebrow. "Oh?"

"Do you care what I do with the rest of the old robos?" Half had worked when we packed them, up, and most of the rest needed simple things like batteries or new wheel casings or new brain chips, some of which I'd planned on scavenging from the oldest and most broken. "I mean, now we really need to save for a real housebot, right?"

She threw her napkin at me. It didn't even come close, just fluttered to the floor. She frowned.

"Does that mean I can use them all for parts?"

"You can throw them all in the river, for all I care."

"The queen of eco wants to pollute the pristine waters of East King County?"

It took less than an hour for her to come down and start helping me. We opened the garage doors to let in a slight breeze and the pale light of a cloudy afternoon. We used the two bots I'd rejected this morning—one industrial red and one silver. I stuck a post in between them, and we picked off arms from gardenbots to attach for robo-arms and -legs. The head was easy; I had a round bot with colored lights that was born to be part of a martial arts game and already had a chain attached to the top. Aliss wound the chain around to be hair. As I looked on and winced, she glued the chain down. I hadn't played the game since I'd met her anyway. But I had liked it.

Just before supper, we heaved the bones of our screwed-together bot up two flights of stairs and positioned it on the end of the deck, in one of the Adirondack chairs. I crossed one leg over the other and balanced a colored plastic glass on the shear that served at the bot's right hand. Aliss positioned

some old augmented-reality glasses on its head and played with the cameras until she had them tilted just the right way. Aliss tapped it softly on its game-ball head and spoke solemnly. "I dub thee Frankenbot."

"Good choice."

She cocked her hip like a pleased teenaged girl and looked down at our ungainly multi-colored creation. "Do you think we need two?"

I winced. It had been my idea in the first place, but that hadn't made it easy. "Let's watch for a week or two. If we need another one, we can go to the junkyard then and get more parts. Let's see how she reacts."

We went down to the kitchen and switched the kitchen computer to show Frankenbot's view of the robot house while we played a word game at the kitchen table.

The next two days life went on like it always had, except we went to the kitchen instead of the deck, and drank our coffee in companionable silence, flipping between the news, the weather, and the neighbor's kitchen. We would have creeped me out, except I'd seen the flash of fear in Caroline's eyes, and I had to do something about that. Stopping a little kid from being scared wasn't creepy, even if part of what they were scared of was you.

On day three, we took our usual lunchtime walk past the robohouse. A soaking drizzle had come to town, so I wore blue wet-weather gear, and Aliss was toggled in a red cap and yellow rain poncho made of new nanostuff so slick the water collected in beads and rolled off, dripping off the end and landing on the toes of Aliss's shoes.

As we passed the robots' house, the silvery garden girlbot slid up to the very edge of their driveway. We ignored her and kept going, walking the half mile to normalcy and then turning around.

The bot still waited for us. As we came by, I waved at her cheerily. "Good day."

She spoke. "Caroline says no fair."

Aliss smiled sweetly at her. "We just admired you all so much, we decided we wanted a robot, too."

"That's not a robot." She was as shiny and perfect as Roberto or Ruby, but she moved a little less smoothly and she squeaked a bit when she turned her head right. Still, compared to her, our Frankenbot was sad.

Aliss cocked her head at the garden bot. "Would you like to come visit?"

The bot shook her head. "I have work to do here, and besides, Caroline would never let me go."

It felt a little bit like progress. We walked back home and jumped in the car and went into Seattle for a rare steak dinner. Over dinner we tried to decide if Caroline was raising the robots or if they were raising her. It didn't seem entirely clear.

* * * *

Nothing else happened for a few weeks, except we watched her through Frankenbot's eyes and she watched us back sometimes, and ignored us completely other times. Once, just as we came home, we caught sight of a black limousine that might have been pulling out from the robots'

house. But nothing seemed different that night, so we decided it had belonged to a different neighbor.

The stock market entered a period of steady growth with particular strength in nanomaterials, genetics, and animal cloning, so I had some free time (clients don't need as much when they're making money). I tinkered with the Frankenbot. One day Aliss found me there and stood staring at me for a long time before she said, "I've had it with robots. It's time for something with a heart."

We picked out a pound puppy, a lab mix with a yellow splotch on the tip of its tail and one yellow foot. It did a lot for the house, giving us poop and paw prints and puppy fur, making the place feel more lived in and noisier. We named him Bear.

Bear changed the nagging game of catch-Caroline's-fancy we were playing. After two days of walking the awkward and adorable Bear past the house, I spotted her peering through the window. She stood still, even when she saw me watching her, neither turning away nor waving. Two days later, in a patch of cool sunshine, she and Roberto tossed a blue ball back and forth on the front lawn while the gardenbot watched. They were there before we went by, and stayed out just until we passed back on our way in. Caroline pretended not to notice us, but she stood at the right angle to catch glimpses of us.

So began the ritual of us walking and them playing, always at the same time each day, just as the sun was highest and day warmest. We waved in greeting the first time we saw

them every day. The rest of the walk, we carefully focused entirely on each other and on Bear.

No parents showed up.

When Caroline was outside, the gardenbot and Roberto were always there. When she did her homework, Ruby was always there. Ruby brushed her hair every night.

After a day so rainy and windy that the idea of a metal man and a girl playing together in the rain made no sense at all (but they did it anyway), Aliss looked up at me while she was toweling off Bear's thick fur. "I think she's starting to trust us, but even Bear isn't enough to do the trick."

Bear licked Aliss's damp face dry with his wide, pink tongue. "I know," Aliss teased him, "It's not your fault you're not quite cute enough. I don't think anybody would be. I know you want to talk to her, too." She looked back at me. "We need to think of something she'll want to come over here to see. We have money."

