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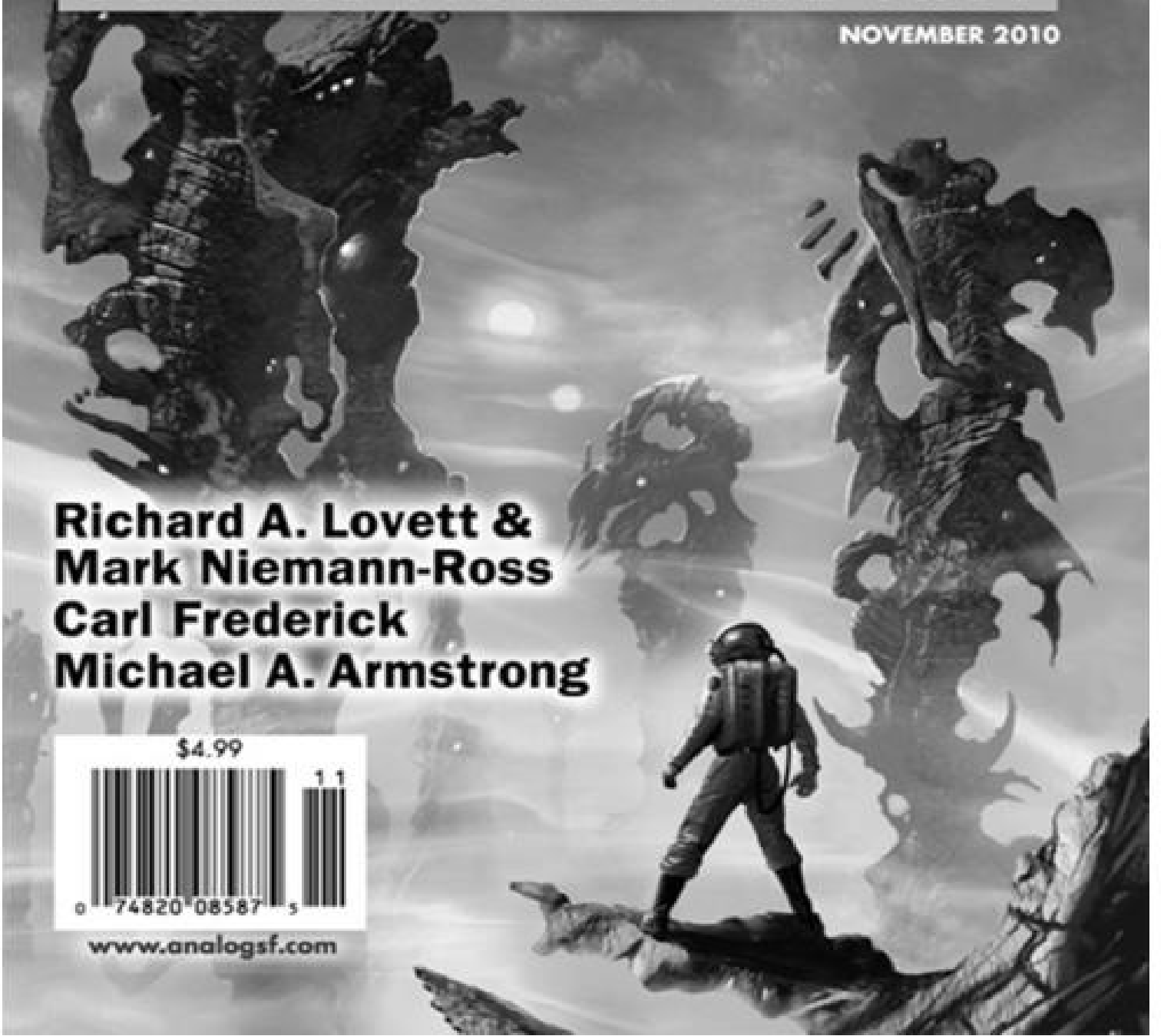
NOVEMBER 2010



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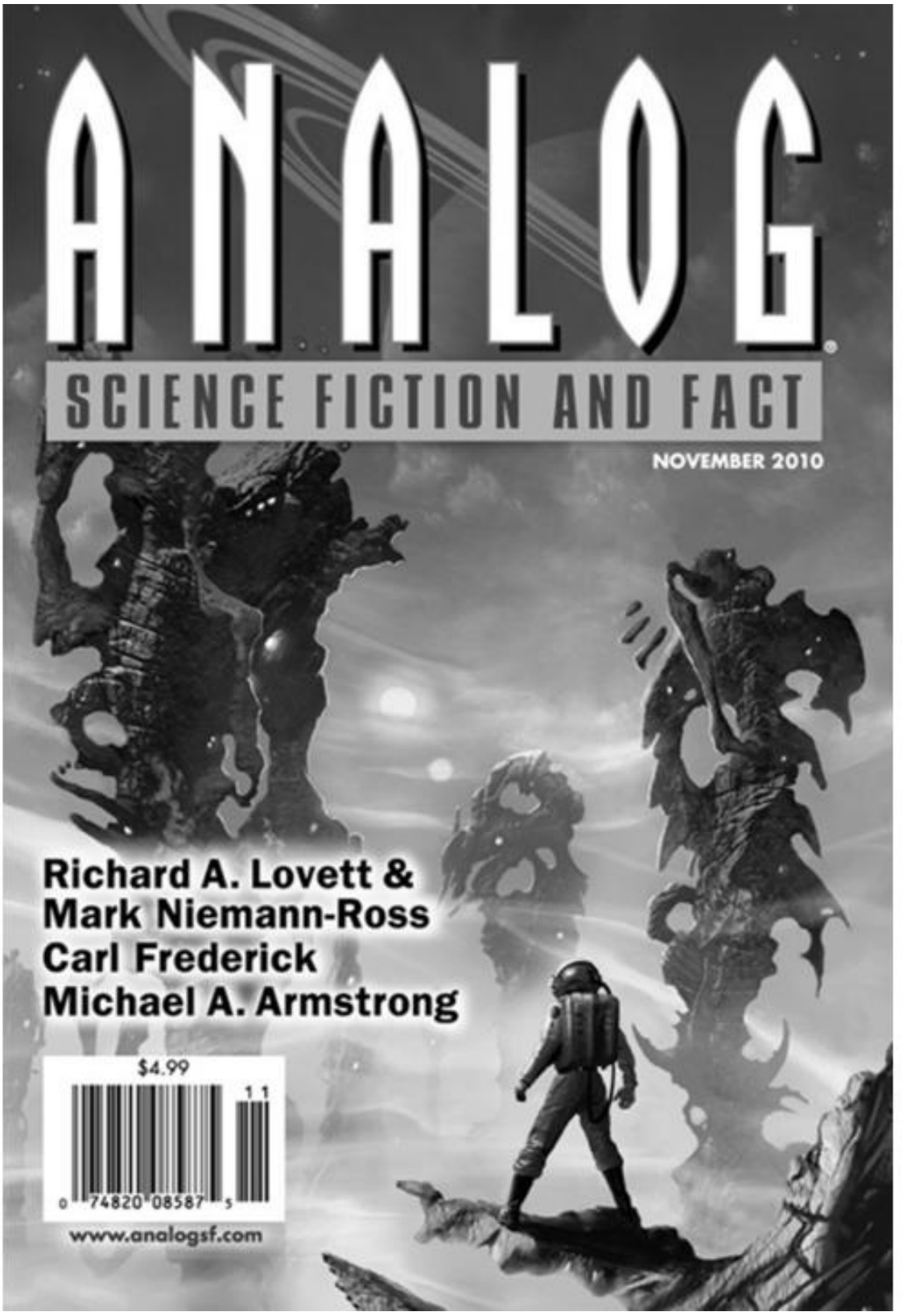
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Reader's Departments

Monday, November 1, 2010

EDITORIAL

Stanley Schmidt

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Jeffery D. Kooistra

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THE REFERENCE LIBRARY

Don Sakers

Space opera isn't what it used to be. And that's a good thing. When Wilson Tucker coined the word in 1941, "space opera" was a term of derision. It was analogous to the earlier term "horse opera," a pejorative label for Western films. Tucker used the expression...

BRASS TACKS

Dear Dr. Stan: I wanted to express my thanks for H.G. Stratmann's "The Day the Music Died" in the May issue. As one who suffers regularly from "earworms," I appreciated the story immensely. Having done what obviously was rather extensive research on the subject, I...

IN TIMES TO COME

Our December issue again offers an unusual combination of a story and a closely associated fact article. The story is Shane Tourtellotte's "The Man from Downstream," about a time traveler who does what he does for an unusual reason, and then faces an unexpected challenge about ...

UPCOMING EVENTS

Anthony Lewis

December is always a slow month for conventions because of the holidays. 19–21 November 2010 SFContario (Toronto SF conference) at Ramada Plaza Hotel, Toronto, ON. Author Guest of Honor: Michael Swanwick; Editor Guests of Honor: Patrick & Teresa Nielsen Hayden; Fan Guest of Honor: Geri...

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Novella

EDITORIAL

RULES AND REASONS

Stanley Schmidt

Most people tend to balk at rules, to some extent, even though they also want the security that comes from having other people follow them. Some kinds of rules, of course, are more likely to meet resistance than others. Most people accept prohibitions against murder, and even hire police to enforce them. They are far less likely to accept an anonymous nosy neighbor trying to get everyone on a block to keep all their window shades exactly halfway up during the day.

Clearly there are different kinds of "rules," some of them essential cornerstones of civilization, some so silly they richly deserve being flouted at every opportunity—and some that really are imposed by a higher power and literally can't be flouted, no matter how much anyone might like to.

No, I'm not referring to the commandments of any religion. Even though many people sincerely and deeply believe that this or that set is divinely inspired or dictated, all such commandments can be disobeyed, and frequently are. But nobody disobeys natural law, because nobody can. Mother Nature is the ultimate exerciser of the classical parental excuse: "Because I say so." You can't run off a cliff, like a cartoon

coyote, and expect to stay aloft, because the law of gravity is what it is—for you and everybody else. And there's nothing you can do about it (though there are things you can do to work around it, like learning the rules of statics and aerodynamics and how to use them).

The "rules" made by humans (or other intelligences) are in a completely different category—or, more precisely, several different categories. Some have the force of law and are enforced by government agencies. Ideally they exist for reasons that most citizens agree are valid and reasonable, but in practice this may or may not be the case. The aforementioned ban on murder is one of the clearest examples of a law that most people want to see not only on the books but enforced. There is widespread disagreement about how to enforce it, but most people agree that the ban is needed, not only for their own personal safety, but because society would quickly disintegrate into chaos if people were allowed to go around killing others who annoyed them. New York State tax law is a good example of a law (or an astonishingly voluminous mass of them) that is far from unanimously approved. Most residents agree that some form of taxation is necessary to finance state services, but there's plenty of controversy about who should provide how much of that revenue and how and on what it should be spent.

A second broad set of rules made by humans, for humans, includes guidelines that people are expected, but not legally required, to follow. These include rules of etiquette and fashion, both of which often appear so arbitrary that it's hard to imagine

what, if any, reason ever existed for their coming to be regarded as rules. You won't wind up in court for wearing your hemline too high or too low, or for using the wrong fork for your salad, but you may find yourself snubbed or looked down on by certain people (whose opinions may or may not matter to you).

Then there are procedural guidelines like the ones that we and other publishers provide on request to authors interested in submitting to us. We call these guidelines rather than rules, partly because it sounds less harsh, and partly because nobody's going to fine or otherwise punish you for violating one of them. But we do wonder what's going on in the mind of a writer who sends us a story with a cover letter beginning, "Thank you for sending your guidelines," and then violates half a dozen of them in the manuscript.

One such writer recently wrote, "I always assumed that a 'guideline' was not mandatory." Strictly speaking, that's true, but such nitpicking seems counterproductive for a writer who wants to have the best possible chance of selling to a particular market. There's a reason for everything our guidelines (or those of any other publisher) ask a writer to do, and the foremost of these, from the writer's point of view, is that we as publishers want to make it easy for you as a writer to present your work in as good a light as possible. That includes presenting it in a form that won't make life unnecessarily difficult for us, as publishers, if we like your story and want to publish it. In our specific case, with our present methods, that means (among other things) that we want the manuscript double-spaced, on

one side of the sheet only, because (a) I read so many manuscripts that I want them to be as easy as possible on my eyes (for which I have no spares), and (b) if we buy the story, the copyeditor will need room to write comments and instructions during the first stage of editing.

Sometimes the reason for a rule seems so self-evident that we've never felt a need to state the rule at all, but it seems that even that can't be taken for granted. Lately, for reasons that perplex me, I've been getting an astounding number of manuscripts with no page numbers, a practice for which I'm hard put to imagine an advantage. If such a manuscript is dropped—or disassembled for production—how will we know which page goes where when it's reassembled?

Production methods vary in detail from publisher to publisher, and consequently so do guidelines. So if you're considering submitting work to any publisher, the first step is to get that publisher's guidelines and follow them exactly. You may be sure that I, when I'm being a writer rather than an editor, do that. And you may be equally sure that I don't waste time or make myself unnecessarily annoying by trying to convince some other editor that he or she should do things my way.

It's not surprising that some writers and artists (usually inexperienced ones) do that; creative people, by the nature of the beast, are especially likely to balk at rules for which they see no obvious reason. (More than one business manager has complained that managing PhDs is like herding cats.) And the kinds of guidelines (or rules, if you insist) I've been describing

are just procedural things like the physical (or electronic) form of a manuscript and how to submit it if you expect a response. When it comes to "rules" regarding creative content, artistic types—again, most often inexperienced ones, but with an important exception I'll mention later—are even more resistant to being "told what to do."

I'll offer my younger self as a sacrificial example. When I started trying my hand at musical composition, I did a lot of listening to a wide range of composers, often following scores while doing so, to get a feel for what kinds of music I liked and didn't like and to try to learn by observation how composers I liked got the effects they did. I also read enough about music theory to know of the existence of rules of harmony, counterpoint, and form—but not enough to really understand what they said or how to apply them. So I said to anyone who would listen or couldn't get away fast enough that in my composition I didn't want to be bound by those silly rules, and in my defense I pointed to the fact that some of the later pieces that I liked—e.g., some by Stravinsky, Shostakovich, and Prokofiev—deviated markedly from those rules. What I would never have said (even to myself), but freely admit now, was that my sneering at the rules was in large part a smokescreen for the fact that I didn't understand them well enough to follow them skillfully even if I wanted to.

What I eventually learned, to my benefit, is that even though some small-minded teachers and critics may regard rules of composition as rules to be followed Because They Are Rules,

that's not really what they're for. They aren't decrees that somebody laid down to lord it over composers and limit what they can do. They're attempts, evolved over time, to codify principles that past composers have found often work. What does it mean to say that a piece of art works? Simply that it has the kind of effect on an audience—listener, viewer, reader, or all of the above—that the creator hoped it would. Audiences are the ultimate judge, and rules exist not to limit creators, but to help them by providing a framework for understanding what is more or less likely to affect audiences in the intended way. Sonata form is not a piece of legislation that says a piece of music Must Have an Exposition That Does This, a Development That Does That, and so on, but an observational description: many pieces that succeeded had this general form, and writing a new one that also does so has a better-than-average chance of seeming well-proportioned and satisfying.

And what about those later composers who fed my defiance by breaking the rules? I realized eventually that, unlike me, they weren't breaking them because they didn't understand them. They understood them very well indeed, but were original and creative enough to come up with new ways of doing things that went beyond the old rules but also worked (on audiences). Important corollary: mere novelty, or just going beyond the rules, is not enough. New ways are successful only if they work, and not all work equally well. In the early twentieth century, there was a fad for "twelve-tone music" among composers; it has had some lasting influence on the work of later composers by

expanding their toolbox, but in its purest form most of it had little success with audiences (largely because it deliberately ignored the fact that some musical relationships really do have a clear physical and physiological basis for seeming special).

Similar considerations apply in any other art, including literature. Beginning writers sometimes grumble that they don't see why every story has to involve a conflict or why they're usually better off avoiding present-tense narration or viewpoint shifts within a scene. It isn't that they always have to follow those rules, or that editors are looking for things to criticize them for. It's that a great deal of shared experience has found that stories following those principles are, in general, more likely to work than those that don't. There can be reasons to violate any of them, dictated by the needs of a particular story—but to recognize when you have one of those special situations, it's very helpful to have a solid understanding of what has usually worked, or not worked, in the past. One of the most popular stories Analog has ever published was David R. Palmer's "Emergence," which violated all kinds of rules: it ran something like 17,000 words, told almost entirely as a monologue, written in a very unconventional kind of English, and containing few characters and almost no physical action—and it powerfully, unforgettably affected almost everyone who read it. But Palmer knew exactly what he was doing, and why, with every word in it—and he could just as easily write a story that does follow all the rules.

So "rules" is a word that covers a lot of ground. Some of

them, those imposed by nature, none of us can choose to ignore. Some of those made by our fellow creatures we can ignore, but at risk of severe penalties. And still others we don't have to follow; but there are frequently reasons why we should, and it's to our benefit to try to understand what those reasons (and their limitations) are.

Next Article

THE ALTERNATE VIEW

E-MAILS TO JEFIMENKO, CHIEFLY ON CLOCKS

Jeffery D. Kooistra

It filled me with deep sadness to learn of the death last year of Dr. Oleg D. Jefimenko. His name will be familiar to some of you as it has come up more than a few times in these columns. I briefly reviewed a couple of his books in “Recent and Worthy” from the April 2003 Analog. I also discussed his work on the theory of electromagnetic retardation in my January 2006 column, “Length Contraction.”

We had a valuable period of e-mail exchanges about five years ago, a portion of which I am publishing here. It relates to one of the most interesting findings of his work and other admirers and “students” of his should know what he had to say.

While doing consulting work in late 2000, I stumbled upon an abstract for a lecture in an old physics journal that I knew he would find of interest. I regret that I didn’t tell him immediately, but better late than never.

I sent the first e-mail on July 14, 2005, with the subject line, “The rate of moving clocks.”

Dear Dr. Jefimenko,

I was going through once again Electromagnetic

Retardation and Theory of Relativity and (once again) came upon this statement on pg. 236-237: “For some inexplicable reason, apparently nobody has attempted to calculate and compare the rates of any types of stationary and moving clocks . . .” This reminded me that I have long intended to send you the ref. in the attached photo. (I finally have a scanner, so now I can just e-mail it to you.)

The ref. is from pg. 770 of Phys. Rev. Vol. 85 (1952). I have never been able to find an article by Ruark in which he followed up on his analysis of simple clocks, and I don’t know if he ever compared the rates of clocks like you did—but this is the closest hit to that I’ve been able to find.

If you know about this already, please pardon the intrusion.

Best,

Jeff

This is what the abstract said:

P1. Electrodynamics as a Basis for Special Relativity. Arthur E. Ruark, Institute for Cooperative Research, The Johns Hopkins University.—The Lorentz transformation is usually derived from the symmetry of the physical experiences of two observers on inertial frames, and the assumption that both observers obtain the same value of c, no matter how the source is moving. Suppose we replace the second postulate by the statement that the Maxwell equations and the Lorentz force are valid for the “resting” observer. We can discuss a simple clock —a negative charge, rotating (sic) around a heavy positive

charge in a plane perpendicular to the X-axis. Setting this system into uniform motion, it becomes the clock of the moving observer. The resting observer can use the retarded potentials to discuss its behavior. A few lines suffice, to derive the mass increase and the decrease of angular velocity that occur when the clock is set into motion. The expansion of times associated with a moving body, the constancy of light velocity for the moving observer, the Lorentz contraction of a moving body, and the Lorentz transformation follow in order, with ease. This attack makes these matters so readily understandable, on the basis of retardation of electrical forces, that it appears to possess didactic value.

Dr. Jefimenko said, in his reply on July 19:

Thank you very much for the very interesting abstract of Ruark's paper on relativity. I did not know of its existence. It is interesting for me for two reasons. First, because Ruark speaks of a moving electromagnetic clock, but mostly because he associates relativity with electromagnetic retardation.

As far as his clock is concerned, it is physically and mathematically much more complex than any of my clocks in Electromagnetic Retardation and the Theory of Relativity (the electric field of a charge in a circular motion is far from simple —see Example 4-4.1 on pp. 89-92 in R & R). It would be interesting to see Ruark's calculations, but it is entirely possible that he had never published them. I suspect that he simply had an idea—an intuition—and submitted the abstract of the paper that he intended to present at the Physical Society meeting

before actually completing the calculations. It is also entirely possible that he never presented the paper at the meeting because, as I suspect, the calculations had not supported his initial announcement. Specifically, I do not think that it is possible to deduce mass increase, time dilation, constancy of light velocity, Lorentz contraction, and Lorentz transformation —all this by simply analyzing the behavior of a moving clock. It may be noted that Larmor, as early as in 1897, concluded that the period of an orbiting electron in a moving reference frame is longer than its period in a system at rest. But Larmor based his calculation on what we now call Lorentz (incomplete) transformations, not the other way around. And as far as the constancy of light velocity, length contraction, and mass increase are concerned, I do not see at all how they can be deduced just from an analysis of a moving clock. I may be wrong of course.

What is especially interesting for me in Ruark's abstract is that he associates relativity with retardation of electrical forces. Until now I believed that the idea of an association of relativity with electromagnetic retardation was original with me. I now see that Ruark anticipated the idea already in 1952. If there shall be a third edition of my R & R, I will mention in it Ruark's abstract and will express my gratitude to you for letting me know of its existence.

So let history show that before his death, Jefimenko did find out that he wasn't the first to notice the connection between relativity and retardation. He did send the book as promised,

and we discussed a number of other things in subsequent emails. But I wasn't quite finished with the matter of the rates of moving clocks.

Paraphrasing from the earlier columns, let "us" again define electromagnetic retardation. Since electric and magnetic fields propagate at a finite velocity (the speed of light), there is always a time delay before a change in electromagnetic conditions initiated at a point in space can produce an effect at any other point in space. This time delay is called electromagnetic retardation. But, for the most part, the equations of classical electromagnetism are not usually expressed in a form that explicitly takes this fact into account. When you do cast the equations in their retarded forms, some interesting results appear.

What Jefimenko found is that relativity is the result of retardation.

In "Length Contraction" I described how retardation predicted length contraction. In "Recent and Worthy" I described how it was done with clocks and said that "Jefimenko's approach is to 'construct' an electromechanical system that could function as a simple clock, and then show how the retarded equations predict that the clock slows down when put in motion." I then described one of those simple clocks, but I need to describe a different one this time.

Picture a coordinate system near the origin, x-axis left to right, y-axis up and down, z-axis positive out of the page and

negative into it. Imagine two like charges q fixed at positions +a and –a on the z-axis. Picture another charge –q near the origin and constrained to oscillate up and down on the y-axis. This oscillating charge is a form of simple clock. If we put this clock system in uniform motion along the x-axis, and apply the retardation equations to see how the motion affects the clock rate, lo and behold we find that the clock slows down at the rate predicted by relativity. Now let's alter the clock by fixing the two like charges at +a and –a on the x-axis (we rotate the clock 90 degrees in the x-z plane) and again put it in uniform motion down the x-axis. This time the clock will also slow down, but at a different rate from the relativistic prediction. (These are clocks #3 and #7 in chapter 10 of Jefimenko's book.)[1]

Although Jefimenko had described this matter in depth in his book, he had not described the "non-Einsteinian" clocks in a paper he had published in the American Journal of Physics. So I asked him why.

Ever since I first read R&R, and also your AJP paper "Direct Calculation of Time Dilation," and now also "On the Experimental Proofs of Relativistic Length Contraction and Time Dilation," I've wondered why you didn't mention in these papers what you showed in the book (what I consider one of the most interesting results of retardation), that being that some simple clocks are "non-Einsteinian"?

Did you think that added wrinkle would detract from the point of your papers? Did the referees balk at it?

To which Jefimenko replied with the following explanation:

As to AJP and non-Einsteinian clocks, there was a non-Einsteinian clock in the original manuscript for AJP. However, the editor, R. H. Romer, declared that he would not publish the manuscript unless I "either REPAIR THE WRONG CLOCK or delete it." Since I could not "repair" the clock (it functioned perfectly, and Romer did not suggest how it could be "repaired"), I decided to delete it, so that at least the basic idea of the dependence of clock rate on clock mechanism would be published.

And I did not even try to include non-Einsteinian clocks in "On the experimental proofs . . ."

He had also sent me a paper of his I had not requested (because I didn't know of it) and in a subsequent e-mail added this additional point:

There is a very good reason why I sent to you the third reprint—the reprint of the article "On the Relativistic Invariance of Maxwell's Equations." Perhaps you already know that at least some of my "non-Einsteinian" clocks can be converted into "Einsteinian" clocks by simply assuming that they are Lorentz-contracted. Of course, I do not believe that relativistic (kinematic) length contraction is a true physical effect as is explained in Chapter 9 of "Electromagnetic Retardation . . ."

But is the dynamic (causal) length contraction suggested by Fitzgerald and Lorentz a true physical effect? About that I have no definite opinion.

However, as is shown in the article “On the Relativistic Invariance of Maxwell’s Equations,” if one accepts the existence of length contraction of any kind, then one must modify Maxwell’s equations and, hence, modify the entire electromagnetic theory and, consequently, the theory of relativity as well.

I finished up my side of the conversation this way, speaking specifically on the reason why the non-Einsteinian clocks were left out:

I find this both tragic and amusing—and it’s also pretty much what I thought must have happened. (I hope you let me relate this story in a future article sometime.) Sometimes my readers ask me why, if certain “heretical” ideas are true, they haven’t heard about them. Well, guys like Romer wouldn’t publish it for one thing.

Jefimenko sent me a copy of his last book,[2] in which he rigorously applies retardation to gravity. One thing he discovered is that some mass distributions will result in repulsive gravity fields.

How do you like them apples?

1 Retardation and Relativity, Jefimenko, Oleg D. (ISBN 0-917406-21-4, 1997).

2 Gravitation and Cogravitation, Jefimenko, Oleg D. (ISBN 0-917406-00-1, 2006).

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THE REFERENCE LIBRARY

Don Sakers

Space opera isn't what it used to be. And that's a good thing.

When Wilson Tucker coined the word in 1941, "space opera" was a term of derision. It was analogous to the earlier term "horse opera," a pejorative label for Western films. Tucker used the expression to refer to "the hacky, grinding, stinking, outworn spaceship yarn." He decidedly did not mean the stuff John Campbell was publishing in Astounding; Tucker was thinking of innumerable hack stories appearing in pulp magazines such as Amazing, Future Fiction, Planet Stories, and Comet Stories. These tales, most of them long forgotten, were also described as "westerns in space"—stories that read as if the author had taken a familiar cowboy story and changed horses to spaceships, six-shooters to blasters, and wide-open prairies to trackless interstellar space.

As SF matured over the next decades, the old-fashioned "western in space" story became scarcer than water in the desert. But "space opera" was too good a phrase to give up. For a while "space opera" meant any adventure story involving space travel, other planets, and/or aliens. Eventually, however, "space opera" came to mean what used to be called "super-

science stories" of the sort written in the late 1920s and 1930s by Edmond Hamilton, Jack Williamson, and the master of super-science, E. E. "Doc" Smith. By this time, the "super-science story" had fallen out of fashion, and no one was publishing them any more. "Space opera" became a term of affection, heavily flavored by the nostalgia of older fans for the stirring stories of their youth. In this period, space opera was a sort of guilty pleasure among readers.

Then the marketing divisions of publishers, sensing the good feelings that the words "space opera" evoked, started using the term to sell books. Before long, anything and everything was being marketed as space opera—including the likes of I, Robot and Stranger in a Strange Land (two titles that would top my list of "Books Not At All Resembling Space Opera.") To a degree, this tendency continues today, so be careful when reading publisher's blurbs and other advertising material.

In 1977, a tiny little art film called Star Wars brought pure-quill space opera to a larger audience. (If you haven't seen the movie, you'd probably enjoy it.) In the me-too world of film, space opera enjoyed a brief renaissance (although no one called it that outside the SF field).

Notice the delicious anachronistic irony here: those books and stories now falling under the category of space opera were not called that when they appeared. Historians of SF, wrangling over which stories are space opera, are in somewhat the same predicament as modern mundane historians trying to determine

what, if any, abnormal psychology applied to Lincoln, Nero, or Akhenaten. Take the works of Olaf Stapledon as a prime example. Stapledon's books Last and First Men and Star Maker are both star-spanning epics in true space opera fashion, but they certainly aren't "Doc" Smith style super-science stories. If you want a long pointless argument, ask some old-time SF readers if they are space opera or not.

In the late 1980s a small number of British writers began to consciously reinvent literary space opera in the "Doc" Smith style. These included M. John Harrison, Iain M. Banks, and Paul J. McAuley. (At the same time, Brit Harry Harrison started his Bill, the Galactic Hero series, which was a hilarious satire of space opera.) These "new space opera" books were of higher literary quality, featuring non-cardboard characters and more elegant prose, and also included speculations based on cutting-edge science. In time, this new space opera became very popular—as it remains to this day.

But why did the space opera renaissance spring from Britain, not the States? I've seen a number of analyses, but nothing authoritative. My own theory is that American publishers in the 1980s were reluctant to publish space opera, considering it either old-fashioned or like Star Wars—and in those pre-Timothy-Zahn's-Admiral-Thrawn days, there was no market for Star Wars-like books. It took the Brits to convince American publishers that space opera would sell . . . at least, space opera written by British writers.

Today's big names in space opera include the fellows

mentioned above, and also Steven Baxter, Alastair Reynolds, Ken MacLeod, and Peter F. Hamilton.

Two subgenres often related to space opera are hard SF and military SF. There's a lot of overlap around the edges; it's impossible to draw hard-and-fast dividing lines. Similarly, the subset of SF that deals with Galactic Empires often bleeds into space opera. Are the Foundation books space opera? Almost certainly not. The Dune books? That one's a little harder.

So what is space opera? The term defies exact description, but lately I've been calling it "grand, melodramatic science fiction productions without the music, but with lots of great scenery, anguish, death, and an occasional fat lady." It's as good a definition as any.

If you want to know more about space opera, look for David G. Hartwell and Kathryn Cramer's comprehensive 2006 anthology The Space Opera Renaissance.

But on to some recent titles.

The Evolutionary Void

Peter F. Hamilton

Del Rey, 704 pages, $28.00 (hardcover)

ISBN: 978-0-345-49657-7

Series: Void Trilogy 3

Genre: Space Opera

Peter F. Hamilton is one of the best space opera writers around today. He writes big, meaty books that interweave the

adventures of dozens of characters on many different worlds, with technologies that perfectly exemplify Clarke's Law: Any sufficiently advanced technology is indistinguishable from magic. His themes are grand, worthy of space opera: interstellar war, Byzantine politics, the clash of religions and civilizations.

With a book of 700+ pages, you'll want to know right away what you're getting into, and Hamilton isn't shy about giving you the clues you need. Take this small excerpt from the second paragraph: "Navigation at that awesome velocity was by quantum interstice similarity interpretation, which determined the relative location of mass in the real universe beyond. This alleviated the use of crude hysradar or any other sensor that might possibly be detected." If this leaves you twitching and foaming at the mouth, then this is not the book for you. If you're left thinking, "Oh, good, let's hear more," then you'll love it.

The Evolutionary Void is the third in a trilogy (the two previous books are The Dreaming Void and The Temporal Void). The Void Trilogy, in turn, is set in the same universe as the earlier Commonwealth Saga, Pandora's Star and Judas Unchained. That's an enormous amount of back-story, about 3300 pages worth if my calculations are correct. There are two choices: read the earlier books first, or just take a deep breath and dive in.