I skipped my planned afternoon of deep market analysis and spent a few hours on the web, looking for a clever idea. I hadn't found one yet when Aliss called me down for our ritual watching of the night settling over the forest. We'd grown used to stopping work for half an hour and letting the day fade from view. We had a glassed-in first floor porch with a swing that was just the right size for the two of us and Bear. The window revealed the base of trees and about twenty yards of clearing we'd built by giving blood to blackberry vines as we chopped and tugged and sawed at them. The resultant clear spot often produced rabbits, squirrels, possums, deer, and once, a lone, thin coyote that'd stared at

us for fifteen minutes before simply disappearing when we blinked. This time, as the light faded through gold to gray, three does grazed placidly along the treeline, their white tails flicking up and down.

Aliss leaned into me. Bear whined very softly, low in the back of his throat, and circled.

The deer reminded me of an ad I'd skipped over a few times in my research. "I think it's time to decorate for Christmas."

"What?" Aliss snuggled closer to me, smelling of hot tea. "It's only November 2."

"Look, Frankenbot was a good try, but he's not mobile."

She gave me a quizzical look. "So? She likes him—I see her look up at him from time to time. And it's a way to watch her."

We'd actually stopped doing that much, since nothing really changed. I'd even added a way to turn his head to watch for birds in the forest canopy most of the time, instead of watching the untouchable and slightly sad Caroline and her family of silver beings. "Well, Bear has been more effective, since he gets her outside." I reached down and patted his shoulders, trying to calm him a little so he wouldn't scare away the deer. "But it's not like we can have a pony here, so upping the ante with more mammals probably won't help."

"Bear could use a friend."

"He might like what I have in mind."

Actually, he didn't.

I ordered and then programmed three deer: a buck, a doe, and a fawn. They were silver, as silver as Caroline's

housebots, and smooth even when they moved. A year—maybe two—more modern than the housebots, their coats silky and shiny, their eyes cameras (as all robots' eyes are cameras), but able to blink and move, and almost as soulful as a deer's actual eyes. To make it even better, they'd been programmed with natural movements, and given behaviors to make them appear shy and a bit wild. The first time I turned them on, the afternoon of December 7, Aliss stood beside them on the damp grass taking pictures, getting close ups of the remarkable wet-looking noses and the delicate ears.

I pushed the remote while standing at the edge of the yard.

The deer turned its head and nuzzled her shoulder. She jumped, then grinned and got them to follow her around in a line.

The first time Bear saw them, the hackles rose on the ridge of his back and he screamed bloody barking murder. We were so focused on the puppy, we didn't notice anything else until we finally corralled Bear. Aliss, firmly grasping the still-struggling puppy's leather leash, looked back at me and said, "Turn around."

Roberto and Ruby stood together at the edge of the fenced yards, regarding us silently. Roberto spoke. "Caroline thought something awful had happened to the dog."

Behind me, Bear howled again, and then the door clicked open, Aliss gave a hushed and insistent command, and the door slid shut again. "I think we scared him," I said.

Aliss came up beside me. "He'll be okay. But please tell Caroline we appreciate her concern. Tell her his name is Bear."

Roberto nodded and said, "She'll like to know that."

Aliss nodded. "Would you like to come in?"

They both shook their heads in unison.

"Please," Aliss whispered. "Please tell her she can come visit. Surely a little girl her age should go places sometimes."

One of the silver deer—the fawn—came over to stand on our side of the fence and watch the two robots, flicking its metal ears back and forth.

Roberto assessed it silently, but Ruby held out a silver finger to the beast, and if she weren't a robot, I would have said she was enchanted by it. She even smiled.

"She'd like to see the deer, wouldn't she?"

Roberto said, "I don't know."

Aliss put a hand on my shoulder. "Do you celebrate Christmas? Will she get presents?"

Ruby spoke for the first time, her voice silky, with natural human inflection. "Of course she will."

"From who?" Aliss asked.

"Caroline's telling us to come back," Roberto said.

So she could communicate with the bots even at a distance. I looked toward their house, but I couldn't see her. Perhaps she could see through their eyes, like we saw her through Frankenbot. "Please feel free to come back," I said. "Caroline, too, if she wants. We will not hurt her."

The robots left, and we went inside to calm Bear.

* * * *

The next day, Aliss left early so I took Bear for our noon walk in a blustery cold with tiny raindrops blowing sideways in the wind. Caroline waved back at me for the first time.

Aliss didn't return until just before our evening watch. She brought a needle and thread and a great big shaggy form with her and set the bundle on the table. I looked closely and managed to resolve the pile of fur into a stuffed dog. She sewed eyes onto it as the light faded from outside, and before full dark, I clicked on the electric light. "You need to see."

She cut the thread she had in her hand and held it up to the light. It was furrier than Bear, and wider, but clearly a dog. "Cindy helped me make it."

Her friend, who quilted and had a sewing machine. "It's for Caroline?"

"For Christmas."

The plush doggie sat overnight in the kitchen. Aliss took two cups of tea upstairs, and we sat together, looking out past Frankenbot and petting Bear. Aliss looked as beautiful as they day we'd moved in, maybe more so because of the fierce determination in her face. Somehow, she was going to win this lost girl over. I folded her in my arms, whispering, "I love you," feeling her breath and her beating heart, smelling the tea and the wet dog and all the things that made our house feel like a home.

In the morning, before she started working, Aliss tucked the dog into a cheerful red and green tote bag. When we broke for our lunchtime walk, she tucked the gift under her arm. It was cold and clear, the ghosts of our breath visible.

We paused to admire the three silver deer grazing in the corner of the front yard while a squirrel chattered at them from a tree branch. As we turned from our driveway onto the main road, we stopped suddenly, our feet stuck to the soft pavement. Even Bear, who growled low in his throat.

I thought about growling, too, but decided not to do it.

A long black car had pulled up into the driveway in front of Caroline's and the robots' house. Her parents? Had she hurt herself? Was she leaving? The idea made me happy and sad all together. The limousine must have just arrived since the hood still steamed in the cold air, and it must have come in the back way since they hadn't passed us.

The doors opened and a stooped old woman got out of the driver's seat. She went and stood by the door, looking at it expectantly. All three guardbots swirled around her feet, petting her like cats. The other doors opened all at once, synchronously, and three gleaming robots rose at once from the car. I recognized them from the same catalog we'd bought the deer, with the same "smoother-than-possible skin made of a million million nanobeings." They'd all been marketed as the next thing in robotic materials and lifelike movement.

The front door opened, and Ruby, Roberto, and the garden bot all walked out, all of them looking downright tarnished next to the new ones. If you looked at them by themselves, they gleamed. But the newer ones were brilliant suns.

Roberto, Ruby, and the gardenbot all looked sad. I thought of the deer, which looked happy even though they were neither happy nor sad, and reminded myself the robots

certainly weren't feeling anything at all. I had to be making it up in my head, and it was silly that I suddenly wanted to know the name of the gardenbot with her silver shears and red bucket.

Caroline trailed behind them. The look on her face drove me forward as far as the property line. Her eyes were red from crying. In the months we'd been watching her, luring her, worrying about her, she'd never cried. Not that we'd seen. She was tough.

The three new robots stood to the side, waiting. They gleamed. All of their clothes were new.

The three old robots slid down into the seats of the big car, smooth as butter, silken as silver, the move both simple and final.

Caroline buried her face in her hands.

Aliss let out a soft squeak of pain so deep it forced me forward, across the line and over to where the old woman stood beside Caroline, watching her, but not touching her. I had Bear with me, close in case the guardbots turned away from the old woman. Aliss followed by my side, her face as stricken as Caroline's. I didn't understand what was going on except the obvious; this woman was taking Caroline's family and giving her a better, newer one.

The woman herself had steel in her eyes, human steel. She looked at least seventy, slightly shrunken and bowed. But not a bit frail. I shouldn't have been at all surprised when she said, "Hello, Aliss and Paul."

I glanced around for Caroline and found her standing by the door Roberto had slid into, watching us and clutching the door handle all at once. It appeared to be locked.

I tried to keep as much control in my voice as possible as I looked back at the old woman. "And you are?"

"Jilly."

I'd heard the name. The first day we were on this property. "You're Caroline's head of security?"

"And you can tell us where her parents are." Aliss hissed over my shoulder. "And why she's been left all alone." Her voice rose enough to make me wince and feel proud all at once. "And why she can't ever leave, and she can't even pet the dog." She glanced down at Bear who was looking between Jilly and his obviously upset Aliss as if trying to decide who bore the most watching. "Why she can't come see our deer and can't even eat my cookies!"

The woman appeared nonplussed by Aliss's outburst.

Caroline's eyes had widened, but she said nothing. The fear in her eyes was worse than I'd ever seen it. Except this time she wasn't looking at me. Poor kid.

I took a deep breath and added to Aliss's list. "And why you're taking the only family she has."

Caroline yelled at me. "It's the deer. Your damned deer were better than Roberto and Ruby, and Jilly can't stand that."

She finally sounded like a preteen girl. But this wasn't the moment to heartily approve.

Jilly responded with a quiet and sure voice. "No. Your help gets upgraded every three years, and you know that. It's simply time."

"It's the deer," Caroline insisted.

I tried to sound calm, but my voice still shook. "They're Christmas decorations." She probably changed the robots because they came over to see the deer. I could still picture Ruby's silver finger reaching toward the fawn's silver nose.

"Does she ever see her parents?" Aliss demanded. "Do they bother?"

The seven-footed roboguards began to circle the old woman restlessly. She gave them hand signals and they stopped, all three of them between us and her. "You're overstepping your bounds. I have no legal right to kill you, but I can take any unleashed dog."

Aliss drew in a sharp breath.

A bright red light played along Bear's leash, just below my hand.

Caroline cried out, "No!"

"Then go in the house," Jilly said.

Caroline had to pass us to go in. Aliss handed her the tote bag. Surprisingly, Jilly said nothing, but allowed Caroline to take it into the house. The three new bots followed her, gliding even more smoothly than the old ones.

I looked at the woman and said, "When Roberto mentioned you, I assumed you were another robot. Now that I've met you, I wish my first guess had been right. You can't give her a family of robots and then take them away." My hands shook. Part fear, part anger. Of course, we should never have let it

continue. Calling the cops once shouldn't have been enough. The poor, poor kid.

Jilly's lips thinned, and for a moment she looked like all of the irascible old women I'd ever met. She probably had two thousand dollars worth of clothes on, and more in jewelry. Thousands of dollars worth of robots swirled around her feet. She looked like stone.

Allis pleaded, "Please. Leave the robots."

No change. But then something more vulnerable flashed across Jilly's eyes and the corners of her mouth softened. She took a deep breath. "Her parents are dead. They died seven years ago. Her grandmother pays for her care, and I take care of her grandmother. That's all I can do. There is no one else. If anything happens to either of us, Caroline could end up in the state's hands."

She waited, let us absorb this. Maybe the woman said this so we'd stop harassing her, maybe because it was true. She was old enough to be the grandmother or the friend of the grandmother. Between being raised by Roberto and Ruby or the State of Washington, it was a tough call.

Aliss's arm snaked around my waist. I'd had a few friends in foster care in high school. One had done well, gone on to college, turned into a lawyer. One had been raped and otherwise ignored by her foster parents and the state. Caroline was old to be adopted easily. And rich, apparently. The state might "need" her money. And even if well intentioned, how would they deal with a kid who knew advanced physics? Would they let us take her?

As if Jilly had been reading my mind, she said, "She is safe and halfway through her first bachelor's degree."