If you dive, be prepared to be confused for a while—but after the first 50 or so pages, you'll discover that the water's fine. Strong, sympathetic characters grab the reader quickly,

and soon you'll be so intent on following them that you'll forget that you don't know all the details of the back-story.

Big, detailed space operas like The Evolutionary Void are like a visit to a foreign country where you don't speak the language. Fortunately, Hamilton is an excellent tour guide; he pays attention to the familiar as well as the exotic, and if you trust him you're in for an enjoyable and enlightening trip.

Transformers: Exodus

Alex Irvine

Del Rey, 276 pages, $27.00 (hardcover)

ISBN: 978-0-345-51985-6

Genre: Space Opera, Media SF

Ever since Star Wars there has been an unspoken connection between space opera in movies (and on TV) and space opera in the pages of books. Transformers, which started life as a line of toys and inspired both children's cartoons and comic books, might seem an odd choice to appear in this column. Trust me, Transformers: Exodus is a fun space opera.

It ought to be fun. The author, Alex Irvine, is an accomplished SF writer—his most recent SF book is last year's Buyout. He knows how to tell a good story, and he knows that good characters can save even the most childish premise. Take a deep breath, ignore some of the names (Irvine got stuck with a planet called "Cybertron" and the "Matrix of Leadership,"

he didn't invent them), and you'll find it fairly easy to enjoy this one.

A gladiator called Megatron (another one of those names) rebels against the corrupt, ordered society of Cybertron. Soon he has followers and a movement all his own, and he becomes a threat to the Powers That Be.

Meanwhile, Megatron's defiance has attracted the attention of a minor office functionary named Orion Pax. Pax first becomes Megatron's disciple, then his friend. But there are betrayals and attacks, and soon the two friends become bitter enemies caught in the middle of a civil war that wracks the entire planet.

If you are a fan of the Transformers, either in their original incarnation or their more recent hit movies, then you'll find a lot to like in this book. But if you don't know Optimus Prime from Omega Supreme or an Autobot from a Decepticon, you'll still be able to enjoy this fun little space opera.

Star and Gods

Larry Niven

Tor, 368 pages, $25.99 (hardcover)

ISBN: 978-0-7653-0864-1

Genre: Short Fiction

Larry Niven doesn't exactly write space opera. He made his reputation with hard SF, with stories based on reasonable extrapolations of accurate science, told in sparse language with

uncomplicated characters. His masterwork is the Known Space series, about 20 books set in a consistent future, of which the most notable are the classic novel Ringworld and its three sequels. He is a multiple Hugo Award winner and a perennial bestselling author. In recent years Niven has been collaborating a lot, most recently with Edward M. Lerner (the Fleet of Worlds Trilogy) and Jerry Pournelle (Escape From Hell).

Stars and Gods is a sampler for the reader who wants to know what Larry Niven has been up to during the past six years or so. There are excerpts from seven novels, both solo and in collaboration; more than a dozen short stories; an assortment of nonfiction pieces; and introductions to many of these items.

If you are a fan of Niven, you'll no doubt want to get this book. You may have already read all the novels, but you might not have seen some of the short pieces, and the personal introductions give an interesting glimpse into the author's mind.

It's a little more difficult to imagine what a reader who isn't a Niven fan would make of Stars and Gods. By its nature, the book is somewhat disjointed and may seem a bit unsatisfactory.

Zendegi

Greg Egan

Night Shade, 279 pages, $24.95 (hardcover)

ISBN: 978-1-59780-174-4

Genre: Man & Machine, Near Future,

Psychological/Sociological SF

Another hard SF writer of note is Greg Egan, and in Zendegi he's given us a fascinating and exciting near-future thriller set in a real but exotic locale.

As the book opens, Australian journalist Martin Seymour is stationed in Iran, covering the 2012 parliamentary elections. It turns out that the elections are anticlimactic; all the opposition candidates are disqualified so the current theocrats stay in power. Only a few weeks later, however, a sex scandal among government officials leads to widespread unrest that eventually topples the government.

Meanwhile, in the U.S., an Iranian exile scientist named Nasim works on the Human Connectome Project: an attempt to map the wiring of the human brain. When funding vanishes and the project is cancelled, Nasim heads back to her homeland to be part of the new revolution.

Fifteen years later, in 2027, Nasim heads a company that provides access to a virtual world called Zendegi. Zendegi is a source of entertainment and a place of business for millions of people . . . but the competition is advancing, and Zendegi is in trouble.

Nasim uses the knowledge and skills she gained from the Human Connectome Project to engineer something new for Zendegi: avatars (called proxies) that are so lifelike that some believe they are actual living beings. For a time proxies put Zendegi far ahead of the competition. Controversy rages over

whether proxies deserve human rights and whether Nasim and her company are enslaving living beings.

Into this mess comes Martin, who's been living in Iran with his wife and young son Javeed. It seems that Martin may very likely die soon, and he is troubled at the thought of abandoning his son. He asks Nasim to create a proxy, based on himself, that could carry on after his death. But will Zendegi itself survive long enough to fulfill Martin's wishes?

The story is gripping, the details of Iranian society and politics are fascinating, and the characters are well drawn and captivating. As if that's not enough, the philosophical questions of identity and humanity, which stay with the reader long after the story is done, are most rewarding. Definitely not to be missed.

Shades of Gray

Jackie Kessler & Caitlin Kittredge

Spectra, 414 pages, $16.00 (trade paperback)

ISBN: 978—0-553-38632-5

Series: Icarus Project 2

Genre: Superheroes

In Black and White, Jackie Kessler and Caitlin Kittredge introduced us to young superheroes Jet (Joan Green) and Iridium (Callie Bradford), who wield powers of darkness and light, respectively. Jet and Iridium started as best friends but became bitter enemies; in Black and White they had to co-

operate to take down the dastardly villain Taser.

In Jet and Iridium's superhero world, there are hundreds of super-powered extrahumans, most in and around the city of New Chicago. For decades, the global corporation Corp-Co has controlled the extrahumans by means of a high-tech system called Ops. At the end of Black and White, Jet and Iridium have taken down Ops—and for the first time, hundreds of extrahumans are free of Corp-Cos control. The heroes realize that they've been enslaved all this time . . . and they're not happy about it.

Shades of Gray picks up where the first book left off. New Chicago is in chaos. Angry extrahumans are ransacking the city; anti-superhero groups are stoking the fires of suspicion and prejudice against the extrahumans. Jet, along with a small group of still-lawful heroes, attempts to quell the chaos . . . a job that seems helpless.

Meanwhile, Iridium is having her own problems dealing with Corp-Co, which is still very much in the fight.

Into the middle of this anarchy steps the sociopath Doctor Hypnotic, bent on his own nefarious schemes. Once again, Jet and Iridium must put aside their differences and work together to save everyone.

Jet and Iridium are engaging characters and their world is intriguing. If you're looking for a light superhero adventure that touches on some fairly weighty questions of morality, Shades of Gray is your book.

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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BRASS TACKS

Dear Dr. Stan:

I wanted to express my thanks for H.G. Stratmann's "The Day the Music Died" in the May issue. As one who suffers regularly from "earworms," I appreciated the story immensely.

Having done what obviously was rather extensive research on the subject, I wonder if Stratmann has found the answer to a question that's tickled my curiosity: Is there a genetic marker for susceptibility to earworms?

I would appreciate it if you could pass that query on to the author, and this bit of apocrypha: Leo Kottke, it is widely reported, once had the Woody Woodpecker theme lodged deeply in his head and discovered what seems to be an earworm eradicator. He learned and played the melody backwards, sucking the worm right out.

Thanks as always for the great mag.

Yours,

Louie Ludwig

New Orleans, LA

Stan,

Your [June 2010] editorial suggesting that religious stories may be a "history of the universe for dummies" really hit home. I

came to this conclusion years ago as a way to reconcile my parents' beliefs with my growing scientific knowledge. Once I started down this way of thinking, two potential short stories came to mind. The first would be an examination of miracles using Star Trek devices. Replacing water with wine is easy if you have a teleporter. The second would expose Jesus as an intergalactic graduate student, running amok on Earth when all the "good" thesis topics were already taken. Speaking of graduate students, I started subscribing to Analog after picking up a copy in the math dept lounge in 1970. Let's hope you can keep my brain working for another 40 years!

Regards,

Dr. William A. Hansen

Dear Dr. Schmidt,

To put what I have to say below into perspective, I have been an avid, regular, and satisfied reader of first Astounding and thereafter Analog since the mid-1950s. I still have almost every copy of the magazine during that period (with just a few exceptions). On the whole, I have received enormous pleasure and considerable education as a consequence, and rarely have I been disappointed with an issue.

However, I felt that the May 2010 issue (with the exception of "Farallon Woman") was by Astounding/Analog standards very disappointing and below my expectations.

Having said that, the June 2010 issue was a delight!

Not a bad record—only one substandard issue (by my own

subjective criteria) in some 55 years.

Please keep up the good work—but please also be kind enough to take another look at the stories in the May 2010 issue; maybe it is just me, but perhaps you too will find something lacking in most of them (even those by authors whose other work I have thoroughly enjoyed).

Yours sincerely,

Mel Anthony

Saumont-la-Poterie

Normandy

France

Dear Dr. Schmidt;

What a fun story! ["Space Aliens Taught My Dog to Knit!," June 2010] A great play on all the conspiracy theorists out there. What made it especially fun is that the protagonists drove right by my house! I could picture every location mentioned.

I've been a reader since I started reading my dad's copy back in junior high. I rarely find a story that I just cannot read. Keep up the great work!

Yours,

Don Harrington

Maple Valley, WA

Dear Ms. Dyson and Mr. Nelson:

I received Rocket Men as a present for my birthday and

have been in the process of enjoying the history of Apollo 11 greatly. While reading it, my July/August 2010 issue of Analog appeared. Being decisive, I read both. And there on its pages was the story “Fly Me to the Moon,” a story of an elderly Apollo “moonwalker” that has to rescue a woman on the Moon using a faux LM.

Going back and forth between the book and the story was exciting as the short story matched the technical accuracy of the book so well. When the term BBQ was used in “Fly Me” to refer to rotation of the LM, it was a new term to me. As I sat that story down, the immediate page that appeared in Rocket Men specifically went into a description of the maneuver. It was as if you both were inside my head filling in complimentary information.

I just wanted to let both of you know how well your two approaches to telling the story of Apollo worked, both with each other and separately. It increased my appreciation of both. Thank you very much.

Ray Crisp

Stan,

I take pen in hand (well, okay, maybe just figuratively) to get my piece in. I have been reading Analog (as well as Galaxy and IF and others since the late ’50s). A recent editorial stirred me up to send a questioning reply.

Way back when, science fiction used to mean stories with lots of Gee Whiz and Wow and Golly Gee and I don’t know what

else. They didn't have to have a moral. The only requisite—if that—was that good had to triumph over evil. I saved most of those magazines and stored them away (probably a little too well because I can't easily get to them to re-read them) but I don't do that anymore with the later issues. Somewhere along the line, someone made the decision that all stories had to be based on "realistic" science. You have good stories now, but they don't have any of the aforementioned characteristics. FTL drives are not allowed, so interstellar travel becomes next to impossible. Death rays and stun guns and all sorts of other weaponry can't exist. Alien cultures have to correspond to what we believe is possible.

I guess my question is, would "Doc" Smith have been published in Analog today? Probably not. His science is not possible as we know it today. Would van Vogt have been published? The early Asimov (before he found out about true sci fi)? A lot of the "old masters" wouldn't make it into print today because their science is not "real." That would have taken away a lot of good, fun, rollicking stories. I mean, cars going 400 mph down super highways crisscrossing America! A young man inventing an FTL drive and taking his girlfriend with him! Star Wars. Star Trek. Tom Swift. Skylark of Valeron.

I quote from your essay, "Even if we ever reach a point where we know everything that could be learned (don't hold your breath!)." How do we "know" that FTL drives can't exist? And please don't drag out Einstein—he has a good set of theories. Years ago, man knew that you can't fly. Wait a minute, that

happened (although we do have to use a machine to do it). So of course we couldn't exceed the sound barrier. Wait a minute, that happened also. If we had put an integrated circuit in front of an electrical engineer 40 or 50 years ago and told him what it could do, he would have said "No way!"

As my wife is fond of saying, "You're ranting." So I'll cut to the chase. Can we have some the old Gee Whiz or Wow or Golly Gee stories back? Until that returns, I guess I'll continue to read Analog but not save it.

I do enjoy the science articles, though. I share a lot of them with my colleagues. My background is chemical engineering (for what it is worth) and a farm boy at that. I guess it was the old stories and the night skies that got me interested in science and I just hung in there.

Thanks for putting up with me, Stan.

Merle Fritz

I'm a little puzzled by some of your claims, such as, "FTL drives are not allowed," since they appear rather frequently in our stories. However, I do agree that I'd like to see more fictional exploration of stories based on science that we don't know yet (and maybe never will), which is, in part, why I wrote that editorial.

But I'm afraid the "Gee Whiz and Wow and Golly Gee" is a lot harder to achieve now than it was back then, in large part because so much has already been learned and done in reality that would have inspired such reactions then, and because so

much more of the population has become accustomed to seeing “science-fictional” dreams come true.

Dear Dr. Schmidt,

I’m a few years behind in reading Analog—up to 2003 at this time—and would like first to offer a kudo on your editorial in the October 2003 issue; brilliant!

And now the comment: I could not help but notice, in the “Moonstruck” serial by Lerner, that multiple gender/racial identities were carefully ladled out amongst the various characters, almost as if the author had a list to apportion. And if he did have a list, was it his or yours? I have seen this before in Analog, especially in stories involving multiple characters, and it always strikes me as artificial and just too politically correct.

Aside from that, carry on with the good work—the content of Analog seems to continually improve.

Charles S. Chase

I doubt that he had such a list, and if he did, it certainly wasn’t mine. I’ve repeatedly criticized such “quotas” (which I’m told some publishers have tried to impose), in such editorials as “Equal Rights for Dumb Blondes” (August 1979) and “Nouveax Clichés” (October 1993). However, while I strongly oppose attempts to enforce a particular distribution of genders, ethnicities, etc., most writers are increasingly recognizing a tendency for things like crew make-up to become more diverse in reality.

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IN TIMES TO COME

Our December issue again offers an unusual combination of a story and a closely associated fact article. The story is Shane Tourtellotte's "The Man from Downstream," about a time traveler who does what he does for an unusual reason, and then faces an unexpected challenge about what to do next. The fact article is Tourtellotte's "Tips for the Budget Time-Traveler," which takes a quantitative look at some of the very practical problems such a traveler would inevitably face. Fact article, you say? No, we don't think it's likely that you'll actually take such a trip anytime soon—but if the opportunity should unexpectedly arise, this is an important part of what you'd be up against.

While "The Man from Downstream" is not part of Tourtellotte's "First Impressions" series, we also have a couple of stories that are parts of series you'll likely remember—Christopher L. Bennett's "Home Is Where the Hub Is," and Brian C. Coad's "A Placebo Effect," in which long-suffering patent attorney Wally Mason is temporarily coaxed out of retirement—as well as some that aren't. One of those, H. G. Stratmann's "Primum Non Nocere," could easily be considered a seasonal special, in a sneaky sort of way—though it could also be considered several other things, too.

UPCOMING EVENTS

Anthony Lewis

December is always a slow month for conventions because of the holidays.

19–21 November 2010

SFContario (Toronto SF conference) at Ramada Plaza Hotel, Toronto, ON. Author Guest of Honor: Michael Swanwick; Editor Guests of Honor: Patrick & Teresa Nielsen Hayden; Fan Guest of Honor: Geri Sullivan; Filk Guest of Honor: Karen Linsley; TM: Robert J. Sawyer. Membership: 21+ CAD45, 13-21 CAD35, 5-12 CAD25. Info: http://sfcontario.ca/, con2010@sfcontario.ca, SFContario, 151 Gamma Street, Toronto, Ontario, M8W 3G4, Canada.

26–28 November 2010

DARKOVERCON 33 (Marion Zimmer Bradley Darkover Grand Council Meeting) at Holiday Inn Timmonium, Timmonium, MD. Guests of Honor: Elizabeth Bear, Amanda-Lee Ronanyne, Katherine Kurtz, Clam Chowder. Membership: until 1 November 2010—$45 adult, $22 6 to 12, free under 6; after that and at the door $50, $25, free. Info: www.darkovercon.org; jaelle@darkovercon.org; Amida Council, PO Box 7203, Silver Spring, MD 20907. Checks to Amida Council.

3–5 December 2010

SMOFCON 28 (SF conference-runners conference) at Sainte Claire Hotel, San Jose, CA. Theme: Building Bridges. Membership: $65 until 15 November 2010, more afterwards and at the door. Info: www.smofcon28.org; info@smofcon28.org; PO Box 61363, Sunnyvale, CA 94088-1363.

17–21 August 2011

RENOVATION (69th World Science Fiction Convention) at Reno-Sparks Convention Center, Reno, NV. Guests of Honor: Ellen Asher, Charles N. Brown, Tim Powers, Boris Vallejo. Membership from 1 May 2010 until some later date (see website for latest details): Attending adult: $160; Attending 17 to 21: $100; Attending 0 to 16: $75; Supporting: $50. [Ages as of 17 August 2011]. 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: http://www.renovationsf.org/, info@renovationsf.org, PO Box 13278, Portland, OR 97213-0278. Facebook: http://www.facebook.com/pages/Renovation-The-69th-World-Science-Fiction-Convention/112169025477179?ref=ts; LiveJournal: http://community.livejournal.com/renovationsf/

Running a convention? If your convention has a telephone or fax number, e-mail address, or web page, please let us know so that we can publish this information. We must have your information in hand SIX months before the date of your convention.

Attending a convention? When calling conventions for information, do not call collect and do not call too late in the evening. It is best to include a S.A.S.E. when requesting information; include an International Reply Coupon if the convention is in a different country.

Previous Article **Novella**

Novella

Phantom Sense

Richard A. Lovett & Mark Niemann-Ross

I've never understood how it could be stalking if all you're trying to do is keep her safe. I just want to be a good father. Make up for all those years of being AWOL because CI-MEMS is a full-time job. You can't be a father and CI-MEMS. That is, you can be one—that's...

Top of Novella

Reader's Departments **Science Fact**

Phantom Sense

A tool and its user function as a unit, and the more complex and tightly integrated they are . . .

Richard A. Lovett & Mark Niemann-Ross

I've never understood how it could be stalking if all you're trying to do is keep her safe. I just want to be a good father. Make up for all those years of being AWOL because CI-MEMS is a full-time job. You can't be a father and CI-MEMS. That is, you can be one—that's the same as for anyone else. You just wind up with big chunks of time when you have to choose between being AWOL from the Corps or from your family. And if you give your family more than a generic because-my-country-needs-me hint as to why, then you're both in trouble.

Or that's how it had been back before I became Staff Sgt. Kip McCorbin (Ret.). Before the (Ret.) bit, that is. Once that happened, it was just me . . . and the secrets.

Twenty years of missions. Twenty years of always being away. Chad, Ethosmalia, Kurdistan, the Altiplano Breakaway. Twenty years of never being able to explain. Then, when it ended and I finally could get my family back, it came at a price, like suddenly being blind. No, that's not right. There are schools for the blind, a whole infrastructure for helping them learn to cope. As long as I had the Sense, I wouldn't even mind being blind. Who needs eyes of their own when they have hundreds at

their command? When you've been given a sense beyond eyes, beyond anything the norms have ever experienced?

Losing that is like losing your sense of touch. The world's still there but you can no longer fully interact. Worse, in fact, because people at least know what a sense of touch is. Here, the only ones you can talk to are Corps psychs who only think they relate. How could someone understand what it would be like to lose the sense of touch if he'd never had it in the first place?

Twenty years of missions, and all the while Cora Ann was growing up. "Where's Daddy?" had given way to "what-ever," until, when they finally told me I was ready to re-enter the Sense-less world, Denise's lawyer said it would be best if I just kept my distance. "She's at a difficult age," she said in one of her kinder comments. "The last thing she needs is you back in her life."

Hell, they're all difficult ages. Toddler, middle school, high school. Back when I had the Sense, I used it on furloughs to track her through her days, step by step. What father wouldn't? Especially when the furloughs were so short, so few? Her first week at school, oh so brave, oh so frightened. Getting her navel pierced? Secretly, she thought, but I was there. First kiss? The guy was a total geek, but so was she. Back then, a solider-type was most emphatically not what she wanted. Back then, her rebellion took the form of geeks and peace rallies—my little radical, growing up in fits and starts when I wasn't there, more and more often hiding from me when I was.

The damn psychs always had the same questions.

How do you feel about that?

What do you do when you feel that way?

I'll tell you how I feel, what I do.

For three whole years, I panicked whenever someone walked up behind me, or when I rounded a corner and found something I didn't know was there. It didn't matter if it was a kid's skateboard or another rehab patient on his own escorted walk. It was the not-knowing that mattered.

Three years of deconditioning until finally I convinced them I was again a norm. In CI-MEMS, that's not a term of respect, but the psychs never picked that up. Three years of learning to live without, but never really succeeding because the absence is always, always there, like an itch you can't scratch or an amputee's phantom limb. The arm he thinks he can lift to grab that cup of coffee. The leg he tries to stand on when he gets out of bed, because a lifetime of conditioning tells him it's there, only it isn't. Because his nerves insist it's still there even though its absence is the single, dominant factor of his life.

With a limb, you can explain all that. With a limb, you can get a prosthetic nearly as good as the original. But how could you explain losing the Sense, even if talking about it wasn't a breach of everything you'd once sworn your life to protect?

That's what I wanted to say during deconditioning. De-con, the Corps called it, complete with the stupid hyphen. Just one more big con, if you ask me: the illusion that when the missions

were all over and done, you could go home and live a normal life. Total BS, something the psychs needed to believe so they could feel better about what they were doing. But I never said any of that because then they might never have let me out.

For three whole years, I tried to pretend I didn't need anything but the senses I was born with. Didn't feel that the lost one was still there but not, like the amputee wondering why the coffee cup won't move when he reaches for it. Until eventually they gave me a pension and released me to the real world. Fifty-one years old, unsuitable for a job. Unsuitable for a family. Unsuitable for life.

The first thing I did was move to the Pacific Northwest. I'd spent a summer there and remembered the amazing, Mediterranean summers. Warm, dry, and pleasant. And miraculously insect-free. You could sleep all night with the windows open, no screen, and nary a gnat. Dine outdoors without flies in your food. A climate where nobody with the Sense would voluntarily go.

Then I saw Cora's latest VidBook post.

I'm not supposed to be viewing her blog. She never let me in as a buddy, but you don't spend as many years as I did on black ops and not know a bit about computers. Not to mention that she'd used her name and zip code as her password. CoraAnn78718. I'd cracked that even before the psychs released me to normal life.

I woke screaming.

I was blind, Senseless. The enemy was out there, and I didn't know where. I didn't know where anything was. Anything could be around the next corner. In the hallway, waiting to pounce, the moment I headed for the bathroom. How do people live like this? How could I live like this?

"I want it back!" I screamed into the night, my voice a raspy whine because I'd screamed this on so many nights since I no longer had to look like I was recovered. "Oh, God, I want it back! I want it back I want it back I want it back I want it BACK!!!"

It was worse than losing Denise. Worse than Cora. This had been part of me. A part that would never, ever be again. Even after three years with the psychs, there were times I wasn't sure I could make it.

Jerret was afraid. So was I, for that matter. CI-MEMS was designed for urban warfare. Tight quarters, where the Sense gave you overwhelming advantage. Not to mention that the rest of the squad protected you like their very lives depended on it. Casualty rates on missions with CI-MEMS operators were one-third those of other ops—and we usually drew the more dangerous missions. It was a good incentive to keep the operator alive.

The first to be aware of danger, the last to face it, that was us. But not in this damn desert, where any sniper with a night scope could nail you from way beyond Sense range. It said something that they'd put two of us on this squad. Too much chance of losing one or the other, someone must have figured.

Jerret's hand twitched, dislodging a member of my swarm that had gotten too close, tickling the hair on the back of his wrist. Sloppy on my part. I'd been concentrating on my fringes, hoping to catch some trace of a Ladenite sniper before he caught us.

Jerret knew what the insect had meant. "I'm okay," he whispered. A human couldn't have heard him from two feet away, but my bugs got it. Only he wasn't okay. Heart rate, respiration, skin conductivity, breathing, pupils . . . all indicated fear. Not to mention deception. Jerret was scared to death. Right on the verge of losing it. Luckily, he didn't ask me because he'd have caught me in the same lie. All these open spaces. We just weren't designed for them.

Cora's VidBook post wouldn't have caught anyone else's attention.

"You wouldn't believe the flies here!" she gushed into the camera, holding it too close, like everyone does, making her look like her nose was three sizes too big. Actually, it's a perfect match for the lively blue eyes and long, blond hair so achingly like her mother's at the same age. "They follow me everywhere! Yesterday four of them—I counted—zipped into the bedroom before I could shut the door. Then they just kind of hovered as I changed clothes. Can you imagine that? Cuh-reepy! Don't they have any girl-flies to peep?"

Zip code 78718 is in Austin, Texas. I've never seen her apartment—I don't want more court orders—but I know Austin. It

has flies, but it's nothing like Virginia, where she grew up. Not in November, anyway.

It was probably nothing, but you don't survive twenty years in CI-MEMS without being paranoid. Even if you're not on a black op, they send you to places where anybody, even the kid begging for change, could be carrying, and where 90 percent of the rest hate you anyway. The easy missions are the hunter/killer ones, where your job is to find a specific target while dodging noncombatants. Then, at least, everything's cut and dried. The patrols that turn you paranoid are the ones where you're just passing through, trying to spot real threats without slaughtering the maybes.

When I was new to the Corps, I tallied two statistics. Bad guys taken out and guilty-acting innocents saved. But after a while, I realized that tallies don't matter. Each mission is a world unto itself. Get in, do the job (meaning get the right people and not the wrong ones), and get out. Preferably with the rest of your unit alive.

I was good at it. Even in the first weeks of training, they told me I had an unusual ability to integrate. What they didn't tell me was this meant the loss, when it came, would be all the more devastating.

I woke with the instant, unmoving alertness only years of missions can train. This time I wasn't in bed; I was on the couch. The TV was on—a get-rich-quick infomercial or something equally late-night brainless.

I wasn't alone. I could Sense someone behind me. He was looking out the window, his face a blur of face paint. Blue jeans and a dark serape. His Uzi was carelessly gripped in one hand, but the nonchalance was deceptive, the relaxation of a snake at rest, capable of coiling and striking before you even knew what happened. He'd done it before, and would do it again until somebody coiled and struck faster. He wasn't expecting anything like that at the moment, but still, he was ready for quick action, studying the road outside, waiting, watching. Waiting for something like my patrol, still out of sight around the corner. His pulse was low, his breathing steady. A trained killer, perfect in his element.

I drew back from my fringe, preparing to report. Take him out or bypass him? The sentry on the other side of the building wasn't as alert. If we could get a couple men in unseen, I could guide them, coordinate the attack, a wordless game of follow-my-swarm and attack when I gave the signal, which could be as simple as a fly buzzing in the ear. We'd done it before, sometimes against as many as four targets spread across a thousand-foot front, one of the reasons I'd quit counting.

But something didn't fit. I couldn't find anyone to report to. Had the sentry somehow gotten everyone but me? And where was my real body, anyway? I was so far extended into the Sense I seemed to have lost touch with my own surroundings.

It was the TV that did it. The infomercial was in English. Not Spanish, Arabic, or anything else. It was telling me how to make a fortune investing in foreclosed properties. Not something a

serape-draped sentry would be listening to, even if he was willing to put up with the distraction.

Still, it was all I could do to force myself to look back. But there was nothing there but a bookshelf. My own books, my own apartment. Me. Alone. In Seattle. As I'd been for two years.

I sat up, pulled the phone from its charger, dialed a too-familiar number.

"Yeah?" a voice said.

"It happened again."

"Flashback, hallucination, or phantom eye?"

"Not sure." I describe the scene. "Might have been the Altiplano. After a while, they all blur."

"Yeah. Last night I was sure there were snakes in the room. Why snakes? I never even saw one in the field. That was the least of my worries."

We talked a bit longer, until I was really ready for sleep. I had no idea who he was; we'd found each other online, and communicated by dummy accounts and encrypted lines. Secrecy's a hard habit to break. But it was better than calling the Corps psychs and getting a diagnosis like paranoid schizophrenia on your record.

The Sense is a lot of things. It lets you see around corners or into any room with a crack big enough for an insect to slip through. But it's more than seeing. If they make a microdetector for something, they can mount it in a swarm.

For a lot of operators, the information's just that: data. You need a computer to interpret it and run the swarm, and you wind up sitting back on base with a bank of electronics: coffee in hand, A/C, the whole nine yards.

But that's just fancy remote sensing.

If you've got the ability to integrate, the data cease to be data. Add an interface descended from those used for prosthetic limbs, like that concert pianist who plays Chopin with a mechanical hand, and you've got true CI-MEMS. The data bits disappear and you wind up with things you simply know, on par with it's raining or I'm on a tropical beach.

Most people never make that leap. But for those who do, CI-MEMS is more than a way to see around corners. It's an emotion-sensor in the air. In a crowded bazaar you know who's hostile and who's just scared. Who'll run away if you give them a chance, who's just out to save face, who's a true believer.

Back on base, though, nobody wants you around. Everyone's got secrets—and while you may not know the details, you sure as hell know when one's there. Not to mention being able to win at poker even if you promise not to peek. Keeping track of things becomes a habit, even when there's no real need. Maybe that's how stalkers are born. The Sense makes you allergic to surprises. If you can know, you want to. If you can't, you get desperate.

The intel had been absolutely clear. The Ladenites were somewhere across the valley. Five square klicks of boulders,

snakes, and who knows what. There were at least fifteen of them, fifteen who the sat intel had caught going in, but not out. Drones had seen four of them again, IDing two as important enough to be worth an incursion into a nominally friendly country.

We'd come in low and quiet, shortly after dark. A quick drop, a not-so-quick march, and now we were staring across the damn Valley of Death, like a scaled-down version of the six hundred. We should have circled east, higher up, and come back, along the ridge. But now, with dawn looming, our only hope was that their lookout wasn't all that well equipped.

"You see anything, Jerret?" I spoke softly, right at the limit of my ability to form the words. No need for radios; our swarms were the best way to communicate. If the answer was worth anything, I'd pass it on to the grunt assigned to keep me alive, and he'd hand-signal it to the others. I suppose in theory the enemy could zero in on the link to and from my bugs, but unless you're using dragonflies or something else big enough to carry a real transmitter, the range is pretty limited. Anyone who has the equipment to sort it out from the background mish of cordless phones, microwave ovens, and garage-door openers is too well dug in for us anyway. In the city, at least. Here, to the right equipment, Jerret and I might stand out like beacons.

Cora's next post was the one that really got my attention.

"You wouldn't believe how hard these flies are to kill! It's like they know what a flyswatter is, because the moment I pick one up, they're gone. I finally got one last night, when it followed

me into the shower. I turned up the water and steamed that sucker, good! Thwacked it with a towel while I was at it."

Lt. McCarthy was going to be hurting tomorrow. If we lived that long. He was staring across the valley through night-vision glasses, in a vain hope of seeing things Jerret and I hadn't been able to spot, and in the process he'd scooched though a field of something like miniature prickly pear cactus. My swarm had all the night vision the patrol really needed, and I could see the spines sticking out of his forearms like a stubble of blond hairs.

I should have felt sorry for him, but only newbies go that heavy on the pain blocker. From the number of spines, he must have wormed his way through a whole patch of the stuff without noticing. Do things like that a few times, and you decide a bit of short-term pain's not as bad as it sounds. Yeah, with less block, you'll hurt more if something awful happens, but the awful stuff is what we're all trying to avoid, anyway.