"But she's lonely," Aliss blurted out. "Can't you see that? Surely there's money? Look at this house! Hire people to take care of her instead of bots."

Jilly watched us for a long while and then closed her eyes, mumbling. I didn't see a communication loop across her ear, but her gray hair was thick enough to hide one. Surely she was talking to someone. In the meantime, the only movement was Bear trying to watch everything at once and the guardbots trying to watch Bear and us and the perimeter all at once. And us, shivering in the cool wind, which made the ten minutes before Jilly spoke seem like forever. "She had a live-in teacher until two years ago. She outgrew her capabilities, and the . . . circumstances . . . were problematical. Caroline is exceptionally bright, and she is doing better in this situation than in her previous one."

She sounded like she believed her words completely.

We stood silent. Surely Aliss felt as struck dumb as me.

"Caroline is scraping the bottom of the kind of complex physics and math that breaks old men's hearts. She does well with machine teachers."

"She has no friends!" Aliss blurted. "At least leave her Ruby."

Jilly stood and watched us, the guardbots floating in agitated tiny circles, drifting up and down, as if restless. At least they'd stopped targeting the leash.

Caroline's face was pressed to the glass in the second-story window, looking down at us all. She was crying again,

her eyes raking the car. In her arms, she clutched the toy dog Aliss had made her. I couldn't see Aliss's face, but I hoped she could see the girl with the dog.

"When did you change her keepers last?"

"I think you should leave now," Jilly said. She punctuated her words with a hand signal that caused the bots to scoot close enough that Bear started barking and snarling. We backed off, but I hated every step. This whole situation was an odd trap, for Caroline for sure, and maybe for us. We stood to the side of the driveway and gave the long black limousine plenty of time to pull away.

"Boy, I thought I hated this before," Aliss said. She wasn't crying, but she'd gone still and angry.

"Did you see Caroline with the dog? I think she likes it."

"I should have sewn in a nail file."

"Maybe. At least we have more information now. We best keep walking so Bear won't be deprived of his routine."

So we did. Keep walking. A bit sad. On our return trip, we looked up at the windows of Caroline's house, but she no longer stood looking out. The roboguards made sure we saw them, floating at the edge of the property, as menacing as the first time we saw them. My feet kept dragging, and beautiful Aliss looked far more disturbed than pretty. Although it took a long time, we made it home.

Even though it was still a few hours before dusk, we both gravitated to the enclosed deck, bundling up under fleece blankets and watching a light wind blow the lowest branches of the trees softly back and forth. It was too early for animals, so all we saw outside were birds; two crows and a

Stellar's Jay. Bear settled for his afternoon nap, and I stroked Aliss's hair and wished we'd never moved here, and never seen the robots' girl, and didn't know about the situation we seemed unable to do anything about. Once Aliss got up and made us both strong-smelling Chai tea, and once we let Bear out at his request, watching him avoid the silver deer like the plague while doing his business. When he came back in, Aliss patted him and held him close. "I hate robots, too."

"Maybe I should program the deer to walk over there tomorrow."

She laughed, a little sad. "I'd hate to see them torn up by the nasty bots."

"Yeah, me too."

We sat and watched the day slide into darkness, not stirring again until it grew too dark to see each other's expressions and Bear began letting out soft whuffs, asking for his dinner.

In the kitchen, habit caused me to turn Frankenbot's eyes toward the robot house. I'd almost reached up to turn the controls back when I noticed something different. "Come here, Aliss."

She was at my side in an instant.

A big square of something white—maybe butcher paper or poster-board—had been taped to the kitchen window. Words had been hand lettered on it. "You can sit on your deck now."

Did that mean we could use the deck now because she'd taped something over the window? Or what?

Aliss seemed more confident than I felt. She took a bottle of syrah and two glasses up the stairs. The door to the

bedroom deck slid open silently as we approached it and sat beside Frankenbot, sharing the empty chair. Aliss poured us each half a glass of wine. She raised hers. "To Frankenbot, who represents our first progress." She stroked Frankenbot's now slightly rusty head almost fondly.

I wasn't sure we'd made progress, but I sipped my wine anyway. I added my own toast. "To Roberto and Ruby and the nameless gardenbot."

Aliss laughed.

Below us, the paper from the window peeled back, and Caroline waved at us.

Two of the three new robots stood in the kitchen watching her with their shiny silver faces.

It was too far away for me to tell for sure, but I thought Caroline might be smiling.

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Reader's Department: **THE REFERENCE LIBRARY** by Don
Sakers

Prisons have been an element in science fiction ever since the evil goddess Issus tossed Dejah Thoris into that revolving jail cell at the end of *The Gods of Mars* (Edgar Rice Burroughs, 1918). More often than not, prison is a plot device, another obstacle that the protagonist must overcome on the way to the happy ending. The Good Guys are thrown in prison, where they must band together with other inmates and find a way to escape. (No, this isn't why science fiction is called "escape literature.") Escape from prison played a major role in Alfred Bester's *The Stars My Destination*. In the movie *Escape From New York* and similar tales, getting out of prison is the *whole* story.

In other stories, prison is part of the background, a deliberate element in the author's worldbuilding, with a specific impact on the shape of the story. This is often where we find the fine old concept of the "prison planet"—a sort of Australia in space, where criminals and dissidents imprisoned for life make a society, usually one that's superior in some fashion or another. In Heinlein's *The Moon is a Harsh Mistress*, the Moon is a prison planet that breaks away from Earth in a parallel to the American Revolution. In Frank Herbert's *Dune* universe, the Empire's harsh prison planet Salusa Secundus is a breeding ground for the Emperor's personal guard, the most vicious and feared fighters in the galaxy. *Alien3* and *THX 1138* are both movies in which

prisons, one way or another, are part of the background. The classic TV show *The Prisoner* was set almost entirely in one of the most bizarre prison communities ever conceived (and no, I didn't understand the ending either).

Then there are those rare sf stories that deal with prison as a concept, usually in the larger context of the moral nature of crime and punishment. In Anthony Burgess' *A Clockwork Orange*, for example, juvenile delinquent Alex accepts psychological conditioning as an alternative to prison time as punishment for his crimes. In "Coventry," Robert Heinlein had antisocial citizens given a choice between psychological adjustment or exile to an anarchist region separated from the rest of the country by an impenetrable force field. Robert Silverberg's story "To See the Invisible Man" (the basis for a 1986 *Twilight Zone* episode) substitutes psychological imprisonment for physical, having convicts treated as if they were invisible to others; similarly, in Melissa Scott's *The Kindly Ones* those who transgress the law are declared "dead" and become socially-invisible "ghosts."

Science fiction has come up with a number of other innovative ways to handle prisoners. Instead of a prison planet, one can play tricks with time: exile prisoners to the distant past, accelerate their personal time so that a sentence of many subjective years lasts only minutes or days objectively, or do the reverse and suspend their personal time by freezing or other form of hibernation (this last has been practiced everywhere from *Star Trek* to *Lost in Space*). Prisoners can serve their sentences in virtual worlds, robot or android bodies, or some high-tech variation of solitary

confinement. In the Red Dwarf episode "Justice," convicts suffer whatever harm they did to their victims.

Interestingly enough, the inmates in science fiction prisons are usually not the habitual criminals and incorrigible psychopaths that we imagine occupy present-day prisons. Oh, there are exceptions, truly bad people who usually get their just deserts by the end of the story—but most characters one encounters in sf prisons don't really belong there. If they aren't innocents herded into concentration camps, they are prisoners of war, political prisoners, or just plain malcontents jailed by an establishment that wants them out of the way. If they *were* actual criminals, they have usually reformed during their time in the slammer. On a prison planet or other prison colony, those who survive are deemed to have proven their moral worth by virtue of that survival. The hapless hero unfairly thrown into prison can always count on finding other unjustly imprisoned individuals as friends and allies. In fact, frequently the hero manages to organize these noble souls into a mass escape or rebellion against the powers that be. The heroic interstellar rebels of *Blake's 7* met on board a transport to the evil Federation's prison planet.

Why don't we see more hardened criminals in sf prisons, or stories dealing with prison-as-punishment-for-crime? For one thing, many science fiction stories implicitly accept the convention of advanced societies in which criminal behavior is regarded as a symptom of mental illness, which is treated or cured. This idea is made explicit in the classic *Star Trek* episodes "Whom Gods Destroy" and "Dagger of the Mind," in which two prison planets hold the mere handful of criminally

insane inmates who have not yet responded to rehabilitation treatment. Contrariwise, a repressive or totalitarian establishment can usually just execute hardened criminals or wipe their brains and set them to work in the mines (any respectable dictator always has a few mines around). Once you cure (or otherwise eliminate) all the true criminals, what you have left as prisoners are people who, one way or another, don't fit into your enlightened (or repressive) society.

Viewed in this light, the whole matter of prisons and prisoners can be seen as another expression of one of the overarching themes of science fiction (and, for that matter, much of American mundane literature): the individual's place in society, and the tension between the two. Here the prisoner (like the alien, the psionic superman, the gifted genius, and the time traveler) is yet another manifestation of the Outsider. Unfairly separated from a society that doesn't accept or want him, the Outsider can flee that society altogether (escape from prison), integrate into the society (work for rehabilitation), attempt to overthrow the society (lead a revolution), or craft a version of society more to his liking (seek independence for the prison planet).

This month I have for you two books that deal specifically with prison, another that features themes of imprisonment, and a graphic novel that includes a prison planet.

* * * *

The Prisoner

Carlos J. Cortes

Bantam Spectra, 416 pages, \$7.99

(paperback)

ISBN: 978-0-553-59163-7

Genre: Psychological/Sociological SF

* * * *

This near-future thriller plays with the concept of suspended animation in prisons. By 2060, the prison system is contracted out to Hypnos, Inc., a company that markets safe and virtually flawless cryonic hibernation. Inmates are frozen and stacked in Hypnos detention centers known as "sugar cubes," to be reanimated when their sentences are completed.

As far as Congress and the public know, that's all there is to it. But Laurel Cole learns that there's more to the picture: undocumented prisoners who don't appear in any records, and who have no release date. Prisoners who have come to Hypnos without trial, political dissidents whose only crime is challenging the status quo. When Laurel finds that one of these inmates is reporter Eliot Russo, missing for eight years, she also learns that Russo has information that could expose both Hypnos and their secret government partners.

Aided by an oddball assortment of co-conspirators, Laurel enters the Washington, DC sugar cube as an inmate. Her first mission is to locate Russo and break him out.

But escaping from a maximum-security installation is only the first of Laurel's challenges. Once she has Russo, the race is on to bring down Hypnos its partners, and to do so before Laurel and her team find themselves permanently on ice.

As conventional as it sounds, *The Prisoner* is a gripping near-future adventure story, and the science behind it is well researched and nicely presented. The pages fly by quickly, the characters are compelling, and the ending is quite satisfactory.

* * * *

The Eternal Prison

Jeff Somers

Orbit, 406 pages, \$12.99 (trade paperback)

ISBN: 978-0-316-02211-8

Series; Avery Cates 3

Genre: Adventure SF

* * * *

If you've met Avery Cates in his first two adventures (*The Electric Church* and *The Digital Plague*), then you won't be surprised that someone throws him in prison. In fact, you might think it's the best place for him.