Usually, only senior officers get command of CI-MEMS patrols. We were just too valuable to risk. But Lt. McCarthy was green. "Don't worry," he'd said as we were leaving base. "Captain Thomas has the Shanghai flu, but he'll be okay. I grew up in Arizona. I know all about deserts. We'll do fine."

Someday, maybe officers will know better than to lie to CI-MEMS operators. It creates "interesting dynamics," a base shrink once told me. Maybe. One thing I'd learned was that outing the liar's worse than playing elephant-in-the-living-room. Though in this case the grunts didn't believe him any more than I

did.

If there's a single piece of my life I wish I could do over, it's the day I hit Denise.

I didn't mean to, at least not that way.

Three weeks earlier, I'd flunked a physical—nothing serious, just a bit of arthritis, creeping blood pressure, and a few other things that might or might not be problems in a couple of decades but that they couldn't risk in the field. Nor did they have a post for me as an instructor. Sorry about that, etc., but we've got all we need.

The first step in De-con is simple. They just quit supplying you with insects. Since most only live two to four weeks, and some are always nearing the end, you decline pretty rapidly. But until you're below 20 percent, you can live at home.

I'd lost that much of my swarm on missions, several times. The blast from a big explosion can do it. And there was the time a wind gust blew my entire fringe beyond retrieval range. Not to mention bats. Even if you're watching for them, they're damn fast and hard to dodge.

But this was different. Lose your swarm in the field, and the techs'll get you replacements as quickly as they can wire 'em up. Here each loss was forever. The psychs say withdrawing that way's better than going cold turkey. Maybe. What it feels like is extended death.

For ten days, I felt my swarm die. There must have been some chemical in the air, because I was losing them way too

soon. I desperately wanted to hold on to what I had. Would have done anything to buy an extra week, day, hour.

Then the neighbors bought their kid a remote-controlled toy—some flying thing that was probably supposed to be a Moon lander. That shouldn't have been a problem, but there must have been something wrong with my bugs' control chips, because the toy threw out enough interference to mess up contact with what few remained. In the field, somebody would have fixed that, fast. Here, I didn't even bother reporting it. They'd have just told me I was ready for to go inpatient a week ahead of schedule. No big deal. Except to me.

Denial is one of the world's most powerful emotions. As long as I was free and mobile . . . as long as I had some remnant of the Sense . . . I could pretend the end wasn't really going to happen. Not yet. Tomorrow maybe, but not today. Until then, I could at least pretend.

Denise didn't know about the Sense. All she knew was that I was special ops and that the spiral tattoo that covered most of my back and shoulders had something to do with it. What, precisely, she'd known better than to ask. But other than a calculator on the inside of my wrist, I'd never favored body art, so she had to have guessed it was some sort of bio-mod.

One of the ironies of De-con is that with the insects gone, the Corps figures there's no need to remove the tat. They think it's a kindness, but actually it's a daily reminder of what I've lost, like the photos of Denise and Cora Ann I still kept on my

nightstand, smiling over me like they no longer do in real life.

Lt. McCarthy was in my section, so monitoring him was my responsibility.

“You see anything, McCorbin?” He spoke louder than necessary, as though he didn’t quite get that I had insects in the very bush he was attempting to peer through.

I inched through sketchy cover until I was close enough for quiet conversation, suppressing the urge to say something insubordinate. How the hell could I see anything? I had my fringe extended as far as possible, but it was only a fraction of the way to the opposing ridge.

“No,” I said. Nothing but rocks. Big ones. Any of which could have a dozen Ladenites behind it.

“What about Lapp?”

“He’d have told me if he did.”

The lieutenant was a vague blur of desert camouflage in my real sight, but in the Sense he stood out like an emotional beacon. Unsure. Frightened. Determined to prove himself. A whole slew of ways to get us killed. There are things CI-MEMS operators rarely talk about, even among themselves. Knowing your squad leader’s self-doubts is one of the scariest.

Scarier still was the subtext. Whatever else he was, Lt. McCarthy was no coward. We were about to become the Light Brigade . . . though instead of six hundred of us, there were only a dozen.

I woke screaming.

I was blind, Senseless. The enemy was out there and I didn't know where. I didn't know where anything was.

We'd been flitting from doorway to doorway, nearly invisible in midnight camo. I'd been at the rear—but not by much, because the place felt like a trap and we needed my perimeter as far ahead as possible. Still, I'd found nothing out of the ordinary. Maybe there was nothing to find. The scariest missions were those where the intel was wrong. Where you inched from house to house, waiting to Sense something before the bullets stitched you . . . only to discover, hours later, that there had never been anything to find.

But this time there was something. I just never got a chance to find it.

Booby traps are one of the things I most feared. Even simple tripwires can be hard to spot. I found better than 95 percent of them, but when I missed one, someone died. It wasn't one of those things I liked to think about.

The only thing I knew for sure was that the entire street exploded. No, that wasn't right; there were no gouts of flame, no crashing masonry. These people didn't want to blow up their neighborhood. These were flash-bangs: concussion grenades. Or maybe just big firecrackers. I'd had someone toss one of those in a dorm room the year I tried college, before I decided that that life wasn't for me. In the confined space, it might as well have been a concussion grenade.

Whatever they were, there were a lot of them, all wired to go off at once. My entire perimeter was off-line, probably dead.

The enemy was out there, alert now, with me suddenly blind as a norm. I was the one who was supposed to know where they were, but even as I sent my few remaining assets up the street, I knew it was too late. And it was all my fault. My fault because I'd not seen the tripwire. My fault because I'd not found the enemy before the explosion. My fault because I'd had so much of my Sense on the perimeter that I now had too little left to do anything other than watch my squad die. Dead from a trick I should have anticipated, a trick that had nearly cost me my hearing in college. My fault—I sat up, pulled the phone from its charger, dialed.

"Yeah?"

"It happened again."

"Flashback, hallucination, or phantom eye?"

"Nightmare."

Or maybe a daydream. Sometimes it's hard to tell. Long ago, after a mission on which we only escaped because I could pinpoint the enemy well enough for our snipers to get them through blacked-out windows, I got wondering how, if I were the enemy, I'd beat myself. Flashbangs was how I'd do it. Or anything that would knock out my swarm over a broad front, all at once. Make me a norm, render the patrol helpless. Then close in for the kill.

We got about halfway across the valley. Still out of Sense

range.

The first to buy it was the grunt assigned to baby-sit me. PFC Aston Stanley. One moment he was worming forward toward the next bush. The next, a high-velocity round punched through the hollow of his neck and into his chest. I knew because I had several bugs right there and could feel the impact, feel the consciousness vanish as the shock made jelly of his chest and gut.

“Sniper!” I yelled, and was already moving, one-two-three seconds before I heard the report of the shot that killed him. Three seconds away. A thousand meters. Impossibly beyond Sense range.

A bullet raised dust in the spot where I’d been half a second before. I braked hard and rolled back the direction I’d come from, just in time to dodge a second round. However many snipers there were up there, they were damned good. And obviously equipped with night scopes.

Desperately I looked for a place to hide. Reversed course again, dog scrambling, hands and toes. This time, the round missed me by farther than before, but that was false reassurance. At this range, the bullet only spent a little more than a second in flight. I couldn’t outguess the sniper forever.

There were no rocks big enough for meaningful cover. Bushes were worthless. As long as the sniper knew where I was, he’d just shoot through them. He might miss a couple times, but he’d get me eventually.

It was the Sense that saved me. At the first sign of trouble, I'd scattered my reserves, looking for somewhere, anywhere to hide, dedicating my biological eyes to my frantic efforts to dodge.

What my Sense found was an arroyo, cutting across the valley floor in front of me. I didn't even bother to see how deep it was. Still scrambling—getting to my feet took too much time—I zigged, zagged, got lucky three more times, and then was falling, headfirst, as a final round spat gravel from the gully wall.

As far as Denise knew, I was about to ship out on yet another mission and wanted every possible minute with her. We'd always been like that, spending those last nights clinging to each other, willing the clock to stop, determined not to waste those precious moments sleeping, because they might be all we'd ever have. For once, there was no risk of being shot, but I still wanted to carry every second's memory into De-con.

Absurdly, it was that desire that cost me my marriage. Irony strikes hard when you have years to regret.

Before CI-MEMS, those final evenings had been just her and me. Then, that had been enough. When you're young, you're sure you can read your lover's mind.

I don't know what happens to most couples. Maybe, if they stay deeply enough in love, they never forget how to read each other. Me, I quit having to guess. CI-MEMS didn't literally tell me what she was thinking, but it did let me know her mood as clearly as my own. When she said, "I love you," I could feel the

depth of it, as hundreds of tiny sensors read the trivia of breath, heart rate, skin conductivity, and skin temperature—not simply as data, but as a gestalt that converted her words to a reality at least as much a part of me as she was.

But now, my swarm was dying and the damn kid's remote was making a hash of what remained. Hour by hour, I was becoming more disconnected. Hour by hour, Denise seemed more distant. At the time, these seemed like separate crises. Only in retrospect did I put them together.

She was in the kitchen, opening cupboards, moving boxes and cans to see what lay behind. Her way of working out a shopping list. Me, I just go to the store and buy whatever looks useful. I've had enough hyper-preparedness on missions.

She didn't notice until I came up behind, put my arms around her, and nuzzled her neck. "I'm sorry about all the times away. This is the last one."

She turned, pulling back to see me better. "Really?"

We'd talked about retirement before, but only in a general way. "Really. There's just one more thing they want me to do. It's even in the States." Actually, it would be on base, but I wouldn't be allowed to see her until I was released, so there was no sense telling her. "No risk of anyone shooting at me."

I expected her to launch herself into my arms, but instead, she drew further away until she was backed up against the edge of the counter. "It's about time. Cora used to worship you. You may have noticed she's not been around much."

I had, but I'd put it down to general teenageitis. But now that I thought about it, she'd been that way on my last couple of furloughs, too. Emotionally AWOL from me, just as I'd been from her. Obvious, now that I thought of it, but most of the time, she'd been beyond Sense range. If a tree falls in the forest, and all that. After enough time, the Sense doesn't just help you interpret reality, it is reality. When she had been around, the contacts had been fleeting hints of a vague wrongness I'd ascribed to normal teenage angst.

But I hadn't really tried, either. Both of those furloughs had been cut short. Emergencies in places where American troops weren't even supposed to be. More opportunities for the tallies of success and failure I'd quit making—not because I'd truly managed to focus on one mission at a time, but because each number in the tally—whether a life spared or a life wasted—was a person, with his own Denise and Cora waiting somewhere.

Tell that to the psychs, and they'd say I'd ceased to believe. But it wasn't that. Some of these people really were bad guys. But in the process of doing what I had to do, year after year, I'd done something to myself, something that made it both more urgent and more difficult to be around Denise, around Cora.

Or maybe I was just burning out. There'd been some pretty hairy missions and even if I could have talked about them, I wouldn't have, because to say anything would have been to reveal just how close I'd come to dying so many times. Without the Sense, I wouldn't have made it through more than a handful of them. Without the Sense, I wouldn't be alive now. With it

gone, I would soon no longer feel alive.

"I'll make it up to her."

"If it's not too late."

There was an edge to her voice I'd never heard before. Or maybe it had been there—it wasn't as if we'd never argued—but no longer able to Sense beneath the words, I suddenly found it overwhelming.

I let a few flies buzz close, but they told me nothing useful. Skin temperature 94.2. Respiration 16. It was just data. My swarm had shrunk to the point where I could no longer tell how she felt.

"Are we okay?" I blurted.

"What do you mean?"

"Are we okay?" I hesitated. Took the plunge. "Do you still love me?"

"What on Earth would make you ask that?"

"That's not an answer. Do you still love me?"

"Like when we were kids?"

"Yes . . . No . . . Like when . . ." Like when we clung against the partings. When we thought each moment might be our last. "Like we used to."

Once, even without the Sense, I'd been able to read her soul through her eyes. But that was then. The Sense had augmented me but it had also contracted me. Now, I couldn't

read anything.

"Like we used to," I said again.

She might have saved the moment with a kiss. Instead, she sighed. "Oh, Kip, of course I love you. It's just that you've been gone so much . . . And when you come back . . . It's as though part of you is somewhere else. Like you don't really want to be here."

"That's not it. It's just the job—"

"That's what you always say. Well, this is 'just'"—she fingered quote marks in the air—"us. 'Just' me. 'Just' Cora."

I felt as though I'd been slapped. And I still couldn't marshal enough bugs to get an integrated read. Heart rate 89. Pupils narrowed. Were those good signs or bad? A trainee could look it up in a manual, but I'd been deeply integrated for so long that I needed a true, fully functioning swarm. Friend/foe. Danger/safety. Love/love-lost. I no longer had enough sensors to translate "data" into "knowing." I was losing that ability just when it felt like my whole life depended on getting it right.

"Are you seeing someone else?" I asked.

"What?" Skin conductivity 7.3. Breath 22. "What the hell are you talking about?" She swatted at a bug, distracting me as I reflexively pulled it back, feeling as though she was trying to destroy what little remained of me.

"You heard me. Are you seeing someone else?"

She pushed past me, heading for the side door, into the

garage. “If you have to ask, you don’t really know me.” A moment later, the garage door rumbled up and tires squealed in the driveway.

The gully was deep enough to hide me, but also deep enough to dislocate my shoulder.

I’d always been told that on the pain scale, unless you go way high on the pain blocker, dislocations are about as close to a ten as you can get. But there’s also something about them that’s the stuff of nightmares. In training, there was a guy who slipped on a run, fell, and dislocated a finger. His left pinky, to be precise. I’ll never forget it, sticking out at an angle fingers aren’t supposed to point. We didn’t have a medic, hadn’t had any training yet in first aid, and it was just the two of us, so we ran back to base. Four miles. He never said a word. I didn’t either, but I couldn’t shut out the image of that hand. And now it was me. It wasn’t just the pain; it was the knowledge my shoulder no longer looked like a shoulder. My vision was tunneling toward a black spot and my ears felt stuffed with cotton—no sound but my pulse, receding by the second.

Then, training took over. Pain tab first. But not too much, because setting a shoulder correctly requires you to feel what you’re doing. Otherwise, you can wreck it forever. Or worse, damage nerves that helped integrate my tat with my swarm.

Next step: breathe deeply, calm down. Not easy because I didn’t have much time. The Ladenites knew where I was and would be here in minutes.

I thought of Denise, Cora. Fought back despair. If I was ever going to see them again, I had to do this right. I willed my breathing to slow, hoping my heart rate would follow. Thought of home. Thought of those before-departure nights in Denise's arms. Felt my heart rate slow. Sensed myself to verify it was true.

Then I had to roll over on my stomach.

The first time it didn't work. Bone rubbed against bone, thrumming through my entire body. For a moment, I thought the cotton would win and I'd pass out, helpless while the Ladenites found me. But when you really have to stay conscious, you can. On the third try, I made it onto my stomach and lay there, heaving, sweat cooling in the small of my back.

Next step, use the good arm to move the bad one out to the side. Slowly, because it hurt like hell. Forget the Ladenites who might already be heading this way. I had to do it right, and right was slowly. Besides, none of this had affected my swarm, and the familiarity of the Sense helped calm me. Reality was more than my own body. Nothing dangerous was coming yet.

Finally, the hard part. Reach upward and back, as though trying to scratch my back. Use the good arm to draw the bad one up and over. And then, snick, with a white-hot stab of pain, the shoulder was again a shoulder.

The disaster came later that evening. By mistake. A trivial, stupid, senseless accident. A Sense-less accident.

After Denise made her exit, I retreated to the basement—a

cocoon into which I pulled what remained of my Sense with me. I tried to watch football. Couldn't work up the energy to care. Channel-surfed. Wondered where she'd gone. Wondered if she was now with him. Wondered who he was. Wondered, in my more sane moments, if I was wondering the wrong things. Wished I knew. Wished I still had the ability to know.

And then, amazingly, I fell asleep.

Emotional trauma does that to you. One moment you're balling your fists, wanting to punch through walls, as though you could physically hammer your way out of the box your mind has put you into. Then, suddenly, you're so tired you can't think. So tired the beer on the end table is an enormous dead weight, not worth the effort to lift, and instead of drinking yourself to sleep like you thought you were going to, you're just suddenly, overwhelmingly asleep.

Until, of course, you wake.

Nowadays, waking comes too many times, too soon, at the behest of a middle-aged prostate. The first time, I stumble to the bathroom and try to pee in my sleep. Sometimes it works. Second time? No way. By then I've had the magic five hours —the amount the Corps says you can function on (if slightly zombified) nearly forever. At five hours, what you think is, Don't think about it! Don't . . . don't . . . DON'T! Which of course means you can't help but think about it. It being the Sense. Or Denise. Or Cora. Whatever was most hurting when you lost strength to lift that beer.

However long Denise was away, it wasn't that long. What woke me was the knowledge someone was there. A swish of feet, a muffled thunk, a shadowed shape between me and the stairs, between me and escape. After enough years in the field, you sleep lightly, wake quickly, and give no sign when you flip from one to the other.

Flashback, hallucination, or phantom eye? Who knows? Once upon a time, she'd have come quietly up, hugged me, and kissed my ear. Once upon a time, I'd have known this, pretended to be pleasantly surprised anyway.

Now, everything was a surprise.

For one horrible moment, I was back in the ravine.

They were coming for me. How many I wasn't sure. I'd had my fringe out too far, too long, and had to pull them back to recharge. With my shoulder dislocated, I hadn't been able to do it. If you don't bring the bugs within a couple of centimeters of the tat, the connection's too remote and you burn too much glycogen powering the charger, like a marathoner hitting the wall. You have to charge them close-up.

But until I'd gotten the shoulder reset, I just couldn't concentrate—not enough to hover insects close enough to do any good.

Now, as I struggled to make up for lost time, I had bugs stacked up like fighter pilots practicing touch-and-goes: zooming in close enough to pick up a bit of charge, then moving out so more could take their turns. I'd be lucky not to lose a few,

as the charges faded in their cybernetic brains and whatever remained of the unmodified insect took over and flew off to do whatever it is insects do on their own.

Meanwhile, I had to move. There'd been no shooting for several minutes, and my squad clearly hadn't won. The Ladenites had to be on their way.

My first job was to reconnoiter. As bugs recharged, I sent them up-gully, looking for branchings. If I could get far enough before the gully got too steep or narrow, I'd be back in the land of boulders and just might be able to keep out of sight. Box myself in and I was dead.

For sixteen hours, I played cat and mouse. Several times, I had clear shots, but didn't dare take them. With the Sense, I could keep ahead, but it was sixteen hours of hyper-vigilance. Sixteen hours of trying to ignore the increasing stiffness of my shoulder. Sixteen hours of being the hunted, rather than the hunter.

When rescue came, I was nearly too tired to care. So tired it took me a moment to react when a fly not mine landed on my arm. So tired I could barely make my eyes focus to see the tiny chip behind its head. So tired, I didn't realize I was safe, not even when the other team's CI-MEMS operator approached, accompanied by none other than a miraculously ambulatory Captain Thomas.

Captain Thomas and his team circled upvalley and around, as we should have the night before. Three hours later, I heard

gunfire, saw the star-bright pinpricks of muzzle flashes. Soon after, they were back with me, taking less than an hour to cross the distance over which I'd played a day-long game of life-and-death hide-and-seek: the confidence of those who'd gotten close enough for their CI-MEMS operator to be sure he'd found everything they were looking for.

They brought two more survivors. One was a grunt who'd managed to find his way to a boulder field from which he could dodge to safety, rock-to-rock.

The other was Jerret.

I hoped like hell I'd never be like him.

There's a way it should be when the woman you love comes up unexpectedly behind you. First is the jolt—the realization someone's there. Then the recognition: a turn, a kiss, pulling each other close and wishing you need never, ever let go.

And while I'd long been faking the surprise, the rest—the never wanting to let go . . . that had been as real on our twentieth anniversary as our first. It was just that Sense had replaced surprise, data had replaced intuition. Nor was the ravine the only time I'd nearly died: it was merely the most protracted.

Too many emotions all at once. Too little knowledge. When that happens you fall back on training. No, you fall back on survival.

If I'd had a weapon, I might have killed her.

I have no idea what I thought I was lashing out at. I had too little Sense to know anything other than where she was. I certainly didn't see a petite woman. More like a hulking enemy.

Getting out of a recliner is normally a clumsy process. But in panic mode it's easy: convulse your hamstrings to push the footrest down, then use the momentum to launch your body forward. That last bit of Sense, or perhaps memory, told me where I'd left the beer can. Energized now by fear and adrenaline, I had plenty of power to lift and hurl it, hearing but not fully processing the yelp as it struck her square on the jaw.

With the hulking menace now off guard, I cut back, hard—hard enough to hear my foot pop as I pivoted back toward the threat. A fracture of the fifth metatarsal, I'd later learn, but at the time I barely felt it. Instead, I drove a punch into the soft, unprepared belly, followed by a forearm across the exposed throat, driving her backward into the oak-paneled wall.

And then, finally, I realized where I was. Who this had to be. What I was doing.

I dropped my arm. "Oh my God." An oath? A prayer? Who knows.

Denise didn't care.

"You bastard," she said.

I stepped back. Groped for words but found none, even as she headed for the stairs—out of my life.

"It wasn't as though I didn't have plenty of chances to

actually have an affair," she said.

I woke screaming. But this time, I wasn't me. I was him, just as I'd seen him on the battlefield that day, with the wild-eyed stare of someone who'd never be the same.

He'd been a bad enough sight physically. Blood and dirt staining his face and uniform a muddy red-brown dusted in white, like an earthquake victim pulled from the rubble. A dirty kerchief wrapped a hand where, I later learned, two fingers were broken. More bandage, fresh gauze this time, supplied by his rescuers, peeked from beneath his helmet, streaked crimson where a wound still oozed.

He had no idea what had hit him. Whatever it was had knocked him out long enough for his swarm to lose direction, wander off, vanish. Long enough that when he woke, he was totally cut off. Long enough he was no longer the Jerret he'd been.

Something similar happens when you sleep, but then, you park your insects in standby mode. It's as automatic as closing your eyes. But in combat you have every resource extended, recalling them only by conscious choice. Had my headfirst dive concussed me rather than dislocated my shoulder, I could easily have been Jerret. Now, at least once a week, I dream I am.

The psychs say gradual withdrawal is best. Maybe. But when I wake screaming . . . the end result appears exactly the same.

"I got a surprise today," Cora told the mirror cam. She was

vidblogging from her bathroom, where she'd hooked a camera to the mirror, talking while applying her makeup. I'd been startled the first time she did that, but so long as she was adequately dressed, I suppose the bathroom's as good a place as any.

The camera was mounted above her head, rounding the curves of her face by foreshortening her image ever so slightly. If she stood in just the right place, it also caught her reflection in a mirror on the door behind, producing a vanishing-infinity effect as Cora fronts and Cora backs disappeared into the distance. It was like seeing her through an endless corridor: the type of thing people describe in near-death experiences, except that in those, there's supposed to be a light at the end. Here, there were only ever-more-distant Coras, receding forever.

"I was in the mall, shopping for a new dress. This one in fact." She stepped out of sight, then back, holding a black, scoop-necked gown. She'd always had good taste.

"Isn't it cute? Anyway, as I came out of Allemontes I was sure I saw Jerret heading for the escalator. I ran over, but by the time I got there, he was gone. Maybe it was just someone who looked like him."

She paused.

"And Daddy . . . I know you're listening. I'm not stupid, you know. You didn't hack onto this; I let you. You want to know about me . . . ?" She drew back, hands on hips. "Well, this is me. I grew up. I get to choose who I date. You were never there. And

when you were there, there was nothing I could do to make you stay. Always another mission. Always off nearly getting killed. You don't think I couldn't tell? "

Tears beaded and she blinked. Blinked again. "Nothing I could do would make you stay. Do you remember me asking about that as a little girl? You just said you had no choice. Well even then I knew that was BS. Everyone has a choice. You chose to be elsewhere.

"Did you know, my sophomore year in high school, all those A's were for you? I thought maybe if I was good enough you'd stay. Silly me. Soccer too. Mom told me you'd been this super-athlete before you went in the Army—sorry, Corps, whatever that was. Why didn't you ever tell us anything? Anyway, the soccer didn't matter, either. Even making all-conference wasn't good enough. All you wanted was your damn adrenaline rush or whatever it was you got out of almost being killed all the time. Nothing I did was ever going to be more important. Nothing was ever going to be good enough."

The tears were spilling now, threatening her makeup. "But it was good enough for Jerret. He didn't care whether I got A's or D's. Didn't care if I dropped out of college. And then suddenly you were back, telling me that if I loved you I'd quit seeing him. And then you were gone again. You had no right. Do you hear me? No right. I know he was a lot older than me. I know he was getting a bit scary—after I dumped him, he came back five times. I'm not stupid, Daddy. But it was my decision. Not yours. Not when you were then gone again on that 'last' mission. The

one that was only going to last three months but went on for years. I can't believe I fell for it.

"In case you haven't noticed, I've got wounds, too. It's just that mine aren't the type to leave scars you can see."

Her face scrunched, and she knuckled tears out of her eyes, undoing any pretense of saving the makeup. "Damn you, Daddy. Damn you for everything."

Then her focus shifted and she swiped at the air in front of her, as fiercely as moments before she'd dug at her tears. "And what the hell is it with these flies?"

For a long time, I stared at her image, frozen in the act of reaching for the off-switch. I could have replayed the whole thing, but there was no point. I merely looked at her, remembering the little girl—the pert nose and half-smile, the eyes, now rimmed with ruined eye-liner, that once never left my own. The eyes in which, once, I could do no wrong. The eyes I had managed to wrong so deeply.

I would give anything for a chance to do it over. But would it be any different? Surely it hadn't just been adrenaline I'd craved. It was the need to be whole: the knowledge that the moment the missions ended, they'd take it away. The dead, sick fear that someday, inevitably they would.

Sometimes I'd thought it might be better if I died in the field. Because with each passing year, the fear of the end had grown: a continual feeling in my gut, like dread crossed with nausea. But then I'd think of Denise and Cora, and know that

coming home was worthwhile. Until suddenly, they were gone and it hadn't been.

I never knew how Jerret found her. He'd been finishing De-con about the time I went in, and had been better at telling the psychs what they wanted to hear. Because if you didn't, they'd keep you forever.

He knew I had a family, so maybe he just thought he'd let them know I was still alive. Not that it mattered with Denise. She may not have known where I was, but the Corps did, and dutifully served her court orders on me. Divorce. No-contact/keep-away. The whole shebang. Custody also—a real insult, with Cora only months from turning eighteen. They wouldn't even let me out of De-con to defend myself. Sent some damn Corps lawyer to represent me—as if he knew anything about what really happened, because if I'd told him, he'd have told the psychs, and Cora would have been a grandmother by the time I got out.

Then one of the orderlies told me about Jerret and Cora.

I spent a week trying to figure out what to do. All the while wondering if they were having sex. Forcing myself not to think about it. But that's not why I eventually went out the window. Even before the ravine, I'd never have wished a Corps member on her. Afterward? I'd seen his eyes. And if I could lash out at my wife . . .

When I'd first seen Jerret in De-con it had been a relief: a familiar face—the only one other than the soon-to-be-too-

familiar psychs. It was only gradually that I realized how long it had been since he'd been choppered out of the ravine. After he was discharged, I did some asking.

Jerret had been in and out of De-con a half-dozen times.

"I can't say anything specific," one of the psychs told me, "but in the combination of PTSD and withdrawal, it's the withdrawal that's the hard part. You have to quit wanting it back. If you don't, you'll never get rid of the bad stuff, either."

"Does that go for my family, too?"

She gave me one of those sympathetically sad looks they must practice in psych school. "Probably."

That was the night I went out the window. For once, I truly knew my priorities.

I was only gone a couple of days, but they cost me two extra years of De-con. It would have been longer if, like Jerret, I'd not gotten good at telling them what they wanted to hear. Until recently I'd thought rescuing Cora had been worth it. But, that was because I thought I'd actually succeeded in rescuing her. As she put it, silly me.

Being in the Corps teaches you to strike fast. Court orders teach the opposite.

Technically, I wasn't restrained from talking to Cora or even dropping by her apartment. But Denise wouldn't see it that way.

For three days I tried to figure out what to do. Jerret and flies. I had no idea how he'd gotten them, but he was CI-MEMS

again. Bootleg CI-MEMS, apparently.

Part of me was appalled. Cora had been wrong about one thing: Jerret's visible scars were only the tip of the iceberg. Give him back a swarm and he'd still not be whole. He'd just think he was.

But I was also jealous.

What would I give to have the Sense back? My pension? My soul? Whatever tenuous link I still had to Cora?

For three days, I listened to her vidblogs, as she rattled on about her health-club job, her plans to go back to college and maybe become a physical therapist, the weather, friends—the aimless chatter of a young woman looking to find her life. No more mentions of Jerret sightings, pesky insects, or me.

Stupidly, I did nothing: the basic training of court orders, not the Corps.

Then on the fourth day, it stopped. No chatter, nothing.

She hadn't missed a posting in six months. Maybe she was just busy. Maybe she had the flu. But the next day was the same. I called her work, but nobody had seen her. "She's never missed a day before," a bouncy-sounding young woman told me. "You don't think anything happened . . . ?"

The day after that, I booked a flight and was on her doorstep. Nothing visibly wrong, but that didn't mean anything, so I retired to my rental car with a super-sized cheeseburger, fries, and enough coffee to keep an elephant awake.

By dawn, I knew. Cora was gone.

Contacting Denise was risking an arrest, and being arrested for anything worse than unpaid parking tickets would probably put me back in De-con forever. Still, I had no choice.

“Woodruff Realty,” a voice not Denise said. “How can we help you?”

Denise had done well since divorcing me, but nobody has live, human secretaries any more. This had to be an answering service. Probably computerized.

“I need to leave a message for Ms. Woodruff,” I said. “Tell her it’s Kip, and it’s about her daughter. Tell her it’s urgent.”

“Certainly, sir,” the voice said, confirming that it was a machine. Nobody outside the military calls people “sir,” either.

Denise chose to call back, rather than have me arrested.

“This better be important.”

No hi, howya doin’. Jerret had somehow sold his soul to get CI-MEMS back. I’d lost mine trying to keep it in the first place. But it wasn’t the time for any of that. “I think Cora’s in trouble,” I said. “We need to talk in person.”

She agreed to meet at a Starbucks a few blocks from her Arlington office. Another flight, another lost night’s sleep. Both my pension and my body were going to take a beating before this was over.

Other than walls decorated with photos of autumn oaks and maples, the Starbucks might as well have been in Seattle.

Probably why she picked it. Generically neutral. Not the perfect place to breach national security, but the best I was going to get.

"I was in special ops," I said. "Mostly of the black kind."

"I kind of gathered that. What's that got to do with Cora?" She'd barely changed since the last time I saw her. Reddish blond hair parted in the middle, no gray showing at the roots, triangular face capable of an elf in grin that could melt your heart in a flash. Not that she was showing it now. At least she could no longer have me arrested. She'd agreed to this meeting. For the moment, the court orders were off.

"I'll get to that. I was in something called CI-MEMS. Cyborg Insect Micro-Electro Mechanical Systems. It uses little, tiny chips to control insects. Houseflies were my favorite, but I could also do beetles, dragonflies, wasps . . . pretty much anything. I controlled them through that tattoo on my back. It's basically a really fancy nano-electric neural interface." Which is why they'd left it intact. Enough nerves had grown into the lattice that removing it would be like peeling away a layer of my brain.

Denise must have been good in her business. She had nothing to say, so she said it.