Avery is a scary man . . . but he lives in a scary world. In this noir-flavored cyberfuture, Earth is ruled by the System of Federated Nations, policed by the dreaded System Security Force (SSF). Avery, an unwilling conscript in the SSF, is good with guns and has a droll sense of humor (one hears echoes of Sam Spade). After surviving killer cyborgs and bioengineered disaster, Avery now runs afoul of the wrong cops and winds up in Chengara, an inescapable prison with zero survival rate. So first Avery has to escape, then he needs

to find out why people he's killed keep coming back to return the favor.

Avery Cates is foul-mouthed and violent, but somehow he manages to be likable as well. His friends and enemies are delightfully strange. And underneath all the blood and guts, the shooting and swearing, the holographic avatars and downloaded brains . . . one gets the distinct whiff of satire, and realizes that no one, least of all Avery Cates, is taking any of this entirely seriously.

A fusion of noir thriller, cyberpunk, and military sf, the bottom line is that Avery Cates is just plain *fun*. If that's what you're looking for, this is the right place.

* * * *

Destroyer of Worlds

Larry Niven & Edward M. Lerner

Tor, 368 pages, \$25.99 (hardcover)

ISBN: 978-0-7653-2205-0

Series: Known Space; Fleet of Worlds 3

Genres: Alien Beings, Bigger Than Worlds

* * * *

Prisons come in all sizes and shapes, but they share the same features: you're there against your will, and you want to escape.

Some decades ago, the alien race that humans call Puppeteers found out that they didn't want to be in the galaxy any longer. The galactic core had exploded, and in a few tens of millennia the wavefront will reach Earth's neighborhood,

wiping out all life. So the Puppeteers (who call themselves Citizens) decided to escape. Fortunately, Puppeteer technology is perfectly capable of moving whole planets. Gathering up their homeworld and five agricultural worlds, the Puppeteers left their sun behind and headed for intergalactic space.

All of this is old news to anyone who remembers Niven's classic *Ringworld*. What we didn't know then, and found out only in the first book of this trilogy (*Fleet of Worlds*), is that one of the agricultural worlds is populated by the descendants of human castaways that the Puppeteers found centuries before. These humans are essentially Puppeteer slaves, working the fields to provide food for the Citizens.

In *Fleet of Worlds* and *Juggler of Worlds*, Kristen Quinn-Kovacs and her associates discovered Earth and the rest of humanity, and led the human agricultural world (now christened New Terra) to independence. New Terra continues to accompany the Puppeteer Fleet of Worlds in its exodus, while Kristen and her people act as explorers to make sure the way is clear of threats.

But now, ten years after *Juggler of Worlds*, a new threat has arisen: an alien race fleeing the same galactic disaster, leaving whole planets devastated in their wake. These newcomers are headed for the fleet, and it's up to Kristen to deal with them.

If you like Larry Niven's Known Space stories, you'll find plenty here to enjoy. There are bizarre aliens both old and new; there's more advanced technology than you can shake a neutron star at; there are ideas to make your head spin.

Characters? Nobody reads Larry Niven for character depth and development—if you want to read about well-rounded characters dealing with complex human problems, this isn't the book for you. But if you want interesting aliens, planet-size and larger threats to overcome, and stirring space adventure, then you should give this one a try.

Of course, this *is* the third book of a trilogy, and as with any other Niven book, you're expected to do your homework first. You'll probably want to have read the other two before you dive into *Destroyer of Worlds*. And while an encyclopedic knowledge of Niven's Known Space milieu is not absolutely required, it wouldn't hurt.

* * * *

Final Crisis: Legion of 3 Worlds

Geoff Johns, George Pérez, Scott Koblish

DC Comics, 176 pages, \$19.99 (hardcover)

ISBN: 978-1-4012-2324-3

Genre: Alternate Worlds, Graphic Novels, Superheroes

* * * *

In addition to being top pre-Golden Age science fiction writers, Edmond Hamilton and Otto Binder both worked in comics. A bit more than fifty years ago, the two of them had a hand in creating a science-fictional team of superheroes that has survived to this day.

The Legion of Super-Heroes (LSH for short) exists more-or-less a thousand years from now, in the 31st century. In a universe of starships, aliens, and an interstellar government

called the United Planets, the LSH is a team of (originally) teenagers, each with a different power or ability. Often they are offworlders whose people developed these abilities to cope with alien planets—for example, settlers on the planet Braal genetically engineered magnetokinetic powers to deal with the hostile metal-boned creatures that inhabit the world, while all inhabitants of Durla are shape-shifters.

Over the decades the LSH (in the fashion of all comic-book teams) has grown increasingly detailed and more and more baroque. There have been several mutually exclusive versions of the team, as their universe was "rebooted" to attract new readers with a fresh start. But one thing has remained constant: the LSH has always been set in the future, and has always used the tropes and concepts of science fiction: alien beings, other worlds, time travel, alternate universes; they are even inextricably linked to that other science-fiction-based superhero, last survivor of doomed Krypton: Superman. As a boy, Superman traveled into the future and had many adventures with the Legion.

And Legion they are: various incarnations of the team have had dozens of members.

In *Final Crisis: Legion of 3 Worlds*, writer Geoff Johns pulls out all the stops to bring all the previous versions of the LSH together in a space opera like no other. And legendary artist George Pérez is right there with him, his intricately detailed pages teeming with literally hundreds of characters.

The plot is fairly straightforward. A powerful, malevolent entity known as the Time Trapper desires to wipe out the Legion, and finds a perfect weapon: an evil version of

Superboy from a universe that no longer exists. The Trapper brings this Superboy Prime to 31st century Earth. The boy—whose unimaginable powers exceed even those of the mature Superman—learns of the existence of a Legion of Super-Villains and liberates them from the prison planet Takron-Galtos. This evil Legion heads to Earth for a final battle with the good Legion.

The LSH calls in Superman from the 21st century, but they know even his power will not be enough. They turn to Brainiac 5, whose super-power is his "twelfth-level intelligence." Brainy summons two alternate versions of the LSH from other realities; he also resurrects some heroes who died fighting Superboy Prime in the present day. For good measure, the outer-space Green Lantern Corps enters the fray.

It's good Legions vs. evil Legion, with the all-powerful Time Trapper manipulating time to his benefit, until Brainiac 5's machinations bring about a deliciously over-the-top ending that proves, once and for all, that there's still fun left in comics.

If you haven't experienced the Legion of Super-Heroes and their fantastic future universe, you owe it to yourself to give them a try. *Final Crisis: Legion of 3 Worlds* is a great way to get acquainted with the team that Otto Binder and Edmond Hamilton created, all those years ago.

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Don Sakers is the author of *A Rose From Old Terra* and *Dance for the Ivory Madonna*. For more information, visit www.scatteredworlds.com.

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Reader's Department: **BRASS TACKS**

Dear Stan Schmidt:

In *Analog's* November 2009's Alternative View, "Lessons from the Lab," Jeffrey D. Kooistra offers a valid criticism of data from the National Weather Service's temperature monitoring stations. But before I conclude this inaccurate data alone throws into question the existence of global warming, I would ask Mr. Kooistra his views on the accuracy of *National Geographic* magazine's photographic archives, which appear to document a significant worldwide shrinkage of glaciers (and polar ice caps) over the past hundred-odd years. *Something* is causing those ice deposits to go away, and it isn't Invisible Ice Thieves from the planet Zorgul.

Richard M. Boothe
Seal Beach, CA

* * * *

Dear Stan,

Regarding the Alternate View column in the November 2009 issue: Kooistra exposes himself as a single data point physicist. Not only do we know that there's increased CO₂ in the atmosphere (it's at this moment higher than any time in the last 300,000 years and increasing daily), but we also know CO₂'s absorption spectrum and like glass, it acts as a greenhouse material! We also have a pretty good idea of what the conditions on this planet were the last time CO₂ levels were as high as they are now. We also notice the

melting of glaciers all over the world as well as the permafrost in at least Alaska, not to mention the Artic Ocean. Looks like we can think about using the fabled Northwest Passage and still be skeptical about global warming? As an engineer, I was trained to look at the big picture in relatively simple terms. The way I see it, we live in a sphere that has several sources of heat energy influx, a blanket of insulation (which we're increasing with the CO2, etc.), and at least one source of loss of the heat that's coming in (radiation to the almost perfect "black box" of outer space). If we are increasing our insulation blanket, and at the same time releasing huge amounts of heat energy, there's only a single path for the immediate future. The only thing we have left to worry about is what the planet will do in response, as there are more feedback mechanisms built into our environment than I can get my mind around—some are positive and some negative. As a pragmatic and conservative old school engineer, I caution Jeffrey not to look at only one data point and to especially not mess with Mother Nature! (Or predict the future from a biased perspective!)

I've been reading *Astounding/Analog* since I was a kid, when my dad would bring it home in the early '50s, and this is the first time I thought I needed to be even a little critical.

Thanks for the many thoughtful reads over the years.

Ron Miller

Colorado Springs

* * * *

Dr. Schmidt:

I always enjoy reading Jeffery Kooistra's Alternate View and this one, citing the inaccuracy of the temperature measurements made by the NWS in support of his skepticism of global warming, was no exception. I downloaded and read the report he cited, written by meteorologist Anthony Watts. I agree with the conclusion that almost none of the temperature-sensing probes are sited for accurate readings of the ambient air temperature. However, given the fact that such things as asphalt-paved parking lots, air conditioner exhausts, and concrete walls exist in the world, one must admit that they contribute to the increase in temperature of the ambient air as, apparently, do all of the sources of greenhouse gases. While admitting that the placement of these temperature probes is neither ideal nor even in compliance with the Nation Weather Services own specifications, I find it hard to say that there is no such thing as global warming when reports are coming in that glaciers are melting all over the world and trees are taking over the tundra. Something is happening to cause all this. By all means, we should fix the siting of the temperature probes to accurately record the ambient air temperature. I'm definitely in favor of gathering good data, but in the meantime, I still plan to do everything I can to make my own energy use as efficient as possible and keep my "carbon footprint" as small as I can.

Paul Baker
Browns Valley, CA

* * * *

Dear Stan:

In the 2009 November issue, Jeffery Kooistra latches onto some poor data collection practices for air temperature to support his skepticism about global warming. The errors quoted don't seem to justify saying that global warming doesn't exist, just that it's not proceeding quite as fast as that particular data implies. One doesn't need sophisticated averaging of daily and seasonally fluctuating air temperatures to *know* that Earth's heat balance is not in equilibrium. Just look at the ice.

The upper part of a container of ice water may stay close to the freezing point as long as some ice exists, but melting of the ice clearly indicates that the container is absorbing heat. Similarly, melting of ice at both poles and in almost every glacier on Earth clearly indicates that more heat is being added to Earth's surface than is being radiated away into space. The real issue is not so much a question of "warming" (yet); it's a matter of how big the imbalance is now, how fast it is increasing, and what we can do to reach equilibrium or better before much of the current land area becomes uninhabitable desert or ocean floor.

Chuck Gaston
Lancaster, PA

* * * *

Dear Dr. Schmidt,

Mr. Kooistra has again raised some interesting issues. He suggests that evidence for recent global warming that is based just on thermometer readings may be flawed due to

local heating affects. This urban affect on local temperatures has long been known, and if that were the only evidence for global warming, then I would agree that some skepticism of global warming might be justified. However, that is not the case, and there are many other means of estimating temperature changes of our planet.