"The chips also carried sensors that let me use the insects for remote sensing. If they could see something, so could I. But it was more than seeing. I could sense hostility, tell friend from foe, know everything going on within about 1,500 feet." I hesitated. Reached for the pain. Took the leap. "That time I

attacked you . . . ?”

She nodded.

“They were taking my insects away. Retiring me. You came up and surprised me. Nobody had been able to surprise me for years. I thought you were . . . some . . . something else.”

If I expected absolution I wasn’t getting it that easily. “So when you were at home, you were spying on me?”

“Yes. No. It’s not that simple. It was like having a sixth sense. One that’s more real than any of the others. I couldn’t help but spy on you. Shutting it off would have been like death. Was like death. That last mission . . . ?”

“Yeah . . .”

“That was the rehab from having it shut off. It takes forever, and you’re never really right.” Or anything close to it, but she didn’t need to know that.

She glanced at her coffee. Looked back up. “So what does this have to do with Cora?”

“Jerret was also CI-MEMS.”

“And . . . ?”

“He took it worse than I did. I at least lost my swarm under controlled conditions.” And still managed to make a mess of it. “He didn’t. That’s why I insisted she break up with him.”

“And . . . ?” But now there was concern beneath the coolness.

“He’s back. I think he’s kidnapped her.”

The voice on the phone was the same as always.

“Flashback, hallucination, or phantom eye?”

“Something else, this time. I need to know how to get the Sense back.”

“Can’t be done. You’re on the wagon. That’s the whole idea.”

“Maybe for you and me. But not for everyone.” I explained. “Do you know where he might have gotten it?”

The silence lasted long enough I thought I’d lost the connection.

“Maybe.”

More silence.

“For God’s sake, where?”

“You’re sure this isn’t for you?”

“How long have I been calling you? Have I ever asked before?”

Another silence. Then a sigh. “Okay. You might try an outfit called EFR. Entomologic Futures Research. They’re in St. Louis. Rumor has it they’re looking to adapt CI-MEMS for civilian police work.”

“Rumor?”

“Good rumor. Very good rumor.”

Another airplane. Another lost night’s sleep. At least this

time Denise was with me. Not like old times—we took separate rooms—but for the first time in years I wasn't alone.

EFR had three floors of a converted warehouse, not far from the Arch. An up-trending neighborhood, but not yet too far up. Perfect for a venture-capital firm with a speculative product.

An hour of "I'm sorry's" and other runarounds eventually took me to the office of Laurel Fuller, Entomologic Futures' product manager, whatever that meant. A woman in her late twenties in a light-gray blouse, black jacket and skirt, eyeglasses to match, and an attitude that would have done my high-school librarian proud.

"I'm sorry," she said. "Our technological explorations are strictly confidential. Even if I had a clue what spy-mints was, I wouldn't be able to help you."

"CI-MEMS," I said. "And I damn well know you know what it is." A bluff, but when that's all you've got, you go with it.

"Kip knows what he's talking about," Denise seconded. "He used to be a CI-MEMS operator."

It was all I could do to keep from staring at her. Had she always been this good at things like this? Not the time to wonder about that. I pulled off my tie, started to unbutton my shirt. "Want to see my tat? If you've got insects, I can fly 'em." Unless they'd changed the interface. But when the military licenses technology for civilian use they don't make it more complex. Generally they dumb it down.

Laurel waved a dismissive hand. "Anyone can get a tat."

“So bring in some bugs. What do you have?”

She stared at her fingernails. Picked at a cuticle. “Where did you serve?”

“The usual. Various –stans. The Altiplano. I can’t go into details.”

More fingernail picking. Then she punched a button on her desk com. “Mitch? Bring me two dozen Popillia.”

My turn to stare back. “Is that the best they’ve given you?” Japanese beetles aren’t worth much except in training. They’re easy to fly, but slow, clumsy, and easy to spot.

She shrugged. “They’re a good platform for our purposes.”

Twenty-four insects is hardly a swarm, and they didn’t have much in the way of sensors. Eyes and ears were about it. Either the military wasn’t yet ready to license the good stuff or Laurel wasn’t ready to trust me with it. Or maybe some of both.

But even with a lobotomized version of the Sense, I felt like God. I looked in every corner of the room, demonstrated to Denise that I could hear every word, could read an e-book over her shoulder. “Hemingway,” I said, when she picked a file at random. “I didn’t know you were into that manly-man stuff.”

“I’m not.”

“Oh.”

She relaxed, let me off the hook. “But I believe you about this insect stuff.” Not that she hadn’t before. Even without the Sense, I realized, I’d have known if she’d been lying. Some

things you lose with time. Others come back. But damn, there was no reason to believe they'd come back for her, too.

"Me too," said Laurel. "So you say this guy's a rogue operator who's got your daughter stashed somewhere?"

"Yes. And if he's integrated—even at the low level I am right now—he's way too dangerous for a SWAT team. He'll see 'em coming before they even know where he's hiding."

Laurel picked up a pen. Flipped it a couple of times in her fingers, then set it back down, precisely where it had been before. "Agreed. That would not be in our best interests." She pressed an ear-chip, turned away, mouthing something. With a real swarm, I'd have known what she was saying, even if she was sub vocalizing, but these bugs weren't up to it. Not that I thought they were the best she had. Nobody who wants to survive in venture capital gives away their secrets that fast.

A moment later, she turned back. "We can give you three hundred Tenibrio molitor and a dozen Bombus terrestis."

"Mealworm beetles and honeybees?"

She shrugged. "Mealworms are easy to get. And we're looking at bees as a means of . . . distraction."

That's not the only thing you can do with bees. There's not much C4 you can strap to an insect, but if you know the guy you're after is allergic to bee stings . . . Spend too long in black ops and your perspective changes. Still, killing a normal, healthy guy with a swarm of bees would be too slow, too cumbersome.

Laurel was talking again. ". . . better sensors than you just tested. The military's not giving up their best stuff, but we're really not sure what can be done with what we have: we've never had anyone fly it who really knows what he's doing." She paused. "I was beginning to think guys like you were all locked away somewhere." Her eyes lifted, held mine for a moment. She knew more than she let on. "Want to take them for a test drive?"

Picking up a new swarm isn't something you can do instantly. You have to synch them one at a time, then lock them in so nobody else can fly off with them, accidentally or on purpose. It only takes a few seconds per insect, but with three hundred, it adds up.

I have no idea what Laurel and Denise talked about in the interim. I could have listened, but I was off in a different land. With each added insect, my perceptions expanded. The data weren't as good as I was used to, but there was no doubt I could integrate it. I was already doing so. I knew Laurel found the room too warm, while Denise, who wrapped herself in blankets even during Virginia summers, was chilled. I knew that Laurel was in her element—and a much more complicated person than she appeared. Denise was trying to act take-charge, but was inwardly tentative, afraid of a misstep.

With twenty-four bugs and limited instrumentation I'd felt like God. Now . . . ? What comes after God?

I brought a couple of Tenibrio in behind Denise, close

enough to smell her hair, touch it. They're quiet fliers, so she didn't notice.

But Laurel did. "So, do you like them?"

Denise jerked, saw the beetles, her emotional read changing like someone had flicked a switch. I might as well have been Jerret invading Cora's apartment.

"Sorry." CI-MEMS would have told her I wasn't. Not really. I was just sorry I'd been caught.

I swirled insects around the room, using the confusion to hide a few in a potted palm. Others I parked in the wastebasket, on a shelf of books, on the doorframe. A hundred extensions of myself, watching from all angles. Gathering data. Telling me how she was feeling. Circling her with eyes . . . with love.

But love wasn't the only thing I was feeling. For years, Senseless, I'd fought off the old fears. Flashback, hallucination, or phantom eye? It hadn't really mattered. Now, even with Denise right there and no sign of hostility from Laurel, I still didn't feel safe. I wanted to extend my fringe, know what lurked outside the door: in the corridor, in the hallway, in the offices beyond.

I slid a few beetles under the doorframe, into the corridor beyond. A rail-thin man sporting a goatee and tiny, black-framed glasses was headed our way, a note projector in hand. For a moment, I was sure we were about to be interrupted, but he went on by without even glancing at the door.

I followed him and found a larger open space, a

combination conference room, computer lab, and cube farm—about fifteen people presently there, but room for more. I didn't have enough bugs to watch everything, so I let goatee-and-glasses go and turned my attention to a middle-aged man with thinning hair, cowboy boots, and a shirt tight enough to show off every ripple of a gym-built body. Even from fifty feet away, he radiated alarm, and my own adrenaline surged in response. A terrorist? A spy? Whatever he was doing, he was talking animatedly on a tat phone.

I kept some bugs at a distance, sent others in low, below the tops of the cubicles.

"Are you sure?" he was saying.

With military equipment I'd have been able to hear the response, even from the tiny speaker embedded in his thumb. But Laurel's mics were barely good enough to catch his own voice, speaking softly into his pinky-mic. Shaka phones, they'd called these when they first came out. "Hang loose bro'," and all that. All the rage for about fifteen minutes, until you realized what an idiot you looked like, using one.

"How do you like them?" Laurel repeated.

I pulled my attention back to her, to Denise.

"Not bad."

Back in the cube farm, the man was still talking.

—"You tried it again? Just to make sure . . . ?"

—"But how . . . ?"

—“Yes, I know how; I wasn’t born yesterday. I mean how could it have happened. I thought—”

“They’re yours to keep,” Laurel said.

“Huh?”

“Use them to track him down.”

I wondered what a swarm like this cost. The Corps had never told us, but there had been rumors. “What’s in it for you?”

She shrugged. “It’s the decent, human thing to do?” She grinned. “And it’s good for us. Our investors wouldn’t appreciate news stories about our tech being used for criminal purposes. Find him, deal with it quietly, and they will be very grateful.”

She paused again. “We might even let you be a permanent beta tester. I’ve heard that people coming out of the program are . . . unhappy. What does it feel like to be . . . what do you people call it? Reconnected?”

“Integrated.” What it felt was very, very good. Like being whole again.

I slid my focus back to my perimeter.

The middle-aged gym rat was still talking.

—“I really don’t care . . .”

—“Just get rid of it. I’ll pay for that, but not anything else.”

I lost interest. Domestic drama, no threat. I pulled back, swirled the bugs, looking for danger. But at first, all I found were snippets of ordinary office conversation. A tech discussion

here. A gossipy pair who knew more of the gym rat's story than he'd like. An argument over where to get the best pizza.

Flashback, hallucination, or phantom eye? Full-blown flashback this time.

It was the pizza discussion that did it. One of the debaters was championing Scolioni's deep-dish over Petrocelli's New York-style. The other was arguing that deep-dish wasn't real pizza. But only the deep-dish fan really cared. The other was just egging him on. Faking emotion without feeling it.

Suddenly, I was on foot patrol in a Middle Eastern market: a cube-farm for street vendors. Endless shops selling dates, figs, scarves, breads, and a thousand other things. Snippets of conversation, jostling elbows, haggles over price. Eyes wary for thieves and pickpockets. Vivid colors and vivid emotions, highlighted by the combination of Sense and adrenaline. Streets like this exploded in shrapnel almost daily. One slip in attention, and this could be next.

I was relatively new to CI-MEMS, about to learn that strong emotions weren't always the important ones. They're just the ones that are easiest to read: people who either loved you or hated you. People who were nervously watching for the next suicide bomber . . . or nerving themselves to push the button. Mercenaries studying their options. So long as you were alert, those stood out like emotional flares.

More dangerous are the subtler ones. The bomber who's not afraid of his own death. The mother numbed by grief, with

little left to lose.

But the most dangerous are the rarest.

The guy who nearly got me that day walked through my fringe without triggering even a trace of alarm. It wasn't that I didn't see him; he was wearing blue jeans and a sheepskin jacket—a Middle Eastern cowboy, guaranteed to stand out. But emotionally . . . zilch. Not angry, not fearful. About as bland as they come. Probably with enough knowledge of CI-MEMS to be specifically targeting me.

He was only thirty feet away when I saw the motion, with my real eyes, not the swarm's. Had something on the fringe distracted me at just the wrong moment, I'd have died, right there. As it was, I saw him unzip his jacket, reach inside . . . and then, my Sense now directed full-force his way, felt just the barest flash of pleasure.

The Sense won't detect a sociopath. Or certain types of psychotics. The most dangerous people are those who simply don't care. Like this one.

Like the guy pretending to argue that deep-dish isn't real pizza.

If I'd been physically in the room with a gun, I hate to think what I'd have done. As it was, it was only when I started sneaking bees under Laurel's door that I woke to the fact I was in St. Louis, preparing to attack a geek for arguing about pizza.

Denise was watching me. I still had a hundred-plus pairs of eyes on her; I'd not diverted any of those for my foray into the

cube farm, had never missed a move she'd made. I'd always been good at splitting my attention. That day in the market wasn't the only time it had saved me.

Laurel was looking at me, too. Waiting for her answer. Reluctantly, I directed most of my sensors toward her, trying to get a better read. She was one of the dangerous ones, but not one of the super-dangerous ones. Emotions well in check, but not remorseless. Sure enough of herself to give me a swarm during our negotiations. But norm-ignorant of the strength of the emotions she'd unleashed? Maybe, maybe not. She might know exactly what she was doing. CI-MEMS doesn't give that kind of information.

"It feels . . . great," I said.

"So it's a deal?"

"It's tempting."

"Then do it. Save your daughter. And yourself."

Yes was on my lips. Sure, I'd thought the pizza-debater was some kind of terrorist. But I'd caught myself before I'd actually done anything. With time, surely I could learn even better control.

But Denise was still looking at me. I could almost feel her eyes boring into the side of my head, though even with the swarm I had no idea what she was thinking. For the first time in decades, I realized that this was normal. Not just normal, but the way things were supposed to be.

And yet . . .

In high school I'd climbed a 14,000-foot peak in Colorado's San Juan Mountains. We'd made the summit by 10 AM, hours before the usual afternoon thunderstorms. But puffy fair-weather clouds congealed with remarkable haste, and minutes later, we were leaping down boulders as thunder crashed and lightning seared the sky. With every meter of descent, I felt safer . . . safe enough that soon I slowed to a walk. When the storm's power caught up with me, I dashed again, to the next glacial bench, the next meadow, the next tarn . . . only to pause again, as the storm gathered strength to chase me down once more.

I decided to be truthful. For Denise? Laurel? Myself? Another who knows.

"It really is tempting," I repeated. "I feel alive, like I haven't in years."

Like I had on the mountain. Extreme life and near death. Maybe Cora had been right. Maybe you can't have one without the other. Or maybe I couldn't.

But with the life came the fear. Extending my fringe into the cube farm hadn't been enough. I'd wanted to go to the street, to the buildings on the other side—to the three-seconds-even-to-hear-it sniper range I'd been unable to Sense the day of the ravine. Beyond that, even, because there are enemies in far corners of the globe who'd blow up shopping malls, train stations, Denise . . .

I'd spent years wishing I could roll back the clock. Now I

could. But if I did, I'd become Jerret.

It took another hour, but I eventually pried out of Laurel (the old-fashioned way, by asking questions) that ERF was the only firm licensed to make or install civilian CI-MEMS chips. Beta-testing was being carried out by several firms, but if I could find one of Jerret's flies, ERF could trace the chip and find out which subcontractor was involved. And with a hoped-for stock offering in a couple of years, ERF was very interested in snuffing out criminal uses, or at least keeping them quiet.

Eventually, Laurel gave me a gadget like an airport security wand. "Find a dead bug and this will read its chip. She paused. "If you can find a dead bug. Are you sure you won't take our original offer?"

That night, Denise and I reviewed Cora's vidblog from the time she first complained about insects. Nothing conclusive, but we both reached the same conclusion.

"The bathroom," Denise said. "That's the best bet. Maybe she managed to hit a few more."

Another day, another airplane. At least this one wasn't a redeye.

Getting into the apartment was a different matter. It was second-floor, which made coming in through a window difficult, even if we were willing to risk it. And there was no key in any of the obvious places: under the doormat, in or under the potted plants on her stoop, on the doorframe. Nothing we could find on or under her car, either.

“Screw this,” Denise said, and marched toward the manager’s office. “Stay out here. Do something . . . manly.” Briefly, I saw the elfin grin. “Preferably out of sight.”

A few minutes later, she emerged with a key. “That was easy. She’s got a daughter the same age.” She sobered. “It helped that she likes Cora. And the lease requires notice if she’s going to be gone for more than a week.”

Mentally, I counted. “This is only day seven.”

“So I exaggerated. Did you really want to wait ’til tomorrow?”

We found what we were looking for on the windowsill. It being Texas, there were a lot of dead insects, but only one had a chip implanted behind its head.

“Damn,” Denise said. “So he really did take her.”

“You doubted it?”

“Wouldn’t you? There’s a reason I divorced you. At the end, you weren’t exactly rational.” She looked up, met my gaze. “Was the withdrawal really that bad?”

“Yes.” If I’d known what it would cost, maybe I would never have taken the implant. But once I had it . . .

I remembered how it had been in Laurel’s office. The godlike power. The sense of being alive again. Had Denise not been there . . . “Jerret’s going to be pretty jittery.”

I read the number to Laurel over the satphone.

“–7987?” she asked.

I double-checked. “Yes.”

“Okay, that one went to Advanced Military Systems Consulting in . . . Tehachapi.”

“Where the hell’s that?”

“California. Between Bakersfield and Palm Springs. They’re one of our smaller subcontractors, working on security aps. Banks and things like that.”

“What’s the address?”

“Uh-uh. They’re our subcontractor. I am this close to a deal with the FBI. Those folks are going to tell me how one of their flies wound up in your daughter’s apartment, or by God, I’ll yank their contract and to hell with the banks. How soon can you get to Palm Springs?”

I shrugged, but we were voice only, so of course she couldn’t see it. “As soon as we can.”

“Meet me at the Hyatt. I’ll book you and your wife a room.”

“She’s not—” but Laurel had rung off.

Another day, another flight. Not the world’s easiest connection, actually. We had to change planes in Vegas. At midnight.

Laurel’s trip wouldn’t have been any easier, but if she was feeling it, she wasn’t letting on. “The Ontario airport’s a little closer, but the hotels here are better,” she said. “Did you have a good night’s sleep?”

Denise shot her a what-planet-do-you-come-from look, but I intervened. “Good enough.” The Corps had taught me that any sleep you actually wake up from was a good one. The past few years had raised doubts about that—the value-of-waking-up part, that is—but right now, I was on a mission. Even jetlagged and without a swarm I felt . . . surprisingly alive.

“Great,” Laurel said, ignoring whatever subtleties she might have observed. She handed me a scone that might as well have come from Denise’s Starbucks. “Let’s hit the road.”

AMSC’s offices were in a nondescript industrial park like a million others. The type of place that has a name like Swan Island, Bluegrass Meadows, or Mustang Heights, and where if you don’t know exactly where you’re going, you’ll wind up walking up and down roads not made for pedestrians, wondering why the hell you can go all the way from number 1401A to 1637D without ever seeing 1513C.

Laurel missed it the first two times, but she’d obviously spent more time in places like this than I had, because on the third pass, she found an unmarked door to a whole slew of offices with numbers in the 1510s.

Two minutes later, we had a bland-looking guy named Bruce Larch offering us coffee.

If he’d ever known real, physical danger, I’d be surprised. Roundish baby face. Too-quick smile, quicker handshake. I’ve bought cars from guys like him.

“One of our bugs?” he said. “In a missing girl’s apartment?”

“My dau—” I started, but Laurel cut me off.

“We’ve got the serial number. There’s no question it’s yours.”

“I have no idea—”

“Don’t give me that.” She stared at him, and I wondered how much money even lobotomized CI-MEMS might be worth on the open market. Laurel, I realized, was probably very good at what she did. “Kip here is one of our consultants. He’s ex-military CI-MEMS. Do you have any idea what those guys can do? Right now, he’s got a hundred bugs hiding in this room—no, you can’t see them, so there’s no point trying to look—monitoring your biometrics. He’s a damn walking lie detector . . .” She glanced my way. “Aren’t you, Kip?”

I nodded. Out of the corner of my eye, I noticed Denise looking too, but there was no way to respond and stay in the role in which Laurel had cast me.

“. . . so don’t scam me or we’ll pull your contract faster than you can get your tie caught in a paper shredder. Do you understand?”

Larch took a half-step backward, bumping into the corner of a beat-up desk that looked like it had come from Office Liquidators. His voice squeaked. “Yes.”

“You should also know he’s ex-CI-MEMS. Do you know what that means?”

Larch shook his head.

“It means he’s been through all kinds of shit you and I don’t want to think about, stuff that drives a lot of them right over the edge. PTSD. OCD. Paranoia.” She shot me a quick look, and I wondered how the hell she knew. Then I remembered the familiar voice on the phone. I wasn’t the only one. “It means he’s one scary dude, Bruce. And he really doesn’t like being played for a fool.” She turned to me. “How many people have you killed?”

I shrugged. “That’s classified.” I picked up a ballpoint pen up from Larch’s desk and pushed the button. Click.

She turned back. “So, Bruce, let’s abbreviate this. How the hell did your insect wind up in an apartment in Austin?”

If it’s possible for a doughy complexion to melt, Larch’s had. “What was that serial number again?”

Laurel recited it like she was talking to a six-year-old. “I think you know where it came from. Doesn’t he, Kip?”

I nodded. Click. Click.

“Don’t tell anyone,” Larch said. “If I lose my job . . .”

“That’s the least of your worries. Do you know who we’re working with at the FBI?”

Larch shook his head. “Who?”

“You don’t want to know. If you’re lucky, you won’t find out. Right, Kip?”

I nodded again. Click. Click. Click.

“So, last chance, Bruce. Your job’s toast. Want to spend

twenty years in jail?"

For a moment, I thought she'd worked him too hard. Bruce's complexion was positively gray. A heart attack wasn't going to do us any good. Briefly, I wished I'd taken Laurel's offer. With a swarm, I'd know if he was in medical danger. But I'd also wind up like Jerret. Damn. Time to act like the norm I now was. Time to act, even if I didn't fully know what I was doing.

I set the pen back on the desk. "Relax. Tell us the truth and we can keep the FBI out of this. Lie . . ."

Larch sucked his lip. "Okay . . . I've got this thing about football. I like the Saints."

"The New Orleans Saints?"

"Yes. And a few other teams. But last year they didn't like me all that much. I kind of wound up owing a bunch of money." He licked his lips. "A big bunch of money. To this guy named Ray Perkins. At least that's what he goes by. Who knows what he's really called. Rumor is he's into all kinds of things. He'd found this bodyguard he wanted to hire. Ex-CI-MEMS, like you. So we made a trade. I got him a few Musca domestica, agreed to keep him supplied. Perkins declined to, uh, collect, the debt."

"Where did you take the flies?" I asked. Briefly, I wondered if even someone like Larch could tell that my interest was more than professional. But I needn't have worried.

"Some condo-hotel thing in Chicago. I don't know the address. We went with a long-lived species, gene-mods, actually, so I only need to bring new ones out every six to eight

weeks. Musca domestica, with double normal lifespan. Sterile, of course, so they don't escape into the environment and mess up the ecology. Even the military's not got 'em yet. Latest thing. Still beta-testing." The used-car salesman, sure that if he could only talk long enough, we'd forget what we'd actually asked.

Laurel saw it too. "Glad to know we're getting something for all that money we're paying you," she said. "Too bad you decided to give it to a criminal. What do they call that, Kip?"

I had no idea. "Treason? Espionage? Misappropriation of government secrets? Something like that."

"You hear that, Bruce? You didn't just give this guy bugs, you gave him super-secret bugs. One more chance. Where did you take them?"

"I told you, I don't know the address." He waved a hand at me, nearly knocking a Darth Vader bobblehead off his desk. "Ask him. He'll tell you I'm telling the truth."

"Fine," Laurel said, taking me off the hook. She spun a computer toward him. "EarthMaps. And don't tell me you can't find it."

"Remember," I added, "misappropriation of government secrets is a felony."

Larch collapsed into a chair. But he turned to the computer, clicked in, worked the controller. Took a dizzyingly fast joyride through urban sprawl. "There." He stopped at a tallish building, maybe thirty floors. "I don't know any more than that. They met me in the lobby, blindfolded me on the elevator. Believe me, I

didn't want to know what floor the guy operated out of. I'm pretty sure he had the whole floor to himself, though, because they didn't seem worried about anyone else being in the hallway. But they kept me blindfold the whole time, so I don't even know what he looks like. Just that he has this nasal accent, like he's from New York or Boston or something."

"Those are kind of different," Denise said.

Larch seemed to notice for the first time that there were three of us in his office. "Sorry. I was born in Orange County. All that East Coast stuff sounds the same."

"What about the bodyguard?" Laurel said.

"Ex-mil's all I know. Though he must have been in the room, because the moment I opened the carrier, I could hear the insects fly out, one by one, like he was taking control of them, then and there. He never spoke, but Perkins called him Jay something or other. Jail? Something weird like that. Jayelle?"

"J.L.?" I asked.

Larch shrugged. "Could be. I really don't get those East Coast accents."

I woke screaming.

I'd been in the ravine, my shoulder not feeling like a shoulder. I was trying to reach behind my back like the first-aid said, only my arm wouldn't do it because something was in the way and the Ladenites were coming, were going to get me, because I couldn't get up and move, but who cared because it

was the shoulder with the tat and I was blind and Senseless and might as well die but that made no sense because the tat was still a tat and the dislocation hadn't torn a nerve, so where was my swarm? Why didn't I know what was happening? Would I even know when a Ladenite tossed in a grenade, concussing me, killing me, letting my swarm get away . . . ?

Phone, I thought, as my senses gelled to the here-and-now. Only there wasn't any phone because I wasn't in my apartment. I was in some damn airport, with dozens of people staring at me like I was crazy. Which I guess I was.

Two of the dozens were Denise and Laurel. "Are you okay? " I think it was Denise who said it, but I wasn't sure.

I nodded. I wasn't ready for words yet. Not unless they were to a faceless voice on the phone who'd been there himself. My arm was pins and needles from how I'd somehow slumped and fallen asleep on it.

"What happened? A nightmare?"

"Something like that."

"How often do you get those?"

"Couple of times a week." I forced myself to keep talking. "Sometimes more, sometimes less. Especially when I'm not sleeping well." Which I never was, but there was no point going into that.

"You didn't do that when we were together."

That wasn't quite true. But the flashbacks had been

different then, and as long as she was there, I'd been all right. At night, I never let myself roll far enough away not to be able to touch her. A fingertip on her back, shoulder, hip—the barest touch was all I needed. Heaven would have been to stay at home . . . and keep the Sense. Purgatory was having to choose. Hell was losing it all. I'm not much of a theologian, but I know a lot about hell. Hell is the never-ending land of if-only. Coulda-shoulda-woulda, that's how the psychs put it, always with an implicit don't go there, as if that's possible. I coulda-shoulda said no to the Sense and served out my term as an ordinary grunt. But would I have done it?

I wrenched out of the past, looked at Denise. Really looked at her, for the first time since . . . The familiar laugh lines, now etched with worry. The once-perfect complexion just starting to change. A decade younger than me, aging well. "There was one time when it was a lot worse," I said.

Her fingers touched her throat. "Why didn't you explain?"

I shrugged. "It was classified." Their answer, not mine. And they'd had me in De-con within an hour. Maybe I wouldn't have cared as much about national security if I'd had more time to think. "But you'd have still thought I was too dangerous." Which, in fact, I had been. Then there'd been Jerret, and after that she'd been as angry as Cora had been.

The Sense or her? If I could choose again, which would it be?

Then I realized that I'd been given a second chance and

hadn't made the same choice. Back in Laurel's office, I'd been handed my dream—and walked away from it. Because Denise was there.

When you've only got one lead, at least there's no uncertainty about what to do next. We needed to find out if Perkins was in that highrise. If he was, Jerret and Cora wouldn't be far away.

The question was how to do it. The building was a cylindrical tower of blue-tinted glass, a lot of space to search. Not to mention that banging on doors was likely to get us shot.

It was Denise who came up with the solution.

"Look," she said, "we know he's got a whole floor to himself, right?"

I nodded. "Yeah."

"And this is an older building. Late 1980s, maybe early 1990s. Certainly no later than 1995 or 2000."

"If you say so."

"So it's not going to be full up. Trust me, this is what I do. That's one of those dead eras in real estate. Everyone loves the latest/greatest, or the cool, older stuff. There's nothing wrong with a building like this—they're often great bargains—but for this guy to pick it . . . well, it says a lot about him."

"Such as?" This wasn't a side of Denise I'd ever seen.

"There are a couple of possibilities, but I'm guessing he's about forty years old, grew up in a place like this when it was

new, but not all that happily. He probably thinks that by redoing it he can somehow change all that." Just like I'd tried to do with Cora, she didn't say. But her gaze was an accusation.

Laurel saved me. "So what's the relevance?"

"For Perkins, not a lot, unless I was selling to him. A lot of what I do is applied psychology. But the point is that this building isn't full up: I'd guarantee it. Any floor with a vacancy's not the right one. All we need is the vacancy list."

Unfortunately, getting it wasn't quite that simple.

Inside, the building seemed innocent enough. Starbucks in the lobby; overweight security guards behind a fake-marble desk. Banked elevators. Boutiques to one side, restaurant/brewpub to the other. An upscale health club in the back, with enough windows that only the most chicly fit would dare use it.

Plastic letters on a brass signboard announced office suites on the lower floors: bland-sounding names with alphabet-soup credentials. Jones Smith Consultants, LLC. Adain Pappalardo, NACT. That type of thing. Fancy-sounding lounge/restaurant on the thirty-fourth floor.

Denise had been online while I'd stepped into a Rite Aid for supplies. Now, barely glancing at the signboard, she pushed the elevator call button, then the button for the third floor. Two minutes later, we were in the sales/rental office, talking to a pale, dark-haired woman whose nameplate proclaimed her to be Hailey Carlton.

Denise handed over her business card. “We’re interested in apartments with lakefront or skyline views,” she said—a nice way of saying everything. “Your building is a bit old, but the location’s attractive. Do you have a vacancy list?”

Hailey smiled. “Yes, but since July, other than for the hotel floors, of course, it’s been sales only. We’re in the process of remodeling and converting.”

“That’s fine,” Denise said. “Even if they don’t wind up living here, Ki–, Kim and . . . Laura here might be interested in investment properties.”

Hailey grabbed a sheet of paper and plucked keys from her desk. “The market’s tight right now, but we’ve got twenty-three units available. Mostly one-bedrooms, but there’s a couple of twos, plus a three, coming up next month. How much are you looking to spend?”

“Whatever gets the best value. Can you just print out the list, and we’ll think about it?”

“You really ought to see them.” Hailey rose. “Pictures and floor plans just don’t do them justice.”

Two hours later, I’d seen enough cute kitchens, cozy lofts, and charming breakfast nooks for a lifetime. And we’d only actually seen half the units on the list. But at least we now had the list. Only four floors were full-up: the seventh, fourteenth, nineteenth, and twenty-fourth. If Larch was right, Cora had to be on one of them.

Back in the lobby, I tried to park Denise and Laurel in the

Starbucks. “This shouldn’t take any more than ten minutes,” I said. “If I’m not back in twenty . . .”

“I’m going with you,” Denise said.

I glanced around. I hadn’t seen any insects, and Jerret would have trouble monitoring the lobby, even if he tried. Buildings like this had a lot of transmission-blocking steel, and it was too cold to put bugs outside for an external transmission relay. Still, there was no use taking unnecessary risks.

“You’re right. Let’s get a real lunch.”

“That’s not—”

But I had a hand on her elbow, ostensibly to steer her out the door, but actually giving it a little squeeze. A private signal. Shhh. I’ll explain later.