For instance there is one recent article (Kaufman et al. 2009. "Recent warming reverses long-term arctic cooling." *Science* 325: (5945, 9/4) 1236-1239) which estimates past temperatures by several different techniques, none of which involve direct thermometer readings. They find that data from each technique supports the conclusion that there has been an unusual rise in arctic temperatures in the past century, consistent with recent global warming. Perhaps Mr. Kooistra might review the techniques used in this study. If he finds flaws in any of the techniques used by these researchers, then he might share them with *Analog* readers in the future?

Otherwise it should be noted that all means of measuring temperature, or anything in science, have technical issues. That is why in science there is cross checking of results, repeated by other workers, and done using different techniques. When many different workers, using many different methods, see the same trends, then it is very likely that something is up. That is the current state of affairs with global warming. The article I note above is merely one of a vast number of studies on this topic. While thermometers are still used to measure temperature, the technical problem that Mr. Kooistra notes has long been recognized. The use of these

other techniques has served as a cross check, and the consensus it that global warming is happening.

Scott T. Meissner
Ithaca, N.Y.

* * * *

Dear Sir:

Jeffrey Kooistra uses his latest (November 2009) Alternate View as a platform to express his dissent from the scientific consensus regarding global warming. This is both his right as an American citizen and the way that good science gets done, since scientific truth is established by an appeal to facts, rather than authority or consensus. However, I see at least three flaws in his argument for greater skepticism regarding global warming.

First of all, the surface temperature measurements are only one of many confirmatory strands of data regarding global warming. Among other things, there is the accelerated retreat of glaciers in the northern hemisphere and sea-ice in the Arctic Ocean. There is also satellite measurement of surface temperature, the changing (poleward) ranges of many different animal species, and much more evidence too extensive to cite in a letter to the editor.

A second flaw is the methodology presented as refuting the reliability of surface temperature measurements. The weatherman he cites, visited three (of 1,221) monitoring stations near his home and on that basis dismisses all surface temperature data in consequence. To put it mildly, this sampling procedure is somewhat deficient.

The final flaw, also related to the surface temperature records, is that the change that supposedly invalidated the results happened in 1979, exactly thirty years ago as I write. My understanding is that the most pronounced increase in the temperature "hockey stick" has occurred in the past twenty years. I suggest that it is unlikely that a change in 1979 only started affecting the temperature readings in 1990 and later.

I believe that Mr. Kooistra would be on somewhat better ground criticizing the anthropogenic hypothesis regarding the causes of global warming than the factual basis of global warming. Even there, it is notable that the most strident critics of the human origins are those whose economic interests would be most drastically affected by development of a carbon neutral energy system (e.g.; oil and coal producers or public officials from states with such interests). And where did the extra CO₂ in the atmosphere come from, if not burning fossil fuels, which had sequestered the carbon for hundreds of millions of years?

In any case, his Alternate View column certainly was provocative.

John Howard Brown, Ph.D.
Associate Professor
School of Economic Development,
Georgia Southern University, Statesboro, GA

* * * *

Dear Stan,

Since my November 2009 column drew so many comments, I've decided that the best way to reply is in an

upcoming Alternate View. I do want to clear up one apparent misconception: I am not entirely skeptical of global warming in and of itself. Given any arbitrary century-long period, it would be odd indeed if the average temperature wasn't trending up or down a little bit during that slice of Earth history, whether humans exist or not. So for it to have gotten a tad bit warmer from 1900 to 2000 would not surprise me one bit. What I am intensely skeptical of is the excessive certainty global warming proponents attach to their claims, both to those of gloom and doom, and to the faultlessness of their methodology.

I am delighted that the column stirred up so much debate, as I had hoped it would, and I want to thank everyone, even those who took me to task, for weighing in.

Best,
Jeff

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Reader's Department: **UPCOMING EVENTS** by Anthony
Lewis

14-16 May 2010

LEPRECON 36 (Phoenix area SF conference) at Phoenix Marriott Mesa, Mesa, AZ. Writer Guest of Honor: George R. R. Martin; Artist Guest of Honor: Charles Vess; Local Guest of Honor: James A. Owen. Membership: \$40 until 30 April 2010, \$45 at the door. Info: leprecon.org/lep36/; leprecon@leprecon.org; (480) 945-6890; PO Box 26665, Tempe, AZ 85285.

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21-23 May 2010

IMAGICON (Alabama area SF conference) at Birmingham, AL. Guests include: Darrell Osborn, Allen Hammack, Ash Evans, Daniel Taylor, M.B. Weston. Membership: \$40 (special rate, may expire; regular \$55). Info: imagicon.org/imagine2010/.

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27-29 August 2010

AU CONTRAIRE (31st New Zealand national SF conference) at Quality Hotel, Wellington, New Zealand (stop in on the way to Aussiecon). Guest of Honor: Sean Williams; Fan Guest of Honor: Paul Mannering. Membership: NZ\$ 60; Supporting: NZ\$ 15; Friday only: NZ\$ 20; Saturday only: NZ\$ 40; Sunday only: NZ\$ 40. Info: www.aucontraire.com.

org.nz/; info@aucontraire.org.nz; PO Box 10104, Wellington
6143, New Zealand.

* * * *

2-6 September 2010

AUSSIECON FOUR (68th World Science Fiction Convention) at Melbourne Convention and Exhibition Centre, Melbourne, Victoria, Australia. Guest of Honor: Kim Stanley Robinson; Artist Guest of Honor: Shaun Tan; Fan Guest of Honor: Robin Johnson. Membership from 1 September 2009 until some later date (see website for latest details): AUD 275, USD 225, CAD 255, GBP 140, EUR 1165, JPY 22,500; supporting membership AUD 70, USD 50, CAD 50, GBP 25, EUR 35, JPY 4900. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Nominate and vote for the Hugos. Info: www.aussiecon4.org.au/, info@aussiecon4.org.au, GPO Box 1212, Melbourne, Victoria, AUSTRALIA 3001

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