I’d done it automatically, without conscious thought. If I’d thought first, I’d have expected her to slap my hand away. Instead, she turned without resistance. “Okay.”

I glanced at her, stunned by the instant, familiar communication. Realized that in all those years, I’d never even thought about another woman. Realized I’d just assumed the absence of a new ring on her finger, too.

“I know,” she said. “But not now.”

Outside, wasn’t the right time, either.

“I’m going up with you,” Denise repeated.

“That’s not a good idea.”

“Why? She’s my daughter too.”

I looked at Laurel for support, but she’d been oddly silent ever since the Starbucks.

“Because he might recognize you.”

“Jerret? I don’t think I met him more than a time or two, and only in passing. He’s more likely to recognize you.”

“Hopefully not.” But that had always been a risk. We had to find the right floor, and the only way to do that was to go up the elevator, with no real excuse for stopping at Perkins’ floor. I was just hoping enough people pushed the wrong button each day for it not to be suspicious. At least Jerret wouldn’t have bugs in the elevator—way too much metal for that to have even a chance of working—but I wouldn’t put it past Perkins to have tapped into the security cams.

I’d thought about that earlier, but it was a big building and we hadn’t been doing anything out of the ordinary. Now, I reached into my bag and presented three of my Rite Aid purchases: sunglasses, a Chicago Bulls jacket two sizes too big, a matching baseball cap, and wrap-around sunglasses that came to weird, streamlined points at each temple. For good measure, I was also thirty-plus hours unshaven.

“How do I look?”

Denise hesitated. “Different. I’d walk right by you on the street, that’s for sure.”

Laurel snorted. “More like cross the street to avoid you.

You look like hell on a hangover."

I stopped mid-stride and stared at her. I hadn't really been all that afraid Jerret would recognize me by sight. If he felt anywhere at all like I had with Laurel's bugs, he'd be far more tied into his swarm than into any other sense. The disguise had been for me: to help quell doubts, so I could flatten my emotional state when I met his bugs. Because what I was really afraid of was the emotional read.

I started to explain all that to Denise . . . but instead I looked again at Laurel. Short, dark hair curling around her ears. Tailored suit, skirt short enough to show toned legs, but long enough to say not-for-you. A woman who belonged in a place like this. Denise fit in, too: softer, more feminine despite the age difference, comfortable in her own skin but aware that first impressions can be everything.

This type of place wasn't me and never would be. Maybe I was going at this backward.

Another trip to the Rite Aid got Denise a pair of schoolmarm reading glasses. For good measure, I had her pull her hair into a severe bun. The net effect was to make her look five years older and twenty years grumpier.

Then we waited for happy hour in the lounge. My original plan had been to ride the elevator alone. Total-cool, total-in-control: fake sociopath. If I could manage to shut down my feelings. Now the goal was to have as much company as possible.

Another of my new supplies was a bottle of beer. The cheap forty-ounce type, whose only purpose is to get you really drunk, really fast. I had it in a paper bag, wino-style, and as we walked back to the condo building, I twisted the top and took a long, noisy slug.

Denise stared at me.

"I kind of need it," I said, which was true, but not for the reasons she'd be thinking. I would have preferred slipping into a bathroom and dumping most of it into the sink, but she needed to see me drinking it, so I saluted her with the bottle and tossed back as much more as I could in a single swallow.

Once, when I was young and stupid, I'd joined a group at a high school track for a midnight "beer mile." Four laps, four beers. A good way to get arrested if the cops caught you, but it had taught me what alcohol and I could and couldn't do together. I'd won the race, in a little under eight minutes. Soon after, the alcohol got its revenge. In about ten minutes, I was going to be very, very unhappy.

As hoped, there was a crowd waiting for the elevator. I drained the rest of the beer, and stuffed the empty bottle in my jacket pocket. Thought about throwing up. Belched instead.

Then I shoved my way in, angering as many people as possible. Laurel looked at me appraisingly, but Denise's glare felt like losing her all over again. I desperately wanted to take her elbow, give the squeeze that said: hush, wait, I'll explain.

But I couldn't. That was the whole point. The stronger, more

confused the emotions, from both her and me, the less chance Jerret would see anything other than what I wanted. Domestic drama, no threat.

The doors sighed shut and the elevator shifted into motion—more smoothly than I'd have liked, but you can't have everything. I staggered anyway, reached out, cursed, and managed to hit about half the buttons as I braced myself. I got another four or five pushing myself back vertical. During my brief stint in college, we'd called this Christmas-treeing an elevator—as in lighting up all the buttons with the old Yule spirit. A really good way to make friends with your fellow passengers.

Seven, fourteen, nineteen, and twenty-four. I'd managed to get all but nineteen. Damn.

If Denise had been watching, judging, I might not have had the nerve to push that last one. There was only one chance in four it was the one I wanted. But she was occupied with some guy in charcoal worsted who was telling her she needed to keep her husband under better control.

"He's not my husband," she was saying. "Not any more."

It was another stab to an already queasy gut, but I took advantage of her distraction to put my thumb on the button for floor nineteen. "Bing!" I said in my cheeriest drunk-voice. I hit floor eighteen for good measure. "Bing! Bing!"

Charcoal Worsted grabbed my arm. "Enough, or the next bing will be me calling security."

Floor nineteen proved to be the one.

I was glad it wasn't one of the lower ones, because each time the door slid open, the rest of the passengers got angrier and angrier. Charcoal Worsted had taken to jabbing the door-close button before the door had finished opening: a move that might have felt satisfying, but did nothing to speed our progress.

By the time we reached floor nineteen, my stomach was very much in rebellion and my head already starting to spin. Why hadn't I eaten something before trying this nonsense?

Luckily, checking each stop for flies had become nearly automatic. All day long, I'd been studying the elevator lobbies, trying to figure out where I would put bugs if they were mine. Especially if I was limited to Musca domestica, gene-modified or otherwise. Houseflies are great for surveillance, but if people see too many, they tend to react.

But I'd forgotten what it meant for Perkins to have an entire floor to himself. Jerret hadn't shown the greatest subtlety in the way he'd stalked Cora, but now, with no need for it at all, he'd planted several dozen flies on the ceiling, fanned out to give plenty of angles into each elevator's interior. It was arrogant, the implicit assumption of someone who felt like king, in the country of the blind. Though even if people noticed, how many would have a clue what it meant?

Charcoal Worsted muttered and again jabbed the close-door button, this time after the door had finished opening. Five seconds later, it was safely closed. I now knew where Jerret

was. Hopefully, he didn't know I knew.

Maybe it was the beer, but suddenly, I felt all the emotions I'd been cultivating strike with renewed force. Still, I was extremely happy I'd changed the plan. With that many flies scanning me, I doubt my fake-psychopath demeanor would have held up. Jerret might not have known exactly what was up, but he'd have smelled something.

By the time we reached the lounge, I was definitely buzzed. Denise stomped out, but I reached forward, took her arm. Forget the elbow squeeze. I needed to talk now, save what I could of our relationship. If I could.

"Floor nineteen," I said. "That's definitely it." My stomach lurched. "I'll tell you more in a minute. First, I need to throw up."

Clearer-headed, I joined her and Laurel a few minutes later at a tiny table with a to-die-for view of the lakeshore. No flies. I looked, but Jerret wouldn't dare invade this place. He'd get swatted for sure.

Denise was still angry. Laurel was working at some kind of straw-colored drink, no ice. Denise was sitting on a leather couch big enough for two, but she wouldn't move over, so I sat next to Laurel.

"So that was all some kind a game?" Denise asked, even before I was fully settled. "First you want to be the big hero, charging off while I stay home—just like old days. Then, when I won't let you, not again, not when its our daughter's life that's at stake, you pull this, this stunt, and make me think you don't even

care—treat me like . . . like, like a damn Army wife. Not a real one: the imaginary kind. The kind they tell you you should be, but who's not really a person. A woman whose only role is to say, 'Yes, I understand,' 'Yes, I'll do what they tell me,' 'Yes, I'll stand behind you,' 'Yes, I'll be everything you need and never ask anything for myself.' Yes, yes, yes, because . . . because you're the one who's always almost dying, and compared to that, what the hell difference do I make?"

Laurel started to rise. "Maybe I should meet you in the—"

"No, you stay here. You're as much a part of this as he is. What did he do? Explain it all to you when he wouldn't to me?"

She shook her head, but dropped back into her seat. Held up a finger to a waiter, pointed to her glass. "No. I just live a little closer to the world he comes from." She looked at me. "The offer's still open, you know. Once the big police forces get in the act, we're going to have to train undercover agents. And in the interim . . . we probably need to keep a better eye on our subcontractors."

This time, I didn't even hesitate. "No."

"I figured, but I'd be remiss in my job not to ask." The waiter was back, with a second whatever-it-was. She nodded, handed him a bill, waved off the change. "And I'm good at my job. Very good. When we go public, I'll be worth millions." She stirred her drink, stared at it, stirred again. "Then, if I'm smart, I'll get out, retire at thirty-five. If not . . . well, at least my father would be proud." She took a swallow. Made a face. Took another

swallow. “He made his first million in some damn dotcom before he was twenty-five. I don’t even remember what it was called. Lost it all two years later. Spent his whole life trying to get it back.” She stared some more into her drink. “Drank himself to death by the time I was in high school.”

She was looking at me now, her eyes so dark they were almost black. “You don’t think I didn’t figure all of this out? Shit, this whole situation just reeks of what I grew up with. Dotcoms? Military? It’s all the same. You get that daughter of yours back, you treat her right, do you understand me?” She drained the rest of her drink in a single gulp, rose, then turned one final time to Denise. “And all that stuff on the elevator? It’s because he knows you. You’d have given the whole show away simply by caring, like a normal person.” She snatched her purse, and for a moment, I saw a glint of moisture in her eyes. “See you at the hotel.”

The rescue plan was something we’d worked out two days earlier. When I woke the next morning, it looked just as risky as before—but neither had any new alternative magically materialized.

This time, Laurel had booked us separate rooms, but Denise and I had spent much of the evening in one of them, not holding each other, but talking like we hadn’t in years. It wasn’t just psychotics and sociopaths whose motivations could evade the Sense. Deeply suppressed feelings could do it, too, I was beginning to realize. When we’d married, the Corps was a presumed part of our lives. I’d never understood how much

she'd come to resent it.

Laurel was the first to knock at my door, holding a nylon bag with a flat, angular shape inside.

"What's this?"

"What's it look like?"

I took the bag, but didn't open it. "We talked about this."

"And if it comes down to him or you?"

"That won't happen."

"Him or your daughter?"

Reluctantly, I opened the bag. Pulled out a 9mm Beretta . . .

. . . and suddenly was back in the market.

Flashback, hallucination, or phantom eye? If there's a single flashback that dominates all others, this is the one.

You do not want to shoot somebody when you have the Sense turned on them, full-power. You feel the impact, watch the life drain away. Even sociopaths know pain, fear the darkness.

The whole thing lasted perhaps three, four seconds. I'd seen the man in the sheepskin coat reach inside his jacket, Sensed the sudden pleasure. Knew it was him or me . . .

Or maybe he was just reaching for a love letter from his girlfriend.

For two, maybe three seconds, I didn't care. Three wild, unaimed shots, and he was down, the market suddenly still. Somehow, my sidearm was in my hand—my rifle still slung over

my shoulder because, no matter how good you are at bifurcation, there's always a risk of losing perspective and thinking you're shooting from the position of one of your insects. Better to keep the rifle slung unless you consciously decide you need it.

I'd thought guiding others in for the kill was the same as pulling the trigger. I'd been wrong. I walked forward in a daze, oblivious to the possibility of additional attackers, ignoring everything but the body on the street. I had done this. All by myself.

He was lying on his back, the jacket half-open. Slowly, with thumb and forefinger, I pulled it all the way open.

The blocks of explosive strapped to his sides should have silenced any qualms. And at the time, they did. The Sense surged back and I felt the relief of my platoon mates, knew I had saved not just my own life, but dozens of others, knew the man before me would have been dead of his own hand, regardless of what I'd done.

That's how it stood for years. Until the flashbacks. Now, all I see is his face: broad planes with incipient crows-feet. Startlingly blue eyes. A blunt, square nose. Matching jaw.

In the flashbacks, there is no suicide vest. Instead, he's clutching a paper, covered in feminine handwriting. Handwriting just like Denise's.

What would my dreams be if I had to shoot Jerret? I didn't want to think about it. But when Laurel gave me a handful of

clips, I took them.

The rest of the supplies were exactly what I needed. I didn't ask Laurel where she'd gotten them and she didn't volunteer. All those police connections, perhaps, though a lot of it was easy enough to get elsewhere.

Denise arrived shortly after. The night before, we'd argued about roles. I'd lost. I tried again now, but she was adamant: no more waiting at home. We also argued about timing. Laurel and Denise wanted to go in right away, perhaps catch everyone still sleeping if Perkins kept the type of hours guys like him do in movies.

But that was the type of nerves you see in soldiers on their first patrol. We'd do better later, when there were more people going up and down the elevators and when Jerret had had all day to become jumpier himself.

What I didn't want to do was think about Cora, so I took Laurel and Denise to the Art Institute. A Picasso exhibit, I think. Afterward, I couldn't have described anything I'd seen. Nerves aren't just for first-timers.

Happy-hour found us again in the lounge: just Denise and me, no alcohol, waiting. I wanted the lounge at its fullest when the alarms went off. The more confused people filling stairwells and elevators, the better.

Her part of the plan was the simplest. Thanks to Laurel's bag of goodies, her purse was full of smoke pellets—easy-to-use ones, made for paintball and for training firefighters. Better

for our purposes than the military kind because they were smaller and non-toxic.

Denise, again in her schoolmarm glasses and tight bun—home-dyed a rather severe gray this time—would hit the eighteenth floor. That was a hotel floor, so she'd be looking for a supply closet, or better, a maid's cart with a full trash bag. If she could do it without getting caught, she'd light a trash fire and supplement it with enough smoke pellets to make an impressive smudge. Then she'd be down the nearest stairwell, pulling fire alarms and dropping more pellets—anything to increase the confusion. Meanwhile, I'd go to the twentieth floor and wait for the alarms.

By 6:30, the lounge was standing-room only. Denise looked around. "Time?"

I nodded, reached across the table, took her hand. "Be careful. Stick to the plan and let me be the one to improvise. It's what I do . . . did." Her hand felt warm, natural. I gave it the tiniest of squeezes. "I—" My throat felt blocked, the words trapped. "I never—"

She squeezed back. "I know." She gave a tight-lipped smile.

"Yeah." There really wasn't any more to say. "Let's go get her."

No battle plan ever goes off without a hitch. This one's was an unexpectedly long wait for a second elevator, after Denise's had left. Maybe I should have used the same one she did, but

that would have left me on the twentieth floor, with nothing to do while waiting for the alarm.

As it was, I'd barely stepped off when the alarms sounded. Distant at first, muffled through multiple floors, then ear-splitting. I pulled the striker pin on a smoke pellet and tossed it in one of those useless brass wastebaskets hotels, banks, and convention centers love so much. Found another wastebasket on the far side of the lobby and dropped one in it, too.

Down the hall, a door popped open and a head peered out.

"Fire!" I yelled. "Get everyone out!"

Then I ran the opposite way, shouting and banging on doors. This was a condo floor, but it had a supply room, unlocked, as I'd hoped. I wrenched open the door, pulled down a shelf of paper towels, wadded them up in a big pile, and struck a match. Tossed in a half dozen smoke pellets for good measure, along with a couple of interesting-looking aerosol cans. By the time I left, one of the cans had already produced a satisfying bang, the sprinklers were starting to fire up, both in the closet and the hallways, and the smoke was thick enough that other people, hurrying for stairwells or elevators, were merely shapes in the gloom.

I found a stairwell at the end of the hall and pushed through. No panic bar, but a fire alarm, which I pulled in passing. No security cameras anywhere in sight. I'd not seen any yesterday, either, except on the elevators. Either this place had really

good, hidden security, or the bare minimum. Hopefully the latter. Otherwise, even if we got Cora out, I was going to have a lot of explaining to do. Not the way I wanted to find out how good Laurel's police connections really were.

The stairwell smelled like the Fourth of July. Apparently I'd hit the same one that, hopefully, had already led Denise to the basement.

The door snicked shut behind me, and I tested it. Locked. Damn. That meant it would be the same on Jerret's floor. I'd been hoping the lack of panic bars meant no automatic locks, but touring the place yesterday, there'd been no way to find out. I dropped down a flight, suddenly glad for Laurel's gun. But just as I got to the first landing, the door flew open, and I found myself staring down at a wiry, tough-looking man with a beard shaved into tiger stripes and what looked like a champagne glass shaved into the side of his head. A fashion-model-gorgeous Asian woman was behind him, in jeans and a silk blouse.

"Shit, Ray," he said into a phone as I pressed backward against the wall, hoping he wouldn't look up. "It's real . . . Yeah . . . Yeah . . ."

"Yeah, it's real," the woman said. "Stay here and get cooked if you want." She pushed by and clattered down into the smoke, pausing a few steps later to pull off her high heels.

Champagne-hair ignored her. "Forget that Jerret guy, bro. All he does is stay with his bitch 'n' all those flies. What the hell

good's he done us . . . ?" He stepped backward toward the corridor. "We really ought to get out of here."

I was on the move even as the door started swinging shut. Even so, I barely managed to get to it. For a whole minute afterward, I held it, only millimeters from clicking shut, as several groups of people pounded down the stairs, some glancing at me, others fixated on getting down.

Alone again, I pulled a bandana out of my pocket and put it on, partly as additional disguise, partly to cut the fumes. I pulled the pins on three more smoke pellets, then opened the door just wide enough to toss them through. No yells, so apparently the hallway was now vacant. Blocking the door open with my foot, I lit a couple of strings of lady-finger firecrackers with a cigarette lighter, tossed them inside, and followed them up with a couple of M80s. Happily, the nearly closed door saved most of my hearing, but Jerret had to feel like he was on the receiving end of my tripwire nightmare: concussion, smoke, shock—and probably a bunch of insects already knocked off-line.

Time for the coup de grace. I pulled out another of my Rite Aid supplies, a can of home-and-garden wasp spray, yanked open the door, and looked for bugs.

They were there, of course, on the ceiling. Jerret was probably already pretty well into a flashback—and I didn't want to give him any chance to recover. If he hadn't been in a secure room when the commotion began, he'd have responded by retreating to the safest place he could think of and shifting as

many assets as possible to his perimeter. And it was hard to imagine he wouldn't have Cora with him. I needed to find out which room they were in before the place was overrun with firefighters.

In one quick motion, I shot a jet of wasp spray at the flies. It was good stuff, and about half of them dropped instantly. More than I wanted—the plan depended on not killing them all—but Jerret's reaction was instant: the equivalent to touching a hot burner. I zapped a couple more flies for good measure, but he was already pulling back, desperate to keep from losing any others.

I chased down the hallway, following the flies. Most were faster than me, but those that had gotten a partial dose of the bug killer were a bit wobbly, and even in the smoke I was able to keep them in sight. Then we reached a door—number 1903, a detached part of my mind noted—and they started diving into a gap beneath it. It wasn't a huge one—when Jerret had cut it into the carpet, he must not have been thinking of a possible mass retreat—so there was a bit of a jam-up as flies were coming in from all directions. Clearly, he was putting the survival of his swarm ahead of maintaining his periphery.

This much I'd planned. Time now to improvise.

First, I shot as many of the remaining flies as I could with the spray. That confined Jerret's remaining Sense to the room. There was a spyhole in the door, though he was probably still too shocked to think to use it. Nevertheless, I ducked sideways,

out of sight. He'd have a gun, and might start shooting. The fire alarm was deafening, almost enough to put me into a flashback, and I knew what was going on. Jerret had to be over the edge.

Armed and irrational. A bad combo, but the only one I was sure I could use. And with his Sense bottled up, we were now on equal terms.

But I didn't have much time. According to my watch, it had only been three and a half minutes since Denise had pulled the first alarm, but there would be firefighters running up the stairs any minute. I had two choices: shoot my way in and try to get Jerret without letting anything happen to Cora . . . or get him to come out.

It would have been simple to work myself into a killing rage. It wasn't as though Jerret had been a long-term member of my unit. We'd only done a few missions together and had barely talked on base. Since then, he'd seduced my daughter, kidnapped her, and for all I knew, raped her. Or maybe he thought he was protecting her, or even married to her.

But I'd looked into his eyes the day after the ravine. Told the same lies to get out of De-con. Flown Laurel's swarm. Jerret was me, but for the grace of God. If there was a God. Two weeks ago, I'd have said there wasn't. But two weeks ago I was a different person: Jerret, but for the grace. Killing him achieved nothing. Killing him was killing myself . . . again.

For once there was no flashback. I couldn't afford one, but I think something in me had truly changed. With a silent prayer to

a God I'd never even have contemplated two weeks ago, I decided to stick to the plan.

"Lapp," I yelled, in my best field-commander voice. "This building is under attack, by . . ." I hesitated, then decided in-for-a-penny-in-for-a-pound, "Ladenite terrorists."

I struck the cigarette lighter, tossed more lady fingers, smoke pellets, and another M80 down the hallway. Good-bye ears. Hopefully they'd recover by the time I needed them. I struck the lighter again and played the wasp spray across it. Hurrah for LPG propellants; the stuff made a dandy blowtorch. I aimed it across in front of the spy hole, blackening Jerret's door, just for the hell of it.

"Lapp," I yelled again, using the spray can to light yet another string of lady fingers. I was going to run out of them soon. "Our CI-MEMS operator is dead. Your unit needs you."

Nothing to do now but wait. I pulled the bug-spray can back, away from the spyhole, reluctantly let the flame die. Then, as the door began to open, I fogged the hallway with the remaining contents of the can. Might as well take out as much of his swarm as I could, the moment he stepped out. I couldn't afford to get it all, but the fewer bugs he had, the less likely he'd be to get a read on me, the less likely to snap back to reality at an awkward moment.

He emerged slowly, one arm wrapped around a terrified Cora, the other hand holding an Uzi.

I hadn't expected the Uzi, had expected a sidearm instead.

We needed to get out fast, and quietly. Otherwise, we were going to have a lot of dead firefighters if Jerret met them in the smoke, looking, in their protective gear, like storm troopers.

Whether Cora was terrified of Jerret or of all the bangs and alarms was hard to determine. But when she saw me, even in the smoke, strobe lights, and din—even with the bandana, hat and glasses, gun—her mouth went wide in a startled O. Maybe she said something. My ears weren't exactly my best allies at the moment. Maybe she was merely about to speak. I met her eyes, shook my head. Stay with him, I mouthed. Or maybe I said it. I was having nearly as much trouble hearing myself as hearing anything else.

"Lapp," I said, forcefully enough that I could almost hear it. "We need to get out of here. Extend your perimeter for maximum threat avoidance." Briefly, I regretted killing so much of his swarm. Still, there ought to be enough left to do the job. "We do not have the firepower for a fight. We need to get out and report to base. Do you understand?"

If he recognized me, it wasn't as Cora's father. Maybe from the missions we'd shared. More likely as a generic battlefield figure from a long-off flashback. As long as I could keep him there, we'd be safe. I wouldn't have to kill again.

I shifted my gaze to Cora. "Do you understand?"

She nodded, still wide-eyed.

"This is what I do," I said. Paused. Remembered Denise. Hoped she was safe. "Did." My hearing was definitely coming

back. “I will get you out.”

She nodded, still wide-eyed. “Da—”

Much as I longed to hear her Daddy—Daddy without the damn you, without the weight of all those wasted years—it was the one thing I couldn’t let her say.

“That’s enough, private,” I barked. “Lapp’s on point. The rest of the unit”—I looked at her as pointedly as I could risk—“will follow his lead. Quietly. Do you understand?” She nodded, silent again. “Good. Let’s roll.”

Cora nodded again, and we started down the hallway. Jerret’s lead wasn’t quite standard, a possessive arm still clutching his “private” in a distinctly non-military manner. But still, we were moving, very much dependent on each other. It had been five minutes since the first alarm. By now, there had to be firefighters in the building.

I don’t know how much of his swarm Jerret had left, but it was enough, because getting out was startlingly easy. Easy enough to again make me wish I was integrated. Until, that is, I looked at Cora. Then it was easier to be as I was.

He found a smoke-free stairwell jammed with people trying to get down from the lounge, and cooperated when I suggested that Uzi-under-the-coat might be a better stealth mode than Uzi-in-plain-sight. Not that he ever let go of Cora, except for the moment when he tucked the Uzi under his coat. For about two seconds, I thought she was going to run—a bad thing because Jerret’s training would make sure that Uzi-under-the-coat

become Uzi-in-plain-sight, very, very quickly. But again, I shook my head, and again, she deferred.

Then we were in the basement, and from there into the parking garage.

I'd warned Denise not to react when she saw Cora. But it was all she could do to stay in character. "Mission accomplished," I said, just to remind everyone we weren't out of the woods. "Driver, take us back to base."

Laurel climbed in front. Jerret opened the back and started to maneuver Cora in ahead of him, but I cut him off. "Lapp, you've got shotgun." He started to protest, but this wasn't negotiable. "Now, soldier. That's an order."

He let go and slid into the front. Moments later, Denise, Cora, and I were in the back. Cora in the center. No thought to that one: the duckling, however well-grown, flanked by the parents. A moment later the car was full of flies. No way we could leave them behind; try that and Jerret would have been back in the here-and-now faster than I could possibly come up with a way to stave it off.

But there weren't that many flies. Forty, maybe fifty, tops. And Jerret was clearly losing his focus on the "mission;" flies were drifting into the backseat, hovering near Cora, circling her head, brushing her cheeks, hair, ears, lips.

Cora never moved, even as a tear slid from her eye and a fly landed to taste it. With a clarity that might have come from a swarm but didn't, I realized she hadn't been raped. Not in any

conventional fashion, anyway. This—this was Jerret's way of making love: like me watching Denise in Laurel's office, carried to its extreme.

Traffic in the parking garage had been minimal—most people fleeing a high-rise fire aren't going to risk getting trapped in the garage. Jerret's voice was distant, muffled by the squeal of tires as Laurel gunned up the ramp toward the street.

Or maybe my own hearing hadn't completely recovered. "What did you say?" I asked.

But it hadn't just been my hearing. When he spoke again, his voice was soft, forlorn. Not a soldier's. Or a kidnapper's. "So few . . ."

I knew what he meant, but Cora didn't know I did. "Usually there are a lot more flies," she said. "Something happened to the rest."

"So few," Jerret repeated. He was becoming agitated. "Where are the Ladenites? Where's the rest of the unit? What happened to my swarm? There was a guy with a spray can. . ."

Uh-oh. I made sure my gun was ready. Cora saw, and another tear followed the first. But she said nothing.

Please, God, if you exist, don't make me have to do this.

Laurel saved the day. "Here, soldier, take this." She fished in her pocket, dropped pills in his hand.

"What are they?" Suspicion hadn't yet hit his voice, but it would.

“Anti-withdrawal medicine. Take it.” She was talking to him, but in the rear-view mirror she was watching me.

“What kind?” His voice was stronger, and my gun was now pointing at him, through the back of his seat. Please, God . . .

“Valium,” she said. And Ambien. I knew. The prescriptions had been mine. Not that I liked to use them. I preferred my flashbacks unmedicated. “Use your swarm,” Laurel added. “See if I’m telling the truth.”

Reluctantly, Jerret pulled a few flies away from Cora. Then a few more.

“I can get you a new swarm,” Laurel continued, once she was sure she had his full attention. In the rearview mirror, she actually flashed me a grin. “Isn’t that right, Kip?”

Laurel had found a way both to save the day and ensure her millions. “Yes. I’ve flown it.”

More flies moved from Cora, into the front.

“But you have to give up Ms. McCorbin. You can’t have both. We’ll give you the best insects outside the military, but you’ll have to do what our psychologists tell you, and wear a tracking bracelet, because you have to let her have her own life. Isn’t that right Kip?”

That one was easy. “Yes.”

“You really don’t have much choice, because otherwise the FBI’s going to get you eventually, and they really don’t like kidnappers.” She paused, accelerated onto Lakeshore Drive,

watching a fire truck heading the opposite direction. Our doing, or something else? There are, I realized, things you never know . . . and never have to know.

"Right now, you've got to take those pills. Because otherwise Kip here is going to have to shoot you. And you know he'll do it if he has to. Isn't that right, Jerret?"

Jerret looked down at the pills. He turned, looked over his shoulder at Cora—his eyes, not the swarm's. She was leaning slightly against me now, and I felt her stiffen. But her face showed nothing. Then, ever so slowly, Jerret raised his hand, tipped the pills into his mouth, swallowed. The opposite choice from the one I'd made. The only one he could possibly make.

"Good job." Laurel sounded like she was talking to a child. She looked at her watch. "We'll be in St. Louis in five hours if everything gets out of the way." She again glanced in the mirror. "Want to come with us?"

I looked at Denise, Cora. Shook my head.

"Didn't think so. Midway Airport's on the way. Tickets are on me. Send the bill." She paused. Jerret was already starting to nod off. "And remember what I told you, okay? Everyone in this life is walking wounded. I'll take care of him; you do what I told you. Make this a win-win-win-win. You, me, Jerret, her. You hear me, Kip?"

I nodded. Started to grin, but she was deadly serious.

"Because life doesn't give you many of those, so you damn well better not waste them." There were tears in her eyes, too,

and suddenly, it no longer seemed funny. There but for the grace of God. Her, me, Jerret, Cora. We were all each other, but for the grace.

The car was on the Stevenson Expressway, heading southeast, the electric motor's whir barely loud enough to mask Jerret's soft snore.

I lowered the gun, slipped on the safety. Looked at Cora, into the eyes in which once, I could do no wrong. Realized that life sometimes really does give you second chances. Can and will, without the shoulda-coulda.

I longed to put an arm around her, pull her tight, hear that all-restoring Daddy. But it was way too soon. Instead, I broke the gaze, looked across her at Denise. And wondered. Was there enough grace for a win-win-win-win-win? You sure as hell don't get many of those. I didn't know, but I wasn't in any hurry to go back to Seattle. Especially in gray, rainy November.

Science Fact

Science Fact

Phantom Science: The Facts Behind “Phantom Sense”

Richard A. Lovett & Mark Niemann-Ross

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Top of Science Fact

Novella **Short Stories**

Phantom Science: The Facts Behind "Phantom Sense"

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SPOILER ALERT: This article addresses how close we are to developing the "Sense" underlying the novella "Phantom Sense," on pages 8–37 of this issue. It isn't necessary to have read the story in order to understand this article, but this article does reveal some of that story's secrets.

Ten years ago a company called WiCab purchased a construction-worker's hardhat and wired it with an accelerometer—a device that measures the force of movement (and gravity) in any direction. Output from the accelerometer went to a computer linked to 100 tiny electrodes held in contact with the helmet wearer's tongue via a special mouthpiece.

The goal was to let balance-impaired users "taste" balance cues delivered as mild buzzing sensations to their tongues. If you stood upright, you felt the buzz in the middle of your tongue. If you swayed, it moved. Your task: figure out how to stand so the buzz stayed centered, where it "should" be.

"It's a very simple concept," one of the inventors, Mitch Tyler, told On Wisconsin, the alumni magazine of the University of Wisconsin, Madison. "It's like having someone place a finger on top of your head to indicate you're upright. If you tip your head, you feel the finger slide off to one side, and you naturally

move your head back to compensate. You're just correcting for a deviation in your position relative to a marker."

It worked. Amazingly well, and amazingly quickly—within minutes, in fact. "Once the concept is in place that the stimulation on the tongue means something about your orientation in space . . . it is very intuitive," Tyler said. "It very quickly goes from being a conscious process to being subconscious."

The device, now sold as BrainPort, is an early predecessor to Kip McCorbin's Sense.

In the story, Kip uses a tattooed implant to pilot a swarm of cyborg insects equipped with microsensors that give him an ability to see and hear at a distance. Lie-detectorlike sensors also let him read emotions to a range of about 500 meters, helping him detect danger. (The range is limited by the ability of the insects to carry batteries powerful enough to relay their transmissions.)

There are a number of technologies involved, but one of the most difficult-sounding ones—interpreting feedback from the swarm—might be among the easiest. That's because, as the success of BrainPort indicates, the brain is remarkably "plastic"—meaning that even in adults, it can be molded to reinterpret the stimuli it receives.

Nor are we limited to using the tongue. Any convenient patch of skin should do. Someday, similar technologies might allow rehabilitation clinics to link cameras or microphones to an

output grid that gives touch-based sight to the blind, or hearing to the deaf. These wouldn't truly be sight or hearing, but to those trained to recognize them, they might seem very much like the real thing, except, perhaps, for differences in resolution due to the comparative "graininess" of touch receptors compared to the retina or inner ear.

Kip uses the term "integration" to describe the process of learning to interpret such signals. In his case, with 300 insects providing multiple types of feedback, it would be more difficult than simply trying to position your head so that an electrical buzz stays centered on your tongue. But the concept is the same. "If you've got the ability to integrate," Kip says, "the data cease to be data . . . [Y]ou wind up with things you simply know, on par with it's raining or I'm on a tropical beach."

Controlling the insects also sounds fanciful, but on a limited scale, it's possible today. In 2009, a team lead by Hirotaka Sato of the Department of Electrical Engineering and Computer Science at the University of California, Berkeley, reported that they had developed an implant that allowed them to remotely fly a beetle, using a laptop computer as controller. (Video of the flying insect is available online.)

The technology, called HI-MEMS (for hybrid insect micro-electro mechanical systems), uses electrodes implanted into the beetle's nervous system and muscles during its pupal stage. As the beetle metamorphoses into an adult, its brain and muscles integrate with the electrodes, which can then be controlled with a chip and microbattery mounted onto the

insect's back. WiFi-style signals to the control chip can then be used to hijack the beetle's control of its wings, allowing the controller to direct its movement.

It sounds a bit spooky. But a press release from the Defense Advanced Research Projects Agency, which has gone public with plans to use the beetle as a platform for sensors such as microphones or gas sniffers, argues that it's not all that strange. Rather, the agency suggests, it's a lot like what we've long done with other animals by lower-tech methods like yokes for oxen or bits and reins for horses.

Nor are implanted chips and WiFi the only ways to take control of an animal's nervous system. At the 2010 annual meeting of the American Physical Society, March 15-19 in Portland, Oregon, Andrew Leifer, a biophysics graduate student at Harvard University, showed videos of how he had been able to seize control of a tiny worm, called Caenorhabditis elegans, using green laser light.

C. elegans was chosen because it has only 302 neurons —and because it's transparent. The latter is important because the key to the research was a gene modification to the worm that allows researchers to activate its neurons by exposing them to green light. Shining light on the entire worm activates everything at once. But training a tiny laser spotlight on a single neuron activates only that specific one. At this point, it's simply a research project, designed to figure out how the one-millimeter-long worm's nervous system works. "This is going to be a really powerful tool that will allow us to probe neural circuits

with unprecedented specificity . . .” Leifer said at a press conference. “We now have the power to systematically decompose a [neural] circuit and tweak each component to see what it does.”

But he can also seize control of the worm’s movements, making it reverse course, turn right, or turn left. “You could play the worm like a piano,” one reporter noted.

The hardest part, Leifer says, was focusing a neuron-sized spotlight on a tiny, wriggling worm. But eventually, he got an assemblage of 700,000 independently controlled mirrors to direct his beam whereever he wanted in a mere 20 milliseconds. “I spent six months writing code,” he adds.

Will this technology supersede HI-MEMS for controlling cyborged insects? Who knows? Leifer’s experiments relied on the fact that C. elegans is transparent. But that’s not necessary for laser control, another brain researcher at the meeting noted. Instead of activating gene-modified neurons by shining green light on them, he said, all that would be needed would be to insert electrodes into the insect’s brain, with each one attached to a tiny photocell. The desired neurons could then be activated with beams of light. Such a method would have the advantage of using signals that don’t produce radio leakage detectable by enemy monitoring stations, but it has the enormous drawback of requiring both line-of-sight and a very fast-tracking laser. Most likely, WiFi would be the preferred option.

Bug Power

In today's cyborg experiments, insects are controlled one at a time with the cursor keys on a laptop computer. But Kip controls hundreds at once, via a tattoolike implant on his body. Again, several technologies are involved.

To begin with, the implant draws on his metabolic processes to recharge the batteries of his insects' micro-controllers when they run low—something that will probably happen fairly often due to limits on the size of batteries an insect can carry.

Not that the insects are likely to carry conventional batteries. More likely, they'll have ultra-capacitors, which store charge, rather than producing it chemically, as batteries do. Large capacitors, already in use in China, can power a city bus, reputedly for fifty kilometers between rechargings, says Saikat Talapatra, a condensed matter physicist at Southern Illinois University. But even better ones are in the works. Talapatra's group is working with single-atom-thick sheets of a super-strong carbon material called graphene, capable of holding massive quantities of charge per gram. Such capacitors also have the potential of being recharged very quickly—just as Kip does in the story by hovering his bugs close to power stations on his tattoo.

The ultimate source of energy, however, is Kip's own biochemistry. And that, rather startlingly, involves a technology that's already available, at least in the design stage.

In 2008, the Greener Gadgets Design Competition

announced the development of a tattooed cell phone, “powered by pizza.” Technically speaking, the phone is powered by cheese or pepperoni. Rather, it runs on glucose, via a coin-sized fuel cell that taps into the user’s bloodstream. As blood flows through the fuel cell, it extracts glucose and oxygen to generate electricity.

The cell phone itself is composed of two pieces. One is a thin, flexible sheet of silicone inserted beneath the skin. That’s the actual electronics, powered by the blood-fed fuel cell. The other layer is the tattoo itself, which is invisible until it’s needed, at which point signals from the silicone implant light up a keypad and view screen. (Sound presumably arises directly from the implant.)

Most of us might not want to be that closely connected to our phones—but if we can do this, we can definitely find ways to harness Kip’s blood to recharge his swarm.

Swarm Intelligence

Controlling the swarm is a bit more difficult. The basic principle is the same as the one used to “integrate” incoming data, but in reverse. Here, rather than commandeering sensory nerves to receive incoming data, it’s necessary to use motor nerves to relay signals to the insects.

The basic technology is already under development for restoration of fine motor control to prosthetic hands. Numerous systems are possible, but one of the most interesting would use artificial neuromuscular connections at the ends of the severed

nerves, allowing them to power servomotors in the prosthetic.

Kip is going to need something similar, although we won't want to disconnect the nerves from their normal uses, so we'll have to tap into their signals without blocking them. In theory, the best muscles to use might be those controlling his hands. That would certainly give him the greatest possible range of control, but it would also mean that waving, pointing, or scratching his nose might send his insects zinging off in random directions. Not to mention that if he walks around moving his hands all the time, he's going to stand out in a crowd.

A better approach is to use small muscles in the chest—a technology already in use for prosthetic hands. When the user thinks, "Open the hand," or "Flex the index finger," the thought actually activates these chest muscles. But electrodes monitoring them pick up the signals and relay them to the artificial hand. It's another example of brain plasticity in action . . . and a rapidly maturing technology, already good enough, advocates say, to allow users to play the piano.

Controlling one insect this way would be easy. The Berkeley lab group that first cyborged a beetle appears to have used only six commands: take off, land, turn right, turn left, climb, descend. Multiply that by 300 insects, however, and Kip has to be able to execute up to 1,800 distinct commands . . . potentially all at once.

Or does he?

If each insect is independently controlled, he has a

problem. And he's definitely going to need the ability to control (and monitor) them one at a time when he wants to. But for general-purpose movement, he can get a big assist from a programming concept known as swarm intelligence.

Let's start with a very simple example: pedestrians on a sidewalk. At the 2010 meeting of the American Association for the Advancement of Science, February 19-22 in San Diego, California, Mehdi Moussaid, a mathematician at the Swiss Federal Institute of Technology, described experiments in which he filmed pedestrians on a sidewalk and catalogued their behavior. In zero congestion, he found, groups tended to walk line abreast. In light crowds, they tended to form V-shapes, with the people on each end moving slightly forward. In more crowded conditions, the V inverted, with the center person taking the lead and others following off to each side, like a flock of geese. And in extreme conditions, groups moved single file.

Does anyone tell them to do this? No. It's the result of two simple motivations on the part of each person acting separately: (1) they want to get from point A to point B; and (2) they want to be able to talk to each other as much as possible, en route. The shifting patterns come about simply as each reacts to what's going on in the immediate vicinity. Line abreast is the most efficient pattern for social interaction, but it's the least efficient for moving in a crowd. A V-pattern still promotes social interaction, but when the people on the ends start encountering too much jostling, they drop back, and the V spontaneously inverts. Single file comes about when

congestion is so extreme that conversation is nearly impossible.

Even more interesting is what happens to solo pedestrians moving in heavy congestion. When they meet head-on they have a tendency to side-step preferentially to one side—right in the U.S.; left in some other countries—presumably controlled by which side of the road cars drive on. The result: suddenly, a crowd can spontaneously reorganize from chaos into lanes, just like highways.

People aren't the only ones who do this; streams of ants going in opposite directions will also form lanes (as will ball bearings rolled at each other from opposite directions), although in this case there won't be the culturally driven "proper side of the road" bias. What's interesting is that it occurs with no overriding control. Rather, each person is pursuing the path of least resistance, with a slight bias toward sidestepping to the culturally preferred side.

Kip's swarm isn't composed of pedestrians on a sidewalk, but some of the same underlying principles apply. "You have a high number of agents, and somehow the whole group manages to organize," Moussaid says, speaking specifically of pedestrians, although the remark applies more broadly. "Individuals having [only] local perception of their environment manage to do something together."

Another term for this is emergent behavior.

At the Monterey Bay Aquarium, in Monterey, California, it's

possible to watch sardines swimming in a giant tank. One moment, they're all swimming in one direction, a united, purposeful-seeming entity. Then suddenly, the entire school changes course. But try to find the fish that initiates the change! Rather, it seems as though the entire school has made a collective decision: we're tired of going this way: let's try something new.

The fish aren't acting in concert; nor are they following a leader. Rather, each is reacting to its neighbors according to fairly simple rules, so quickly that the "decision" to switch courses seems to have been made collectively. The flocking behavior of birds is similar. And it's easy to mimic. In lecture notes for an introductory robotics course, Maja J. Mataric, director of the Center for Robotics and Embedded Systems at the University of Southern California, describes a simple procedure for creating robots that flock like birds (or school like fish). All that's needed is for each robot to follow three simple rules:

- Don't collide with another robot.
- Don't get too far away from other robots (with "too far" being defined more precisely in the actual programming).
- Keep moving.

That's it. This won't control where the flock goes, but it will cause the robots to group and move as a unit.

Another simple type of emergent behavior is what Mataric calls "wall following." This involves a single robot, interacting

with an environment about which it has very little information. Here, the instructions are:

- Move at random until you encounter a solid object.
- Don't get too close to it.
- Don't get too far away, either.
- Keep moving (but don't simply oscillate back and forth).

The result: a robot that prowls walls, either in two dimensions (if it's a wheeled robot rolling across a floor) or three (if it's a cyborged insect).

Obviously, Kip doesn't want his swarm to behave like a school of fish. And simply following walls is a bit boring. But the same basic approach can give us more complex behaviors.

If we wanted, we could combine the wall-following and flocking algorithms to produce a flock that follows walls. With the right constraints on each robot's optimum distance from the walls and each other, we could get them to fan out across the entire face of a building, letting their onboard cameras and other sensors peer through all the windows. Or we could program them to recognize open windows or other gaps, so that when one finds a way in, it could lead the others inside, too.

In other words, given a few simple rules, the members of the swarm can be programmed to react to each other and their environment, forming complex, seemingly coordinated behaviors, without the need for Kip to control them one by one.

All of this makes Kip's job a lot easier. Rather than trying to

fly all 300 insects individually, he simply divides them into task forces and gives each group a simple instruction, such as “fan out,” “establish a forward perimeter,” “hide,” “monitor object X,” “find a way into that building,” etc. These assignments activate various algorithms that would let the swarm, or a task force, carry out much of the job on its own, while Kip looks on, occasionally taking control of individual insects if he needs to do something specific.

That sounds complex, but remember what we said earlier about brain plasticity. When one of us (Richard) was in eighth grade, his parents made him take a typing course. At the start, everything was one letter at a time as he searched the keyboard for the right keys. S o m e t h i n g l i k e w r i t i n g l i k e t h i s. Now, typing is nearly automatic. He thinks, and the words appear on the screen while he performs very complex movements at up to 100 words per minute. If he tries to think too much about what he’s doing, in fact, he freezes up. It’s like walking. He just does it.

Any time we do a skill like that—whether it’s typing, shooting hoops, or playing fast-acting computer games, we’re using the same basic skills Kip uses to pilot his swarm. And just like Kip and his fellow CI-MEMS operators, some of us are good at it, some aren’t, and some get addicted.

Short Stories

The Zoo Team

Allen M. Steele

We were somewhere over Australia, about a quarter of the way to Mars, when Miguel flipped out. Ron and I had a lot to do with his breakdown, and when it was all over we were quite proud of ourselves. A good, full-blown mental collapse takes time and effort, of course, and we'd spent the last...

Contamination

Jay Werkheiser

Ari allowed his skimmer to brush the outer edge of Nouvelle Terre's atmos-phere. He tried to imagine air jostling the light nanofiber support frame, whistling through the skimmer's magsails....

The Deadliest Moop

Michael A. Armstrong

They'd been about to power down for the day when dumbass Sven pulled in the squid. The Anna Marie had been dragging the high orbits, 100,000 klicks up, working the fringe because Cap had gotten nervous going any shallower. Ian had thought him a pansy-ass until the Carly Renee doing a 75k pass...

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The Zoo Team

What's between a simulation and a Real Thing?

Allen M. Steele

We were somewhere over Australia, about a quarter of the way to Mars, when Miguel flipped out. Ron and I had a lot to do with his breakdown, and when it was all over we were quite proud of ourselves.

A good, full-blown mental collapse takes time and effort, of course, and we'd spent the last few weeks laying the groundwork. Ron-Jon had a tendency to snore, so we picked that as the starting point; he and I shifted our schedules so that he'd sack out at the same time as Miguel, giving him the full benefit of Ron's nasal performances. Truth be told, Miguel could probably sleep through a train wreck, but he pretended restlessness, twisting around in his bag while Ron made like Branford Marsalis with a broken reed. After a couple of weeks, Miguel was appropriately twitchy; he griped and complained, and made such a show of being surly that it was hard to tell whether he meant it or not.

By then, I'd started up the paddleball. I smuggled one up to the Mess in my flight bag, not really intending it to be part of the act, but because fooling around with it always helped me relax. So I'd float around the station—pardon me, the Mars Expedition

Simulator—bouncing that little red ball on its elastic string, making sure that I was always in the same compartment with Miguel when I was the most active. It got on his nerves, and after awhile he had something else to bitch about.

The most cunning bit, though, were the chess games. The fold-down table in the personnel module had a built-in chessboard, its surface and the bottom of the pieces fitted with Velcro to prevent anything from floating away. Miguel was a hell of a player—I knew that for a fact, because he'd outfoxed me time and again when we were training together in Alabama—but over the course of several weeks he deliberately threw games to both me and Ron, signaling us that he was about to make a bad move by prodding us beneath the table. So I'd take his queen or Ron-Jon would knock off a knight, and Miguel would snarl something obscene before pushing himself away from the table and through the module hatch. And every time he lost, Miguel would make sure that his anger was just a little worse; no full-blown tantrums, just indications that, day by day, he was losing his shit.

When any of these things happened—the snoring, the paddleball, the lost chess games, all the other scenes the three of us staged over the course of eight weeks—we'd have to restrain the occasional impulse to glance at one of the camera lenses not very well concealed in the bulkheads or ceilings. They wouldn't have shown us anything, of course, but at times like those, we would've loved to know what the NASA and Skycorp shrinks were making of the little scenarios we were

putting on for their benefit.

We played to those cameras right up to the end. The day before Miguel went bonzo, Ron and I slipped away to the Personal Hygiene Area—in non-technical parlance, the head—while Miguel remained on watch in the command module. To make it even more convincing, we muted our headsets, and even stuck a piece of tape over the ceiling camera. There was another lens concealed within the passageway, though, along with a hidden mic, so we played to that, making sure that we didn't close the hatch while we had a private chat. It lasted only a minute or so, but it gave Dr. Heinemann and his people something else to write up. Like they didn't have enough already.

So when Miguel flamed out, it wasn't spontaneous human combustion; we'd spent a lot of time stoking the furnace. But he was the leading man in our little melodrama, so we let him pick the time and place.

Tuesday, June 8, 2023; 0915 GMT:

"Will you knock it off with that thing?"

"What thing?" I hung upside-down in the service module, feet anchored to a restraint bar, bouncing the red ball off my racket. Bonka-bonka-bonka-bonka . . . "This thing?"

"Yeah, that thing. Cut it out." Miguel hovered above the atmosphere control console, e-book in hand, trying to take accurate readings from the various flatscreens. All of them displayed false data, of course, just as the plasma displays

behind what would have been normal portholes showed us Mars as we would've seen it from twenty-four million miles away. Nice work, really; whatever Hollywood special-effects outfit Skycorp had subcontracted for this part of the Mess had definitely earned their money.

"Sorry. Didn't know it was bugging you." I caught the ball, tied it against the paddle, slipped it into the back pocket of my jumpsuit. Miguel glanced at me, and when he did, his right eyelid twitched a little as a very subtle wink. A signal: do something else.

"So . . . how's your family?"

'They're fine." Terse, staring at the panel again. Little red numbers on little blue screens.

"Great. Glad to hear it." I unhooked my feet from the bar. "How's your sister?"

"Fine." He touched his e-book screen again; I noticed some crude, hand-drawn circles in the margins. Doodles. Good. Shrinks love doodles. "Why're you asking?"

I somersaulted, came down behind him, and grabbed a wall rung. "Just asking. Seems like a nice girl, that's all."

He didn't look back at me. "So why do you want to know?"

"He's just asking a question." Ron was coming through the hatch from the personnel module, hair still wet from the sponge-bath he'd just taken. "What's the big deal?"

"Yeah, that's all." Then I turned away from Miguel and

muttered something nasty about what I'd like to do with his sister.

He caught it, as I knew he would; I'm sure the people in Huntsville did, too, because I said it just loud enough for the hidden mics. In the next instant, Miguel dropped the e-book and came at me, launching himself across the narrow compartment. I turned around just as he grabbed me by the collar and rammed me against a bulkhead.

"Say that again," he snarled in my face, "and I'll kill you!"

So I grinned and said it again.

As I said, we'd planned the whole thing in advance, before we'd even left the ground. In his pocket, Miguel had a stage knife: a six-inch switchblade, pearl handle and everything, just like the ones the L.A. street gangs carry, only this one had a phony blade that couldn't cut cheese and, when pushed against a solid surface, retracted straight back into the handle. Skycorp wasn't the only one to use Hollywood magic; Miguel had a friend who worked for a prop supply company.

Miguel yanked the knife out of his breast pocket, flicked it open. My eyes widened, and I yelled, "Whoa, man, waitamminit . . . !"

"What the hell are you doing?" Ron shouted. "Leggo of him!"

He pushed himself toward us, but Miguel kicked him out of the way. Ron flew across the compartment, flailing his arms helplessly. And then Miguel turned to me again and, muttering a

Latino obscenity, shoved the blade into my chest.

Ron's aim was perfect—at that instant, he landed next to the main communications panel. One swipe of his elbow across a pair of toggle switches, and the Ku-band transceiver was down. He quickly checked the radio, then looked back at Miguel and me.

"Okay, that's a wrap," he said. "We're off the air."

Miguel still had his knife thrust up to its hilt in my heart. Hearing Ron, he pulled the knife away. Sproing, the blade reappeared. "You okay?" he asked.

I looked down at myself. I wasn't even nicked. "I'm good."

"Didn't mean to slam you so hard," he added, genuinely concerned.

"Don't worry about it." In zero-gee, any action like that can be enough to hurt. Considering that I'd been lethally stabbed, though, I was feeling pretty good. "Does this mean I can have a date with your sister?"

"No." He gave me a wry grin. "She's married."

"Nice job, gentlemen," Ron-Jon said. "I think that'll keep 'em busy for a while."

"How long do you want to stay dark?" Pushing myself away from Miguel, I floated into the command module, and checked the simulator com panel. Although Ron had knocked off the real-time wireless link, the Mess's time-delay communications system was still operational. No text messages from Huntsville,

or at least not yet; we were still on fifteen-minute delay. The longer we played possum, though, the more likely the boys in Huntsville would believe that something had seriously gone bad up here. No doubt, Dr. Heiney was already on the phone with the flight director, telling him that Team Zulu had cracked.

"Let 'em stew a bit." Miguel said as Ron-Jon disappeared through the hatch leading to the personnel module. "I'd like to have a drink first."

Ron had gone to fetch the fifth of tequila we'd been saving for this moment. It was concealed in a locker, where it had been hidden ever since we'd arrived on the Mess two and half months ago. We'd have to use squeeze-bulbs, of course, but at this point none of us minded. If we were going to get booted from the Mars program, we'd might as well go out in proper Zoo Team style.

"Suits me." I said, and was turning to go get my pack of Bicycles when we heard a loud bang! and felt a hard thump against the hull.

That's when the joke ended.

The joke started about four months earlier, when NASA picked the crews for Skycorp's Mars Exploration Simulator and it turned out that Miguel, Ron, and I would be on Zulu Team. But if you want to understand the punch line, you have to go a little farther back, to when NASA decided that they needed to do orbital flight simulations before they sent a second mission to Mars, and contracted Skycorp to handle the logistics.

Everyone has seen the pictures that Ares I sent back from Mars, of course: American and Japanese astronauts walking across the cold red landscape, raising their respective flags and making awestruck comments about the Arsia Mons volcano. But what most people didn't know is that those were the mission's best moments, carefully selected and edited for public consumption. Most haven't seen the more tawdry incidents witnessed by flight controllers in Houston: the abusive remarks, loud arguments, sexual harassment, fist-fights, and so forth that had half the six-person crew no longer on a casual speaking basis with the other half—and all but two on anti-depressants—by the time the ship reached Mars.

But NASA and NASDA officials noticed, as did the committees of both Congress and the Diet that had oversight over the respective space agencies of their two countries. And since Ares I produced less scientific data than expected, the shortfall was blamed on low crew morale. So the government committees issued a mandate: before Ares II could be funded any further, mission planners would spend more time learning how to keep astronauts from going chimp during long-duration flights.

NASA turned to its major contractor, Skycorp, to carry out a new round of psychological testing. Skycorp had already learned a lot about space crew psychology from its power-sat construction program, and one important thing they'd discovered was that the results that came from ground-based simulators were questionable at best. Sure, there had already

been several studies in which groups of people had been sealed within small, spacecraft-like habitats for months at a time. But the results of those experiments weren't totally reliable, mainly because the men and women in those simulators knew they weren't really in space. The presence of gravity couldn't be avoided, and there were other subtle hints that the millions of miles that supposedly separated them from Earth were only a fiction, and on the other side of the airlock hatch was a great big world full of pizza and beer and sex and all the elbowroom you could want.

The psychologist in charge of the Skycorp studies was one Joseph Heinemann, Ph.D., late of the Harvard medical school. It was Dr. Heinemann's contention that the only way Skycorp could reliably test, train, and select the crews for Mars missions would be to build a small space station whose interior would resemble an Ares spacecraft as much as possible. Placed in low orbit above the Earth, the Mars Expedition Simulator —which, naturally, became nicknamed the Mess—would have fake portholes that were actually video screens, and all space-to-ground communications would be subject to delays that would become increasingly longer as the test went on.

Dr. Heinemann then devised a two-part program. In Phase 1, four teams of astronauts, with three persons in each team, would spend ninety days—that is, about half the time it'd take a ship to get to Mars—aboard the Mess, doing everything that an Ares crew would do during the outbound leg of their mission, while ground controllers studied their conduct through hidden

cameras and mics. Once those four teams—designated Alpha, Gamma, Theta, and Zulu—completed their turns in the Mess, the results would be studied and the findings would be the basis for Phase 2, when the six astronauts who'd done best during the Phase 1 test would be the ones selected for Ares II, and would hence go into training for the mission itself.

To be sure, this was an expensive and rather time-consuming way of determining who'd be most likely to crack under pressure. On the other hand, no one ever again wanted to see footage of an astronaut threatening to gouge out another guy's eyes with a plastic spork. So Dr. Heinemann's proposal was approved, the Mess was built, and an announcement was made that the window was now open for applications to the Ares II training program.

I wanted to get on the next Mars mission, as did just about everyone else in the space business. It was like offering a climb up K2 to hardcore mountaineers: who can resist? But I knew my chances of being picked were somewhere between nil and zip. Sure, I'd spent a year working on Skycorp's SPS-1 project, but my company record was . . . well, questionable, to put it mildly. "Disciplinary problems" is the expression most often used in my performance reports. Oh, I did my job well, and my safety record was unblemished. But I had a tendency to talk back to the boss, and bureaucrats give me a real pain in the neck. That sort of thing doesn't fly well in NASA's button-down, no-nonsense culture, and even though I sent in my application, I figured that, a year or two later, I'd still be parked on a barstool at the Cape,

waiting for my union rep to find me another low-orbit construction gig.

So I was surprised when Skycorp invited me in for interviews and physicals, and even more surprised when I made it to the short list. Face it: I was a space monkey, a grunt with some technical skills and the ability to bolt two pieces of metal together while floating upside down. And I had an attitude. I had little business being in the same room with NASA and NASDA astronauts who had doctorates like I have calluses and who'd been first in everything they'd done since childhood. Next to these purebred Best Of Show champs, I was some mutt who'd managed to sneak in through the dog door.

As it turned out, though, I wasn't the only one. It wasn't long before I realized that two other Phase 1 candidates weren't Boy Scouts either. Miguel LaCosta was another former Skycorp contract worker, and before that he'd worked for one of the space tourism companies. He was a USAF-trained left-seater who knew his way around the cockpit of anything that had wings and a hydrazine engine, but a rep for practical jokes had made him persona non grata with most of the privates. NASA had no more room for him than they did for one of their own: Ronald Johnson, a former Navy flyboy who'd been something of a star in the astronaut corps before he'd gotten caught in a Texas whorehouse with a girl in his lap—yes, I said that right—and a whiskey bottle on his knee. Bye-bye Ron-Jon . . . or at least until he had the temerity to apply for the Mars program and, like Miguel and me, was astonished to find himself on the short list.

So here was the Justice League International, and here was the Legion of Super Pets. And guess which one was assigned to Zulu Team, the first group to spend three months aboard the Mess?

At first, Miguel, Ron-Jon, and I could hardly believe our luck. As the first group to go up, we'd also be the first to come back down; that meant we'd have time to goof-off until the final crew selection was made and Phase 2 would begin. That, along with the fact that none of us really belonged there in the first place, made each of us wonder what we'd done deserve our great fortune.

We weren't lucky. The exact opposite, in fact. But it took awhile for us to find that out.

When Skycorp built the Mars Expedition Simulator, they used inflatable modules that could be easily lifted into orbit aboard an expendable launch vehicle. The Mess had three modules, each about the size of a bus, connected together in tandem; they were made of some industrial-grade polymer that could take sea-level pressurization, and had various solar arrays, radiator panels, tanks, and antennas sticking out in all directions. At the aft end of the station was a hard-hull airlock module, and attached to it was a three-man re-entry vehicle that Miguel, Ron-Jon, and I were supposed to pretend didn't exist until the last day of our mission, when we'd be allowed to climb aboard for the ride back to Earth.

I was familiar with inflatable modules from my time on the

powersat construction project. Beamjacks called them “hot dogs” and although the company kept insisting that they were safe, none of us trusted them very much. They were a cheap, lightweight substitute for metal spacecraft hulls, and even though they’d been proven to be resistant to cosmic radiation and micrometeorites, everyone who used them was aware that they were vulnerable to one particular kind of orbital threat.

And, damn it, that’s exactly what happened to the Mess. It got hit by a piece of space junk.

Sure, USAF Space Command constantly tracks the location of all known orbital debris, and periodically the ground controllers in Houston would gently maneuver our little station so that it was out of the way of a fuselage panel, screwdriver, or third-stage fairing that would come barreling toward us at 3,600 miles an hour. But the boys at Cheyenne Mountain can’t locate and track everything. Now and then, some object gets lost or jettisoned that isn’t reported for one reason or another—usually stupidity—and it orbits Earth until it either finally falls into the atmosphere and burns up, or hits something else up there and thus causes someone to have a really lousy day.

I had no idea what struck the Mess other than it was bigger than a washer and smaller than a pen, and it made our lives really interesting. Within seconds of the thump-and-bang of it hitting the simulator, a very non-simulated master alarm went off in the command module. Miguel and I were still staring at each other when Ron-Jon came back through the hatch.

“Blowout,” he said.

“Uh-huh.” Miguel calmly put the fake knife back in his pocket. “Emergency stations, gentlemen.”

In science fiction movies and novels, you often see astronauts going into a blind panic when there’s a catastrophic accident. Who knows, that sort of reaction may happen from time to time. But it didn’t happen to us. Miguel, Ron, and I were well-trained and experienced, and since we’d already rehearsed emergency procedures for the Mess, each of us knew what to do. As team leader, Miguel went straight to the command module, where he entered the six-digit code into the main computer that disengaged the simulation routines and returned the Mess to normal operation. While he did this, Ron-Jon went about trying to locate the source of the blowout and, if possible, making temporary repairs. My job was to go to the airlock, suit up, and prepare to either go EVA and fix the problem from outside the Mess or, if all else failed, get the re-entry vehicle ready to serve as a lifeboat in case we had to abandon the station.

I was still blessing some Skycorp engineering team for having developed zero-pre-breathe spacesuits that could be donned and cycled through an airlock in minutes instead of hours when I heard Miguel’s voice through the earpiece of my bunny cap. “Huntsville, this is Zulu Team,” he said, as casually as it this was a routine radio check. “We’re reporting an in-flight emergency. Suspected collision with a foreign object and possible cabin depressurization. Do you copy?”

A few seconds went by, during which I thrust my head through the suit's neck ring and reached back with both hands to seal the back-hatch. I was reaching for my gloves when Skycorp Control came over the comlink. We were no longer in time-delay, so we heard Capcom at once.

"Ah, affirmative, Zulu, we copy. Is this Mission Commander LaCosta?"

Miguel must not have yet turned the cameras back on, and was relying on voice-only communications. "Affirmative, Huntsville," he said.

"Commander LaCosta, weren't you experiencing another in-flight emergency just a few minutes ago?"

"Negative, Huntsville."

"Please explain."

Oh, hell. I'd almost totally forgotten the little skit we'd performed for Skycorp Control's benefit.

"Huntsville, we apologize," Miguel said. "That was a practical joke on our part. I assure you that this is not another joke."

Before Capcom could reply, Ron-Jon's voice came on. "Huntsville, this is Lieutenant Commander Ronald Johnson. I have not been harmed. Commander LaCosta did not really stab anyone. And, no, this is not another joke. Over."

I quickly activated my suit radio, switched over to the channel for the Mess's long-range communications system.

“Huntsville, this is Lieutenant Commander . . .”

“We copy, Zulu.” Capcom apparently didn’t want my side of the story; the fact that I was alive and well was enough for them. “We’ll discuss the earlier incident later. Please describe your current situation. Do you copy?”

“Roger that, Huntsville.” There was a hint of relief in Miguel’s voice; Skycorp Control no longer believed that he’d just planted a six-inch stiletto in my chest. “We’ve gotten a cabin leak message and are showing a DP/DT of .125 psi. We’re currently searching for the source, and we’re preparing the REV for Orbit Mal Proc.”

“We copy, Zulu.” A long pause, during which I imagined the scene in Skycorp Control: Capcom, Flight, and the rest of the ground team, hunched over their consoles as they muttered into one another’s headsets, trying to decide whether they should take the Zoo Team at their word. Because let’s face it: we hadn’t exactly been anyone’s ideal astronauts, and this wasn’t the first stunt we’d pulled. Which is why Zulu Team was called the Zoo Team more often than not.

I was reaching for the rack holding my gloves and helmet when my gaze fell upon the one porthole in the Mess that didn’t have a fake image of Mars on the other side of the glass. From here, I could see Earth, 260 nautical miles below . . . and it didn’t look right. What should have been a steady view of a gently curved horizon was instead a starless black void. A couple of seconds later, the limb of the Earth appeared, the

South Pacific a bright blue expanse shaded by misty white clouds. But then it turned upside-down and tumbled away, replaced once more by nothingness.

I hissed under my breath, then touched my mic wand. “Hate to say it, gentlemen, but our problems just got worse.”

The Mess had been placed in equatorial low orbit and Zulu Team was about three weeks away from being sent up to it when we learned the true nature of our mission.

By then, we were nicknamed the Zoo Team, and with good reason. Miguel, Ron, and I tried hard to be proper Space Cadets, but our mischievous ways kept coming back to us. Every morning for two months, the three of us arrived at the Skycorp training complex in Huntsville for ten to twelve hours of intensive exercises overseen by “technical associates” who’d never been in space themselves. So we’d find ourselves being lectured on orbital rendezvous techniques by a kid who’d never been in a cockpit—not a real one, at least—or receiving instructions on how to don a spacesuit from some dweeb who wore Velcro-strap sneakers because shoelaces were too much of a hassle.

Making matters worse were our colleagues. A finer group of stiffs, there never has been. Six men, three women, each looking as if they’d just marched off the Liberty University campus: eager, well-scrubbed—I swear, I think some of them brushed their teeth four times a day—and utterly lacking any individuality. One guy insisted on opening our morning briefing

with a prayer, another was proud of the fact that, at age 29, he was still a virgin, and one of the women blushed whenever toilet paper was mentioned. They didn't drink, smoke, or say anything more harsh than "gosh darn" . . . and it goes without saying that none had a decent sense of humor.

You have to give Zulu Team some credit: we actually made it through the first four days of Phase 1 without cracking a joke or pulling some sort of gag. But there was no way we could've continued our training without screwing around one way or another; otherwise, we would've lost our minds. So first came the muttered wisecracks, which were met with cold glares and whispered shushes that only encouraged us, and then came the straight-faced innuendos and disguised insults, which usually went over the heads of their intended targets, and finally the practical jokes, like rigging the eight-ball of the cockpit simulator so that it was always upside-down, or slipping a couple of drops of lubricant to the front zippers of the women's jumpsuits so that they'd constantly slide down when we went out for our morning jog.

A few weeks of this, though, and we began to wonder whether we were pushing our luck. The Zoo Team was having fun, sure, but while it seemed peculiar that no one ever gave us a serious reprimand or threatened to bounce us from the program, we knew it was all too possible that we'd go too far and end up being left behind when the final crew selection for Ares II was made. So Ron, Miguel, and I talked it over during a Saturday night beer run, and decided to cool it for a while.

Yet it didn't matter. We eventually found out that the Zoo Team was never meant to go any farther than Earth orbit.

Our information didn't come from a memo or a conference room, but from a pillow. Ron-Jon never lacked for girlfriends, and his latest was a young lady who worked as an assistant to one of our specialist associates. One evening, while she and Ron-Jon were in bed, she told him something that he promised to keep to himself, and then revealed to Miguel and me the very next morning.

"We've been set up," Ron said quietly, once he was sure that there was no one else in the training facility locker room. "Our team, I mean . . . there's no way any of us are going to Mars."

Miguel stared at him. "Want to run that again?"

"The other nine are the final candidates for the mission," Ron said. "Six will be on Ares II, and the other three will be back-ups. But once Zulu Team comes back from the Mess, our job will be done . . . because our job is to screw up. That's why they picked us in the first place."

What Ron learned from his cute little fink was that the three of us were on Zulu Team specifically because we were bad apples. Dr. Heinemann—a.k.a. Dr. Heiney, as Miguel had dubbed him because of his rather large posterior—privately believed that it was unlikely that Skycorp would ever be able to select a final crew which would not to have psychological problems of one sort or another. But since NASA and NASDA

had invested a considerable amount of money in the Mess program, he didn't want to admit that to them, nor did he want to be held responsible if the Ares II crew had the same problems as Ares I. So he'd figured out a way to shave the odds just a little bit.

"Zulu Team is expected to screw up," Ron-Jon said. "In fact, they want us to screw up. That's our mission . . . to botch our flight so badly that we'll make the other three teams look good. So if Ares II fails because there's another crew crack-up, Skycorp can always point to the results of all the Mess missions and say, 'Well, see, we always knew there was a chance things would go wrong . . .'"

"So they're grading on a curve." Miguel nodded. "That's why they're sending us up there first. They're figuring that our flight will fail and the next three missions will succeed, and once they lump all the results together . . ."

"They'll have a set of statistics showing an increased probability of crew failure simply because one of the four test teams was a bunch of goofballs," I said.

"You got it." Ron-Jon's expression was unusually dour; he didn't mind being a jester, but he didn't like being played as a fool. "So we're not going to Mars, no matter how well we do up there. In fact, my guess is that, even if we do a perfect job, they'll throw some sort of no-win scenario at us."

"And use the results of that as the info they need." I slowly nodded. "Yeah, I see what you're saying. Once we're in the

Mess, they can manipulate the scenario however they want. Solar flare. Meteor collision. Reactor meltdown. Any sort of catastrophe you can think of . . .”

“Unless we come up with our own scenario first,” Miguel murmured.

I looked at him, saw a crafty glimmer in his eyes. “Come again?”

“We’re not going to Mars,” he went on. “We know that now. But that doesn’t mean we have to be puppets, either.” A smile crept across his face. “They want us to fail? Okay, fine . . . but maybe we can fail on our terms.”

That’s when we started coming up with our little practical joke. Four months later, though, I didn’t feel much like laughing. Not as I looked out the airlock porthole to see Earth spinning around and around like a towel in a laundry dryer.

But it wasn’t the planet that was tumbling end over end; it was the Mess. The blowout had been sufficiently violent to cause the station’s escaping air to act like a jet, causing the entire station to pitch forward in an axial roll. And although we hadn’t yet felt any physiological effects of the spin—our fake portholes and instrument read-outs, in fact, had ensured that we wouldn’t know what was going on—I knew that it was only a matter of time before the g-force increased to the point that we’d lose consciousness and black out.

But that wasn’t the worst of it. My suspicions were confirmed a few seconds later, when Capcom’s voice came

online again. “Zulu, this is Huntsville. Samoa Tracking indicates that your orbit appears to be deteriorating. Can you confirm?”

“Roger that, Huntsville,” Miguel said. “My instruments show that the accident has caused a change in our attitude and altitude.”

“Affirmative,” I said. “I confirm through visual sighting.”

From elsewhere in the Mess, Ron-Jon chimed in. “Huntsville, I’ve found the location of the decompression. It’s a small hole, approximately half a centimeter in diameter, located on the upper port side of the personnel compartment. I’ve plugged the hole with a T-shirt and I’m about to use the seal kit to make emergency repairs.”

This was good news, at least. Now that Ron-Jon put a stopper in the hole, the Mess no longer had a pressure leak and we could concentrate on our larger problem: namely, stopping the station from cartwheeling into Earth’s upper atmosphere.

A long pause. “We copy, Zulu,” Capcom said at last. “Please be advised that you’re coming within range of Monterey Tracking, and we’re prepared to hand you off to an associate who’s standing by to assume emergency flight control.”

Oh, how wonderful. Skycorp was going put our fate in the hands of someone who’d probably learned how to fly a spacecraft from playing a desktop flight simulator video games. “Um . . . negatory on that, Huntsville,” Miguel said. “We’re going to execute Code Whiskey Tango Foxtrot instead.”

Another pause. “Please repeat, Zulu. We don’t . . .”

“Copy that,” I said. I knew what Miguel meant even if Capcom didn’t; Code Whisky Tango Foxtrot was Zoo Team talk for I’m about to do something crazy; go to a private frequency so I can tell you what it is. So I switched to another freq and said, “What do you have in mind, Miguel?”

“I think we can take care of this ourselves. Can you enter the REV and commence ERO?”

“No sweat. Be ready in a minute.”

ERO stood for Emergency Re-Orbit, a maneuver we’d practiced during training exercises in Huntsville. The Mess had four reaction-control rocket clusters, with each RCR mounted on one of the service module’s four sides. They could be manually fired to readjust the station’s attitude, all right, but they lacked sufficient thrust to stop its spin or return the Mess to proper altitude. For that, they’d need a little help: namely, the REV’s big engine.

For this to work, though, the thrusters and the REV would have to be fired at exactly the same time, in exactly the right pattern. If we got it wrong, we’d actually increase the station’s spin, and make our problems worse. So it was a risky maneuver, yes . . . but better this than trusting some dude on the ground.

Discarding my gloves and helmet, I opened the docking hatch and pulled myself into the REV’s tiny cockpit, squeezing myself into the left-hand seat. Once I was strapped in, I switched on the instrument panel and warmed up the engine. As I did all

this, I could hear Capcom nagging Miguel, demanding that we tell them what we intended to do up here.

"Ready when you are, Miguel," I said, still using the private channel.

"Roger that," he said, then muted the ground link so that Huntsville wouldn't distract us. "I've got my eye on the screen. On my mark, fire the main engine at full thrust for two seconds. Copy?"

"Copy." I rested my hand on the throttle bar. "On your mark."

Through the narrow cockpit windows, I saw only darkness. Then Earth's curved horizon came up from below, the South Pacific a couple of hundred miles below. Hawaii had just become visible when Miguel said, "Three . . . two . . . one . . . mark!"

I pushed up the throttle bar, heard the dull rumble of the REV's engine behind me, felt a tremor pass through the Mess. I silently said One Mississippi, Two Mississippi, then hastily jerked the bar back down, cutting the thrust. "How was that?"

"Okay," Miguel said, "but we're still tumbling."

"Hey, warn a fella next time, awright?" Ron-Jon squalled. "I'm about to puke back here."

That was the first time any of us had cracked wise since the crisis began; we needed the laugh. "Let's try again," Miguel said. Once more, Earth had vanished through my windows. "Mark on three, three-quarters thrust this time."

“Copy.”

“All right, get ready . . . three, two, one . . . mark.”

We went through the routine again, and three more times after that. And after each time I fired the main engine and he fired the RCRs, I could see that Earth was coming up a little more slowly and that it was a little farther away until, just as the Mess was passing over the coast of Ecuador, the station stopped spinning entirely and Capcom informed us that, according to Monterey Tracking, our altitude had returned to normal.

That was also when Huntsville informed us that a shuttle was on its way up from New Mexico to take us back down. I’d already figured that retrieval would be necessary; I’d used up nearly one-third of the REV’s fuel reserves in our ERO. Nonetheless, I was surprised to hear that Flight had decided to cut the rest of our mission short.

Ron-Jon wasn’t. “Better update your resumes, boys,” he said as soon as the three of us met up again in the personnel module. “I think we’re going to be looking for work again.”

He was right, of course. Perhaps Team Zulu had displayed grace under pressure, not to mention no small amount of ingenuity, by saving both the Mess and ourselves from certain destruction, but we were hardly forgiven for the stunt we’d pulled just before that. And while it would be nice to say Dr. Heinemann was so impressed by our astronautical skills that he recommended that Zulu Team be assigned to Ares II, the sad

fact is that exactly the opposite happened. Miguel, Ron, and I barely walked down the ladder from the Skycorp shuttle that had rendezvoused with the Mess two days after the accident when we were bundled into a waiting jet and flown to Huntsville, where we spent the next three days being grilled, together and separately, by so many different people that we must have been interviewed by half of Skycorp's management by the time we were done.

Dr. Heinemann was among them, and while he wasn't the worst of our interviewers, he made up for it with a persistent belief that there hadn't really been a collision, but that we'd concocted the accident ourselves. Fortunately, on-site inspection of the Mess backed up our story; the hole in the station had been made from the outside, not the inside. But Dr. Heiney had it in for us. We'd screwed up his experiment—never mind that we were supposed to screw it up, just not the way we did—and, in the end, he got his revenge.

Six days after the accident, the three of us were marched into a conference room on the top floor of the company's offices, where a half-dozen or so suits and Dr. Heiney sat on either side of a long, black table, at the other end of which was seated Skycorp's CEO and president. After spending the next ten minutes ripping us apart, he told us what we'd expected to hear anyway: we weren't going to Mars, and we could collect our severance checks on the way out the door.

And that was it. Our space careers were over.

Or so we thought.

I still had friends in the company and at NASA, and over the next eighteen months or so, I heard about what happened to the Alpha, Gamma, and Theta teams. As it turned out, Team Zulu's performance turned out to be the high-water mark. At least Miguel, Ron-Jon, and I got along together; the other teams were so high-strung, their members were at each other's throats before the first four weeks of their respective missions were over. And when Team Gamma had an accident of their own—an oxygen tank exploded—they panicked so badly that Huntsville had to order them into the REV, which was then piloted to the ground by remote control. Only three of the nine guys on those teams ended up going to Mars; NASA had to pull together the rest of the Ares II crew from other sources, and those people were not put aboard the Mess first. The station was deorbited shortly after that, and the last I heard of Dr. Heiney, the old quack was teaching Psych 101 at a community college somewhere in Louisiana.

Ares II got safely to Mars and back again, though, and so did Ares III. But after that, Skycorp took over the Mars exploration effort. Together with a Japanese company, Uchu-Hiko, they announced their intent to establish a permanent settlement near Arsia Mons. I guess someone must have rethought the criteria by which they picked the people who'd colonize Mars, because about six months after that I got a call from Skycorp's HR office, asking if I'd be interested in coming in for an interview.

I wasn't. By then, I'd married and found a new career as a freelance writer. And to tell the truth, I was also still burned about the way we'd been treated. So I turned them down, albeit more politely than they deserved, and went on my way.

But Miguel and Ron-Jon didn't. And that's why today I received an e-card from them: a picture of the two guys, their hands around the other guy's throat, their tongues hanging out of their mouths as they mug for the camera. The inscription is a cliché—Having a wonderful time, wish you were here—but it's what is in the background that got my attention: a big window, and on the other side of it, a desert of red and rocky sand.

In the end, the Zoo Team managed to get to Mars, in spite of itself. Maybe that's the way it was supposed to be.

Next Article

Contamination

Different folks can have different opinions, but they may not all be able to act on them. . . .

Jay Werkheiser

Illustrated by Vincent Di Fate

Ari allowed his skimmer to brush the outer edge of Nouvelle Terre's atmos-phere. He tried to imagine air jostling the light nanofiber support frame, whistling through the skimmer's magsails. Excitement pulsed through his veins at the thought of being so close to the blue and white surface, perhaps

closer than any human had ever dared. Nothing but his skinsuit and a few hundred kilometers of atmosphere separated him from the living, breathing landscape below. He spread his arms and legs, trying to feel the minuscule tug of atmospheric drag.

Is that what wind feels like?

His faceplate HUD showed a ripple in the magsail's yaw loop. The threat of a coil collapse brought his mind back into focus, and he hiked up the field strength to gain some altitude. He savored every precious minute the skimmer took to climb away from the atmosphere. Nouvelle Terre's secondary sun climbed over the horizon, visible only because the primary sun hadn't yet risen. He scanned the starry sky, taking advantage of the view before primary sunrise darkened his faceplate. Earth's distant sun was almost directly overhead, a pinpoint at the tail of a zig-zag of stars. The drive flare that cut across the constellation chilled his good mood. After a generation of silence, what could the Earth people possibly want?

Bah. Figuring that out was the job of bureaucrats. Ari preferred jockeying around with a skimmer, launching and retrieving microprobes, and taking time to enjoy the freedom of flight. Before long, the Gardien rose above the limb of the planet. He'd be home within a half hour, pining for his next chance to fly free.

"That you, Ari?" If his solitude had to be interrupted by a human voice, he could do worse than Maura's.

"Who else would it be?"

He knew damn well who she was afraid it might be. He tilted his head upward toward the spear of light that dominated the sky. A new ship from Earth arriving unannounced after all these years was reason enough to be on edge.

“I’ll have your approach vector in a moment.” Maura’s image in his faceplate wore the drive flare like a burning gash on her forehead. “Your drop was perfect. The microprobe will skim the atmosphere deep enough to pick up some dust samples, but high enough to avoid surface contamination. With any luck, some of those dust grains will carry living spores.”

“We wouldn’t need luck if they’d let us dive lower. Damn Earthborn are too cautious.”

“You managed to get a pretty deep dive on that last orbit.” She pursed her lips in mock disapproval. “You’re going to catch hell for your little maneuver.”

“What? I was just dropping low for a perigee kick.”

Her laugh was pure music. “Good luck getting the director to buy that one. She’s in a foul mood.”

He snorted, momentarily fogging his faceplate. “She doesn’t need my help. Dear old Mom takes foul to a new level, even for an Earthborn.”

“Don’t be cruel. They earned the right to be grumpy.”

“Maybe they’d be more caring if they hadn’t cranked us out of their wombs like an assembly line.”

“Have some respect. You don’t know how long they’ll be

around."

"We'll be restocking our supply of Earthborn soon, from the looks of it." He gestured toward the light as he spoke, even though his helmet's cam couldn't show it. "It warms my heart to know that even the Secretary-General has no idea why Earth sent a second ship after all these years."

She huffed. "You have no respect for authority, Ari."

"It's all part of my charm." He flashed a grin that he hoped was rakish before realizing that it was wasted out here where she couldn't see it.

A partly suppressed smile bloomed on her face. "What would be charming is treating me to one of those new beefmeat burgers imported from the moon base. I hear they taste just like natural meat back on Earth."

"And who would know? The Earthborn are so old even their taste buds are dying."

Her head shook back and forth in his faceplate. "You shouldn't be talking like that on an open channel."

"All right, I'll be good." He grinned. "Now are you going to give me an approach vector or am I going to do another orbit?"

"Uh . . . hold on a sec. Ari? I have the director on the line."

"What? Did she hear—"

"Shhh. I'm getting instructions now."

"She probably just wants to bust my ass about dropping too deep into the atmosphere. Heaven forbid we risk

contaminating their precious pristine planet with my ashes."

"Okay, she's sending a new orbit for you."

"What the hell? She wants me to take another lap? Is something wrong with the microprobe?"

"No, the probe's fine. I don't like this, Ari. She wants me to sign off. She's taking over—"

Maura's image dissolved into the black of the sky. He turned his focus back to the Gardien, wondering what was going on there. The bright point of light, now high above the horizon line, offered no answers. After an endless pause, the incoming message indicator lit.

The director's gaunt face floated before him. She looked desiccated, like a corpse left outside to vacuum-dry. A specter from a distant world, Ari thought. This new world is ours to explore, not theirs. Explore, but never touch.

Her sunken eyes pinned Ari in place. "Skimmer pilot, report your status." The voice was scratchy and hoarse, weary from two hundred years of life, yet still it carried the aura of authority.

He eyeballed the dropdown at the top left of his faceplate and brought up the system check display. The bioscrubbers were pumping out oxygen faster than he could breathe it; the oh-two tanks were full. The magsail loops were well below the critical temperature where they would stop superconducting. "Nominal, ma'am." After a moment's pause he added, "Except the radio. I lost contact with shipboard control." But that's not a malfunction.

“I know.” She nodded slowly, carefully, as though afraid her neck might snap. “For security, I will be your only contact with the Gardien during this mission.”

That put a lump in his throat. “And what mission is that?”

She gazed at him, unmoving, for a long moment. “A small vessel has entered orbit of the planet.”

“Not one of ours, I assume.” He glanced once again at the enigmatic flare from Earth. “They’re pretty far out and still under heavy deceleration. I’d have expected them to wait until they made orbit.”

“Clearly Earth’s propulsion technology has improved since we left.”

“So the Earth people put a, what, probe or something into orbit? What am I going to be able to do about it?”

“A shuttle. For now, just observe. You’re the only manned asset I have on orbit at the moment.”

Asset? That’s all I am to her? Before he could say anything, his HUD indicator signaled an incoming data packet. New orbital parameters. He eyeballed the dropdown at the top left of his faceplate and brought up a visual overlay. The orbit was eccentric, with a perigee lower than he had ever gone. His heart skipped at the thought. Permission to skim the upper atmosphere? Hell, yeah!

Excitement bubbling in his veins, he hardly noticed when the director disconnected. The forbidden dream—to touch a

living world—was about to come one step closer. But to touch was to contaminate, he knew, to introduce his alien proteins and nucleic acids into an ecosystem that might not be able to handle them. We'd never know what was native and what was from Earth. We'd lose irreplaceable data. All true, but so damned frustrating.

His altitude grew gradually toward apogee, giving Ari plenty of time to stare at the living world below. His eyes traced the arc of a coastline, vivid blue overlaid on shades of tan and green, until he lost it in swirled white clouds. He tried to imagine what it would be like to stand on that beach, to feel the moist wind in his face. What sounds would there be? What did it smell like?

"Um, Ari?" Maura's voice, tight with stress, startled him. "I'm defying orders by contacting you, so I'll have to make this quick."

He glanced up at the curved horizon line. The Gardien was a bright light shimmering through the upper edge of atmosphere. "What's wrong?"

"They're planning to land."

"Who? The people from Earth? Nonsense. They sent us to preserve the ecosystem. They wouldn't risk contaminating it."

Atmospheric distortion crackled in his ear. Their ancestors sent our mothers; we were frozen embryos when that decision was made. Attitudes back on Earth may have changed.

How dare they risk destroying a lifetime of study? How

dare they touch the world, experience it up close, achieve his dream?

And what the hell was Ari supposed to do about it?

Somehow, solitude had lost its charm. He busied himself by fiddling with the radio. Maybe the director hadn't shut down his emergency channel. His heart thumped in his chest when he found the radio wouldn't respond to his command. His oxygen-use indicator briefly flashed yellow—he was using oxygen faster than the bioscrubber was producing it.

He forced his breathing into a practiced rhythm, slow and steady. No sense depleting the oh-two tanks unnecessarily. He eyeballed the radio diagnostic software. Red error messages scrolled up his faceplate. The radio was fried.

Wait. The content of the error messages belatedly registered. The radio was fine; it was the software that was fried. And how exactly did that happen?

The director's data packet must've contained more than orbital data. She really doesn't want me contacting anyone. What else did she sabotage?

Hell with her. He looked up along the skimmer's carbon fiber frame. The magsail's superconducting loops doubled as his radio antenna. The kilometer-long nanofiber filaments that made the loops were invisibly thin, and even if he could see them he wouldn't have been able to manipulate them by hand. Not without risking a coil collapse. Without those superconducting coils pushing against Nouvelle Terre's

magnetosphere, he would have no way to maneuver.

That left the backup transceiver, a small dish mounted on the bottom of the skimmer's frame. The software for that was scrambled too, but it should be easy enough to write a few lines of code to keep it aimed at the nearest geosynchronous relay satellite. If he remembered its longitude correctly.

He activated the faceplate keyboard. Writing code by eyeball was frustratingly slow. His temples throbbed with stress by the time he was ready to test it.

". . . unidentified craft . . ."

Was that a voice in the static? He tweaked the longitude value by a fraction of a degree. "Shuttle Feynman to unidentified craft. Can you respond?"

Ari's heart tried to claw its way out of his chest. I'm a skimmer jockey, not a diplomat. He blew out a few deep breaths and eyeballed the transmit icon. "Are you really from Earth?" His voice wavered, rising in pitch as he spoke. Stupid first words.

"That we are. We've come to join the colony. Only we can't seem to find any of your settlements."

"Settlements? On the surface, you mean? We study the surface remotely, from orbit."

"You're kidding."

Ari hesitated, his mouth open, unsure what to say. He wished he could talk to Maura.

“You got a name, son?”

“My name’s Ari.”

“Well, Ari, you might want to give your orbit a nudge. You’re going to pass dangerously close to us.”

He pulled down the graphics overlay on his HUD. The skimmer’s nanoprocessor had located the Earth shuttle and showed its projected orbit as a bright green curve. Sure enough, his orbit intersected it near perigee.

“Sorry about that, Earth ship.”

“Aw, hell. Call me Bill.”

Ari eyeballed the nav dropdown, nudged the magsail’s current.

OVERRIDE.

What the hell? He tried again, with the same result.

“Um, Bill? I’m having a bit of a problem here. You’ll have to clear a path for me.”

“Understood.” There was a long pause while Bill attended to whatever details he had to take care of. “I’ll fire a quick burn, push myself above and behind you. There’s gonna be hell to pay, though. It’ll delay my landing by at least two orbits.”

“You can’t land.”

“And why would that be, son?”

“That’s a unique ecology down there, something new and alien.” He repeated the words almost verbatim from the

schoolvids. “It needs to be preserved. Introducing Earth life before we understand it could be disastrous.”

“You came all this way just to hang in orbit and watch?”

“Observe, study, report. Our mothers have been sending yearly data bursts back to Earth since they got here.”

“Records from before the war are sketchy. The receiver stations must’ve been lost.”

War? A queasy feeling rose in his stomach. After a long moment, he managed to say, “The Earthborn taught us that Earth was unified.”

“What? Oh, you mean the UN? Broke up years ago when the Chinese seceded.”

“You didn’t get any of our data bursts?”

“All we knew is that there was a colony at Alpha Centauri. We came prepared to conquer the wilderness, not for life in orbit. Hell, our anti-rad meds are almost gone.”

“Meds? Why not use gene therapy? My adrenal cortex produces all the androstenediol I need to keep me safe from radiation.”

“You’re genetically engineered?”

“No, we use gene therapy. We’re hoping to engineer the genes directly into the next generation. Save them the booster shots.”

There was a long pause. “We have laws against that.”

“Earth has laws. They’re four light years away.”

“Humph. Maybe. Attitudes are harder to change than laws. There’s a lot of people who would die before they pollute their bodies with foreign genes.”

Ari shook his head behind his faceplate, even though he had an audio-only connection. “I guess I just don’t understand Earth people.”

“Goes both ways, son. I couldn’t imagine living my whole life in a tin can.”

Not a tin can, but surely cramped quarters compared to an entire planet. How can we even begin to relate to them? Unsure what to say, he let the silence drag on. His eyes drifted back to the HUD. The shuttle’s projected orbit shifted slowly, sluggishly. Yet the orbits still intersected. His skimmer was adjusting the magsail current automatically, maintaining a collision course. He manually cranked the pitch loop’s current.

OVERRIDE.

Panic rising up in his throat, he desperately scanned the horizon line for the Earth shuttle. Not a chance—even if it were naked-eye visible, it would still be below the horizon.

Incoming message. He nearly jumped out of his skinsuit when the light came on. He eyeballed the receive icon.

The director’s skeletal image appeared on his faceplate, her eyes stern, her jaw set. “Break off communication with the Earth shuttle at once.”

He almost welcomed the familiarity of her emotionless tone, her lifeless face. “I’m just trying to understand them, ma’am.” He felt like a child standing before her judgment.

“Unacceptable. You will communicate with no one.”

“You’ve gone to a lot of trouble to keep me quiet. What are you trying to hide?”

She sighed, a rasping groan from her lungs. “They are dangerous.”

He nodded involuntarily. They very well might be. But how did she know that? How did she know that the craft was a manned shuttle? Or that they were planning to land? “You’ve been in communication with the Earth ship.” It was an accusation, not a question.

She stared long and hard. The fire in her eyes faded. A slow, stiff nod confirmed his suspicions. “The Secretary-General has been negotiating with their leaders. They won’t listen to reason.”

“You hid it from us. All this time you knew they were coming, what they intended, and you kept us in the dark.” The realization struck Ari square in the chest—he knew more than was good for him. “And just what is my mission?” His voice quivered.

“We cannot allow them to contaminate the ecosystem. I am truly sorry.”

“You uploaded a virus with your data packet. Took over control of my magsails.” A glance at the HUD overlay showed

the orbits still intersecting, despite the Earth shuttle's evasive maneuvers. Even a light craft like the skimmer—maybe 150 kilos of man and support frame—became a deadly projectile at orbital speed. He would do significant damage to the Earth shuttle, if not turn it to slag.

She sat motionless for an eternity, while Ari waited to hear his death sentence. The oxygen-use telltale flashed yellow in his faceplate, and he realized that he was breathing fast and hard. Finally she spoke. "So many sacrifices."

So that's it. "Let me talk to Maura. You owe me at least that much."

Her head moved sluggishly from side to side. "I can't allow you to communicate with anyone on the ship. I'll relay a message for you."

"No, thanks."

"Who is your gestational mother, young man?"

"You are."

Her gaze wavered for just a moment. "Oh. There have been so many." Her eyes no longer focused on Ari, but on the distant past behind him.

He broke contact, allowing his silence to speak for him. Her image winked out, leaving him with nothing but the drumbeat of his pulse in his ears. The stars ahead, just above the horizon line, wavered with atmospheric distortion. The living landscape below slid past him as he drifted inexorably toward

extinction. What price is too high to preserve an entire ecosystem? The Director had made her answer clear.

"Uh, Ari?" He jerked to attention at the sound of the Earthman's voice in his helmet. "You mind shifting course away from us?"

Damn. "Um, yeah. I have a real problem here. You need to abort your landing. Head back to your ship."

"No can do. Orders and all that."

"Listen. The Secretary-General is serious about this. If you try to land, we're going to be orbital debris."

"Aw, hell. Why would you want to do that?"

"She's using me as a guided missile and I can't do a damn thing about it."

"This thing steers like a pig, son. Even if I started a burn right now, you'd be here before I broke orbit."

"I don't think we're going to live through this."

There was a long silence. Finally, Bill's voice came through soft and gentle. "You may not. I have orders to blast you out of the sky if need be." They brought weapons. For a brief moment, the thought was more disturbing than Ari's own impending death.

He wondered what kind of weapons they had. Projectile launchers, laser weapons, particle beams? His gaze dropped to the living world below and he wondered how they might devastate the pristine ecosystem. We spent our lives worried

about the consequences of a single microorganism wreaking havoc. What about a swarm of armed Earthmen?

But what about his own people—his own gestational mother—only too willing to kill for a planet they'd never even touched?

He was dropping low over Nouvelle Terre's pole, heading for perigee near the equator. His HUD showed the magsail maneuvering loops pulsing with current, pushing against the planet's intense magnetic field to shift his orbit. Adjusting to the Earth shuttle's maneuvers. He tried in vain to crank up the current in the main thrusting loop to increase his speed and push himself into a higher orbit. Perigee kick. The nanoprocessor refused his commands. If only he had some way to adjust the magnetic fields.

Particle beams.

He inhaled sharply at the idea. He just might live through this after all. But the Earthmen would live too, and they'd surely land. What cost is too high?

"You there, Bill?"

"I'm not going anywhere."

"How long do I have?"

"We'll have to hit you as soon as we have line of sight. Even so, dodging the debris will be dicey."

"I need to know why."

"Why what?"

“You have to know that landing on the surface will do immeasurable damage. Even if you don’t harm the ecology directly, you’ll destroy the opportunity to study it. It’ll be contaminated, and we’ll never know what it was like before. Why would you do that?”

Ari heard an exhaled sigh. “Hell, kid, no one wants to despoil your world. We’re just looking for a new home. You know, a place to raise children without fear of pollution or fallout.”

“But you don’t know how Earth life will interact with the life down there.” He swept his arm across the expanse of the world below him as though Bill could see him. “We’ll never get another chance to study the ecosystem in its natural state.”

“I’m not here to debate philosophy with you, son. All I know is that we need a place to live. Think how much more we can learn by getting up close and personal with the life down there.”

“We already know a lot. We . . .” And what do we know, really? We’ve been here for a generation. “We know how the pseudoplants down there do photosynthesis. We know they use something called pyranosyl-RNA for their genes. We know . . . we know a lot. I’m not a scientist.” His words didn’t sound convincing, even to his own ears.

There was a long pause. “You’re going to be coming over the horizon soon and I’m going to have to . . .” His voice caught, as though unwilling to say the words. “I’m gonna have to do something I don’t want to do.”

“Can you hit me with a beam of charged particles?” He hadn’t realized he was going to say it until the words came out. His heart pulsed in his ears.

“Uh, yeah, I’m sure we could rig something, but why—oh, I get it. The beam will push against your magsail and deflect your path, almost like a particle beam launch system. Brilliant. But the radiation would fry you.”

“It would fry an Earthman. Maybe not me.”

Ari heard Bill whistle loud and low. “You have balls of steel, kid.”

“One more thing. My ship’s blocking my transmissions. There’s someone I’d like to talk to before this goes down.”

“No problem.” Ari could practically hear him grin. “I can punch a signal through anything they’ve got.”

Nothing to do but wait and wonder. He looked down at the deep blue ocean below him and was rewarded with a flood of guilt. Is my life really worth the risk to the planet? Risk versus reward. On the surface, they could learn in a year more than we’ve learned in a generation.

“Okay, Ari.” Bill’s voice startled him. “I’ll relay your signal with a little bit of a kick. It’ll get through. Transmit whenever you’re ready.”

He switched to Maura’s comm channel. “Are you there, Maura?”

Her face appeared on his faceplate, grainy and pixelated.

“Ari? Are you all right?” As she spoke, her image froze, then jumped once again to real time.

“I think so.” He knew she’d hear the lie in his voice, so he didn’t wait for her to call him on it. “I have a bit of a problem. I’m going to be taking a few rads out here. I need to know how much is too much.”

Her voiced tensed. “How much? How fast?”

“Bill? You listening in?”

“I’m here, son. We’re getting the particle beam set up now. We’re going to have to wait until you come over the horizon, so you’ll be damn close. We’ll have to give you a pretty big dose to deflect you enough. Call it eight to ten Sieverts.”

Maura’s image froze again, this time with eyebrows knotted in concern. “I don’t know,” her voice said from the still image. “That’s cutting it close, especially since it’s going to come over a short period of time. Androstenediol isn’t immunity, it just helps you keep your blood and marrow cell counts up.” His faceplate jumped to a moving image, still wearing the same furrowed brow. “You’re going to get sick, at the very least. Ari . . .” Her voice wavered.

Ari choked back tears. “Hey, I’ll be fine. You know me; I’m too insolent to die when I’m told to.”

She exhaled a tiny laugh.

Bill’s voice spoke in his ear, gentle and soft. “I just activated the particle beam. You should see a change in your

orbit soon."

Ari waited for—what? Pain? Tingling? He felt nothing. He activated the HUD's graphics overlay. His projected orbit shifted to the right as he watched. Thrust is perpendicular to the beam path.

Would it be enough?

The orbits still passed so close they appeared to overlap. The Earth shuttle was approaching fast, but he still couldn't find it with his naked eye.

"Ari." Maura's voice in his ear was husky with emotion. "If you don't make it—"

"I will." But the lines still intersect.

Her image nodded, jerky and pixelated.

Bill's voice cut in, tense. "I'm not sure about this."

Ari thought he saw a light behind Maura's ghostly image, low on the horizon line. A star?

Before he could be sure, it brightened and was gone.

The HUD showed that he'd crossed the Earth shuttle's orbit. He realized that he'd been holding his breath. He blew it out in a blast of air against his faceplate.

"Woo-hoo! That was close!" The tension was gone from Bill's voice. "Your heart in your throat, kid?"

Ari nodded. He can't see you. "It's still beating, so it's all good."

“True enough.”

It occurred to Ari that Bill hadn’t been sure they were going to miss. He’d risked his life for Ari. “You should have shot me down,” he said. “Why didn’t you?”

“Hell, I’m no killer, son. Not if I can avoid it.” He paused a long moment, then added, “You’re not the only one who can disobey orders. Looks like we’re both going to catch some hell.”

“Your leaders should go easy on you. At least they’ll get the landing they wanted.”

“Maybe. All this maneuvering has my orbit fouled up. I don’t think I can make a safe approach to the landing zone. I’m going to have to abort.”

Ari’s eyes went wide. “You’re lying.”

“Hey, a pilot has to make judgment calls. By the time the inquiry is done, word of this incident will have spread. Everyone on this shuttle knows what happened here. Your girl back on your ship knows. It’s hard to keep information bottled up.”

“You’re taking a big risk,” Ari said. “Why?”

“You seemed to think it was important. And everyone else seemed willing to kill over it. I just figured someone more important than me should make the call. Let our leaders talk it out with yours. I think they’ll be more willing to come up with a solution with their people screaming in their ears.”

Ari caught himself nodding again. “Sounds like a plan.”

“You’d better get your ship to send a rescue party. You’re going to need medical attention. Soon.”

“Rescue mission’s already scrambling,” Maura said. “They’re going to bring you directly to the decontamination lock.”

Decontamination. Ari chuckled. Maura’s image looked at him questioningly. “It occurred to me that no amount of decontamination is going to stop what’s coming.”

“What do you mean?”

“The Earth people,” he said. “They’re so different, Maura. Almost as different as the life down on the surface. I wonder if we should be worried about another kind of contamination.”

“We’ll adapt,” Maura said. “We’ll have to.”

Will the same hold true when Earth life finally meets alien ecology? Ari wasn’t the man to answer that question. Maybe no one was qualified.

But they’d find out. Soon enough.

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The Deadliest Moop

Sometimes it's obvious that there's a problem, but not howbig it is. . . .

Michael A. Armstrong

They'd been about to power down for the day when dumbass Sven pulled in the squid.

The Anna Marie had been dragging the high orbits, 100,000 klicks up, working the fringe because Cap had gotten nervous going any shallower. Ian had thought him a pansy-ass until the Carly Renee doing a 75k pass took an old Soviet spy satellite right across the beam and blew up. Cap might be a schmuck, but his hunches paid off—good or bad—and he ran a slick tiller, too.

Besides, Ian had to admit, it was Cap's crabber. His call.

They'd been pulling in good sets the past week, the pots catching lots of debris, most of it crap, but sometimes you got decent stuff—a few artifacts there, maybe some high-grade metal here.

Asshole that he was, Captain could guide a crabber neat and smooth in a high-velocity orbit, easing the Anna Marie right up to a patch of moop—material out of place, but wasn't that everything?—and throw out the pots just right so they'd scoop it up without shredding them. Some crabbers liked to take debris

straight into the hold, but Cap said some crabbers liked to die, too. He'd used pots, always used pots, and if a chunk came in too fast, you'd lose a big cage of high-density, photodegradable plastic and not your dang ship.

Cap might run the ship, but Ian ran the deck, he and Todd on the grapples, Sheila on the boom crane, and newbie Sven there in the sorting belt. Guy had an eye for stuff, Ian thought, and could flick through moop as fast as it came in, and not even miss a shiny. Sometimes new guys worked out okay from the start.

You had to move fast on deck, out in that big steel cage fifty meters long and twenty-five meters square. Rack 'em and stack 'em, that was the trick. Ian and Todd pulled in the pots with the grappling hooks, big harpoons on steel cables, Ian on the dorsal and Todd on the pectoral. You shot the hooks, hoped they caught because you only had one pass, and started reeling in the pot as soon as the baby caught. Cap stood there behind an observation port, counting pots and making sure they didn't miss a set.

"What good does it do cleaning up orbits if you add to the moop?" Cap always said. Ian knew better than to point out the pots would turn to plastic dust inside of a year. Cap didn't always like to hear logic. Pots cost money, anyway.

Sheila pulled in the pots with the boom crane and damn, that lady had a smooth touch. The pots came in with a little momentum—too fast and you'd ram it right through the port and

wouldn't Cap like that? Shelia had to slow the pots down and slide them into the bay, rack 'em and stack 'em, oh yeah, baby. Once the pots got racked, poor old Sven had to dump them and sort them. Rack 'em, stack 'em, dump 'em, sort 'em, that was the drill.

Todd had just grabbed his last pot and Ian was passing his set on to Sheila. Ian had gone on private comm to Todd trying to figure out if they should go help Sven sort or just let him sweat, but Sheila caught on to them—she couldn't read lips, but she saw them talking—and shook her head and held up five fingers. Yeah, Sven had to come in on five, he'd been in his Deimos suit too long, they all had, but Sven was at the stern closest to the sun and catching most of the rays. Give the guy a hand, she meant and didn't have to say it.

"I got me something," Sven said over the loud hail. "It ain't aright."

They'd remember that phrase later, up before the tribunal. Ain't aright.

The Anna Marie had left the Lagranges six weeks ago, out to fish a big gnarly patch of moop 100k up from earth. Cap liked to say he'd been in it since the first lottery, when the old freighters hauling nickel ore from the asteroids first came back to earth orbit and found damn near every high-altitude satellite blown up by photodegradable-plastic cluster bombs.

Everyone blamed the Chinese, but no one could pin it on them, not enough to start a hot war. Crabbers liked to talk about

a secret bonus if anyone ever hauled in a smoking gun, something to nail the Chinese and get the Nations pissed off enough to stop the Chinos once and for all. But that was just crabber talk, really. Funny how that worked out anyway, Ian thought. Real funny. The Nations ponied up the bucks to hire the crabbers to clean the debris, and what with tariffs on the Chinese and all, huh, the Chinos paid most of it, so it all worked out anyway.

Truth was, Cap came in on the second lottery, after a dozen freighters kinda missed the learning curve and became one with the moop. Plus, well, the Anna Marie had been a hog anyway, and though Cap wouldn't say it, the reason he'd never won the first lottery was, well, because the old girl hadn't arrived quite in time for it.

Sometimes late was better than first, particularly when first meant never. Boom.

The Nations paid good money to clear the orbits. With five-hundred-million tonnes of shredded moop whipping around Earth, most of it no bigger than a half meter, hardly anyone wanted to risk coming up out of gravity. You could send out a robot freighter and cross your fingers, but living cargo? Leave it to the military jocks.

Until then, no one had figured out how to make space habitats profitable, and who wanted to live in a pressurized can when you could set your foot on solid earth—or Luna? Even a cold-ass, dark corner of Antarctica beat out space. Air, water,

gravity: there was a lot to like about that, even at eighty below.

The Satellite War changed all that. You had all these spacers stuck in orbit, all the solar power in the universe, and as soon as the crabbers started hauling in moop, plenty of good quality building material. Snag it, haul it to the Lagranges and dump it, and there it stood out of harm's way and ready for some tinkerer to start building away. A couple of old crabbers who'd had one close call too many built a smelter, started inflating big aluminum balloons, and quicker than you could say "shore leave," you had Dutch, the crabbers paradise, named after the old Aleutian port, of course.

They called it the squid 'cuz that's what it looked like: a torpedo-shaped cylinder with fifteen wriggly arms that unrolled five meters long after Sheila dumped it out of the cage with a bunch of other moop onto the sorting belt. The body wasn't more than two meters, if that, clean and shiny and not pitted like it would have been if it had been in space for longer than a decade. Pretty much everything in orbit had been up there at least a decade, and the squid should have been pockmarked or sandblasted from millions of micrometeors—only it hadn't.

Ain't aright for damn sure.

Sven pulled the squid off the belt into a bin. Ian and Todd had to swim over to Sven and keep the belt moving. Moop stuck to it, little teeth around the half-round pipe moving stuff along. Sheila dumped the last pot and the three of them finished the sorting—nothing more of consequence, just lots and lots of

dull gray fragments—all the time eyeing that squid. Sven had sorted a few shinys, nice clean pieces of steel, but that squid held their attention, for all sorts of dang reasons.

Ian ran through the list in his head:

A) It was intact.

B) It didn't look like anything in space they'd ever seen, and all they hadn't, courtesy of endless watches browsing Gilbert's Catalogue of 100,000 Satellites and Other Orbital Debris.

C) And, oh yeah, it was intact.

"What you dickheads starin' at?" Cap yelled over the loud hail.

Ian looked over at the observation deck. Cap, nice and comfy behind thick Lexan, saw him standing there, hands on hips. "Got us an anomaly, Captain," he said. You never said Cap to his face.

"Anomaly?" Cap asked. He moved a camera on a boom arm out over the salvage bin, scanned it up and down. "Bring it in," he said.

"Uh, Captain . . ." Sheila started to say.

"Bring it in."

She glanced over at Ian, and he nodded. He was deck boss, he'd take the grief.

"Captain, Nations protocol calls for an anomaly to be quarantined," Ian said. That meant tagged and bagged and left on deck for some Nations investigator to handle. Good idea,

Ian thought.

"Bring it in," Cap said.

"I'm gonna have to log a protest," Ian said. That was the union rule, too. If your captain made a bad decision, you covered your ass by making a protest.

"So logged. And Deck Boss?" Captain banged the thick port. "Bring it in."

That would be the second dumb thing they did: bringing in the squid. The first dumb thing had been catching it in the first place, or not dumping it once they realized what they had. But, you know, it looked all shiny, they'd say later. That was the thing about crabbing: you saw so much dull gray junk that the shiny stuff made you want to reach down and pick it up, like bright blue sea-glass on a white beach.

Idiots. They brought it in.

Cap had the sense to keep the squid sealed in the big garage lock, strapped at six points, those weird tentacles flopping loose in zero gee. The crew floated in through the little airlock in the tunnel running along the spine of the ship. They looked out at the squid through a nice thick viewport, still in their suits, Sheila standing by at the panic button, ready to slam shut the port shutters should anything get hinky.

We're way beyond hinky already, Ian thought. Light-years.

Sheila ran a scanner on a little boom arm over the squid, the scanner's big camera recording away down to macro,

mapping every pit, scratch, dit, and dot. It ran into the hot spectrums, too, temperature and radiation, all that stuff.

"We'll blow it if it's at all hot," Cap swore, the first sensible thing he'd said since "bring it in." Only sensible thing so far.

Thing was, the squid whistled clean, no radiation and cool as space, just like pretty much any hunk of moop short of an old satellite nuclear reactor. Well, nothing above background. As Sheila ran the scanner over the squid proximal and distal, dorsal and ventral, her hands moving the robocam along like she was petting the thing, a display showed the topography of the damn squid. Little tiny laser beams bounced back and forth, mapping its texture down to nanos.

"Nothing," Sheila said.

They glanced up at the display. Anything out in space more than a month would have micropits from all that dust slamming into it—steel, metal, plastic, you name it. Flying through space was like glass shooting through a sandblaster, and with the big orbital bang, there was a heck of a lot of sand to blast.

"What do you mean, nothing?" Cap asked.

"I mean, nothing. Whatever the hell that thing is made of, it's polished smooth down to the molecular level," she said.

"Huh," Cap grunted.

They all looked at each other. When Cap grunted, it usually meant he was about to do something stupid.

"Blast it," he said.

“What?” Sheila asked.

“Shoot it. The plasma cannon?” He waved his hand up at the smooth-bore plasma cannon all crabbers carried. They had one fore and aft, on gimbals, and one in the hold. Idea was if a big chunk of moop was going to get personal with the Anna Marie, you’d blast your way through it. Same idea if something came into the hold too fast: blast it back out.

Sheila didn’t even have to look at Ian for him to say it. “Captain, with all due respect. . . ,” he said.

“Oh, hell, you pansies. So logged. I’ll do it myself,” Cap said.

He stepped over to the cannon rig, strapped himself in, and gripped the two pistol handles. The cannon swiveled around out there in the hold, business-end turning down, and Cap pulled the triggers.

Was that the second or third dumb thing Cap did? Ian thought. He was losing track.

The plasma cannon really didn’t shoot plasma. It used plasma to shoot moop, random bits of shredded crap like shotgun pellets, an old-fashioned kinetic gun. Kaboom. The bolt of pulverized metal and hot gas roared down in a nice little narrow cone toward the squid. Anything else it would have blown to bits, or at least dented severely.

Only, well, the blast bounced off the squid, a nice billiard shot, out and away at the same angle it had hit, which was a good thing, because the shot had come from fore and got

reflected aft, right at the outside docking bay doors.

Sven lost his newbie stripes right then for what he did, and if they made it to Dutch, the crew definitely was going to buy him a night's drinks. Damn kid slammed his hand fast on the panic button that blew the aft door open, irising away in little metal leaves like an old-fashioned camera shutter. He'd later say it was just damn luck he hit the green button and not the red.

And Sheila, even though her hand hovered over the port shutters, never even touched the button. She was going to buy the first round, Ian thought. Second and third, too.

The blast still nicked the inside edge of the door as it opened up out of the way, but the door panels had a little give and could be pressured up enough to compensate. If the door had blown, they would have been hosed. No docking garage, no big airlock. No airlock, no way to haul in moop. No moop hauled in, what was the point? They'd have to limp back to Dutch, get repairs, and then go back out and reset their pots.

"As I was saying, Cap," Ian said.

Cap gave him a hard look, but shut up. Guy knew when not to push it—you could give him credit for that.

Still, it was data, Ian thought. Now they knew why nothing pitted it, why however long it had been in space nothing had dented, scratched, or marred its pristine surface.

"Fucker has a damn force field," Todd said.

"Ya know," Cap said. "I think it would be a good idea to

quarantine the squid."

But it was too late for that.

Later, at the tribunal, after they'd all been hauled up one by one to make their depositions, and then one by one again to go through any discrepancies between testimony, they all agreed on only one thing: The squid came alive. What happened after that none of them could agree. It might have helped if the radiation blast hadn't blown the camera, too.

Sheila said she saw the squid roll over, open wide those fifteen tentacles, cut them loose and leave them behind like a lizard's tail, and then jet away through the open hatch.

Todd said he saw the squid just squirt out, vanishing in a puff of plasma or something, "like a big stinky fart," he said.

Sven said he didn't see anything, that one moment the squid was there, the next it was gone, and who the fuck knew where it went?

Ian knew what he saw, though, because he was watching Cap. The squid opened wide its tentacles, sure. It dropped its tentacles and jetted away, Sheila had that right. Only when it opened up those long arms, its mouth, if that's what you could call it, a row of fifteen teeth overlapping, that mouth opened up and out came a little silver sphere.

And Cap squeezed the trigger on the plasma cannon again. He'd deny it, said Ian had it all wrong, nothing like that had happened. It was what Sheila said and Todd said, the thing just disappeared.

No way, Ian thought. Cap fired, and the plasma cannon fired straight at the smooth silver orb. Maybe it had been a lucky shot. Maybe Cap knew exactly what he was doing, because when the plasma beam bounced off the orb, it bounced straight back toward the plasma cannon, all the energy coming at it meeting energy going back out, like two fire hoses blasting away at a soccer ball in between.

The orb fell back into the squid just as the squid slowly eased out of the docking bay, which was a good thing, a real good thing, because it blew up.

Not just blew up, though, like a big nuke or something going boom. It like vanished blew up, that's what it did. One moment it was there and another moment it wasn't.

Later, when he got really good and drunk, Ian puzzled it out. That silvery surface was like some sort of energy shell, nice and thin, he figured, surrounding whatever guts and mechanism worked away inside the squid. When the orb blew up, of course the energy inside got reflected back, the energy shell confining it, until all that energy got spent grinding up the squid's inside, and the whole thing collapsed like a balloon. Ian swore he saw a little silvery dust where the squid had been, but maybe he hadn't seen even that.

Years later, Ian ran into Cap at the crabber's bar in Dutch, the Spacey Dawg.

"It was a bomber," Cap told him after they'd finished most of a bottle of twenty-five-year Lagavulin single malt whiskey, and

they were too drunk to care about talking about something they'd sworn never to speak about.

Nothing official had ever come out. There had been the tribunal, a lot of big Nations hoohahs reaming their asses out for not being so careful, especially Cap. Cap took all the blame, but he took it grinning, because he'd figured it out, figured out what he had done was awards time, except you didn't give medals for things that no one acknowledged happened, even if it had saved earth from evil alien space monsters.

Funny thing was, even though the crew of the Anna Marie never crabbed again, what with bonus pay, a mysterious settlement that one day showed up in their accounts, and stuff like that, they did pretty well—well enough to afford bottles of single malt Scotch flown all the way up from Earth.

"Evil alien space monsters," Cap said that night years later. "Think about it. If you were an alien race and you knew another intelligent race had become uppity with space-faring ships and stuff, you'd want to mine their home planet. Blow up satellites and ships, make the orbits hard to get through. Send in a bomber and keep mining the orbits until the other race gave up. "

"Yeah, right," Ian said.

"Think about it," Cap said again. "You know those arms the squid left behind? You ever think about what happened to them? No one ever told us, because the Nations don't want anyone to know we'd been attacked by aliens. Cool stuff, those

arms, that metal. Pretty tough, tough enough to make shields so ships can fly through moop now."

"Huh," Ian said, thinking about how clean that squid had been.

"Whatever," Cap said. "It wasn't Chinese. It wasn't some supersecret terrorist group that blew the orbits the first time. It was aliens, some kind of probe that came into our solar system, saw what we were up to, and blew it all up. It would have blown us up, too, kept mining our orbits until we gave up and stayed on the planet. And we stopped it."

"You really think so, Cap?" Ian asked him.

"Ah, what the hell do I know?" Cap said. "I'm just a dumb dingaling crabber. And I thought I told you never to call me 'Cap.'"

"Sure thing, Captain," Ian said, pouring out the last of the Lagavulin. "Buy you another bottle?"

Novelettes

Howl of the Seismologist

Carl Frederick

Alex rolled the flimsy plastic bishop between his fingers for a few seconds before placing it on king's knight two. Then, while his opponent thought, he idly dropped his hand to scratch Wegener between the ears. After another ten minutes or so, the battle, heated yet silent, drew an observer—a...

Outbound

Brad R. Torgersen

I was eleven years old when the Earth burned. I can still remember Papa running into the hotel room on the space station, screaming. What he said, exactly, I can't recall. But there was fear in...

Top of Novelettes

Short Stories

Howl of the Seismologist

The line between "researcher" and "research instrument" grows ever finer. . . .

Carl Frederick

Alex rolled the flimsy plastic bishop between his fingers for a few seconds before placing it on king's knight two. Then, while his opponent thought, he idly dropped his hand to scratch Wegener between the ears.

After another ten minutes or so, the battle, heated yet silent, drew an observer—a youngish woman who by standing next to the picnic table shaded the board from the glare of the Sun.

Alex's opponent, an Asian man of aristocratic mien, glanced up at her. "Guten Tag, Kätchen," he said.

"Konnichi wa, Wakabayashi-sama," she answered.

The man nodded, then returned his eyes to the chessboard.

Several moves later, the man shook his head almost imperceptibly. "A draw is offered."

"A draw?" Alex thought he had a marginally better position but felt it would be impolite not to accept. "All right. Fine."

The man leaned back. "One is new at the village?"

“One is.” Alex nodded. “I’ve just moved into an apartment here.” He extended his hand over the board. “I’m Alex Prendergast. Summer postdoc.”

The man shook the proffered hand through an arc of a few centimeters, then set up the pieces again. “Takeo Wakabayashi —on staff here—particle physics.”

Wegener scrambled to his feet and howled.

“Oh, no, Wegener,” said Alex. “Not another one!”

“Is something wrong?” said the woman.

“No,” said Alex, taking a little notebook from his pocket and logging the howl. “Probably not.”

“Probably?” The woman slid onto the picnic table’s bench. “And I’m Katerina Schneider.” She threw a glance off to the looming Wilson Hall. “I’m afraid I’m something of an alien here . . . being a neurobiologist.”

Alex laughed. “Then I’m an alien as well.” He pocketed his notebook. “I’m a seismologist.”

With a slow, deliberate motion, Takeo made his first move, then cupped his chin in his hands. Alex noticed that he had fingers pushing against his ears.

“What’s a seismologist doing at Fermilab?” said Katerina.

Alex made his move. “I applied for a grant to see if Fermilab laser micro-position detection technology might be applied to earthquake sensing.” He spoke softly out of consideration for Takeo. “The Large Hadron Collider has

sucked up all the particle physics money. But there's still earth science money to be had."

Takeo made his second move—a book opening. Alex also stayed with the book. "Since the Tevatron will be obsolete when the LHC goes up," he said, eyes on the board, "Fermilab is looking for other things to do." He looked up from the board. "And since you brought it up, what's a neurobiologist doing here?"

"I'm here on leave from The University of Berlin, researching the possible detection of cosmic ray burst particles by living organisms."

"Interesting."

Takeo made his move and Alex returned his attention to the game.

For the next ten minutes or so, no one spoke. Takeo had taken his fingers away from his ears. Then, as Takeo reached for a chess piece, the ground began to vibrate. A second or two later, a low rumble filled the air and the ground shook. Several of the chess pieces fell over.

"Ach Duheilige . . . " Katerina grabbed on to the table.

Takeo sat frozen, holding his chess piece as if by having lifted it, he had caused the shaking.

"Not to worry," said Alex, throwing a quick glance at his dog. "I think it's only a minor quake. Should be over in a few seconds."

They sat in silence until, about fifteen seconds later, the ground went still.

“Well, that was certainly fun,” said Katerina, releasing her death grip on the picnic table.

“I bet we’re close to the epicenter. The P and S waves felt as if they came almost on top of each other.” Alex reached into his pocket. “There’s never a seismograph when you need one.” He pulled out his cell phone. “I have the Lamont Observatory on rapid-dial.”

He connected to Lamont, gave a report, then said, “Three point one. Interesting.” He hung up, checked his watch, then pulled out his howl notebook and logged the quake.

“It is hoped the Tevatron has not been damaged,” said Takeo.

“At 3.1 on the Richter Scale,” said Alex, “the Tevatron’s probably safe.” He slipped the phone into his pocket. “On the Mercalli Scale, it’s probably only a four.” He glanced down at the scattered chess pieces. “Or maybe a five.” He looked across to Takeo. “How ’bout we call this game a draw as well.”

Takeo nodded, then set up the pieces again.

Alex saw other people coming from the buildings in the village. They seemed drawn toward Wilson Hall, the nerve center of Fermilab.

Alex and Katerina stood from the picnic table.

“Let’s see what news there is,” said Alex, glancing down at

the still-seated Takeo.

“Perhaps another game first?”

Alex smiled. The man was clearly an addict. “Thank you, but perhaps later.”

Takeo nodded and then, with a sigh, he stood. The three of them, along with Wegener, headed toward Wilson Hall.

“Professionally,” said Alex as they ambled in the late summer sun, “this is very embarrassing.” He looked back at Wegener. “My dog is better at my job than I am. He saw this quake coming.”

Katerina raised her eyebrows.

“Really,” said Alex. “He predicted it. I’m sort of in competition with him.”

“You really feel you’re in competition with . . . with your dog?”

Alex gave a quick, tight smile. “Actually, I’m a better seismologist than my dog because . . . because, these days, real seismologists can actually prevent some quakes.”

Katerina stared at him in silence.

“Yeah. I know,” said Alex, made nervous by her gaze. “But it’s true. We are beginning to be able to avert quakes in some cases—by drilling and blasting in unpopulated parts of a fault to release pressure.”

“That’s not the issue,” said Katerina, softly.

“Oh, you mean my competing with my dog.” Alex gave a short, high-pitched laugh. “Yeah, I know. But it’s a comfort that Wegener can’t prevent quakes—considering that he predicts them a lot better than I do.”

“One might wonder,” said Takeo, “if it can truly be called prediction.” He sounded bored with the discussion. “Perhaps the dog, through his paws, is just very sensitive to vibrations—and can feel them before humans are able to.”

“My dog has detected quakes even when I’ve been sitting at a bank of seismographs, tiltmeters, low-frequency vibration sensors, strain meters, and ultrasonic detectors. I found nothing while he sensed a quake.”

“Indeed,” said Takeo, skepticism clear in his voice.

“I don’t understand it, either,” said Alex. “But it’s not vibrations. It’s . . . it’s something else.”

Takeo’s lips formed a cold smile. “One might entertain doubts as to whether there is anything else.”

“Look,” said Alex, with more heat than he’d intended. “Everything we know about in the physical world is just an amplification of the human senses. And pigeon and shark senses, too, if we include static electromagnetic fields.”

“The strong nuclear force?” said Takeo.

“All right,” said Alex. “Make that everything we know about the macro world. What if there are other phenomena that we don’t have senses for?”

“Such as ESP,” said Takeo. “Pseudoscience?”

“Sure. Why not?” Alex threw up his hands. “Precognition violates causality. Telekinesis violates conservation of energy. But perhaps telepathy does exist. It doesn’t violate any law of physics.”

“But telepathy wouldn’t explain predicting earthquakes,” said Katerina, her eyes more on Takeo than on Alex.

“Maybe some creatures can detect other physical phenomena,” said Alex.

Katerina gave a quick, furtive smile.

“Physical,” said Takeo. “What physical phenomenon is it, then? If there is another sense, it must be addressable by physics.” He smiled. “It is regrettable, but ghosts and spirits don’t come under science.”

From the corner of his eye, Alex noted Katerina scowling at Takeo. Clearly there was some negative chemistry between them.

“My dog does predict earthquakes,” said Alex, firmly.

“One suggests it is otherwise,” said Takeo, equally firmly. “And why then cannot all dogs predict quakes?”

“I wondered about that myself.” Alex paused, feeling exposed and foolish, before daring to tell them his speculation. “I got Wegener from a German Shepherd rescue organization. He was a drug-sniffing dog put out of work by the new electronic noses.”

“But one does not understand what relevance this has to—”

“During his training, Wegener probably had to sniff a lot of drugs.”

Takeo laughed. “Is it suggested that your dog acquired this alleged earthquake ability during a drug high?”

“I don’t know. Maybe. I’m not an expert on canine brain chemistry.”

“Ridiculous,” said Takeo under his breath.

They walked in silence for a few minutes. Then Katerina said, “I didn’t think we were in danger of quakes here in Illinois.”

“Actually,” said Alex, “this part of the country is the second most active for quakes. In fact, Batavia sits over an extension of the New Madrid Fault.”

“Seismology sounds like a very interesting and satisfying discipline,” said Takeo in a tone of voice suggesting an apology for his previous discourtesy.

Alex nodded. He hoped Takeo would interpret it as “apology accepted.”

They walked again in silence until, out of the blue, Katerina asked, “What’s your dog’s howl duty cycle?”

“His what?”

“I mean, what percent of his howls—howls for unknown reasons, that is. What percent actually . . .”—Katerina seemed to be carefully choosing her words—”actually correlate with earthquakes?”

“I don’t really know.” Alex glanced at Wegener. “But my dog can predict a Richter 3.0 or greater quake anywhere within five or six hundred miles.”

“Five hundred miles.” said Katerina. “Impressive.” She seemed momentarily distant. Then her expression changed to one of resolve. “Perhaps we could have lunch tomorrow. To talk about earthquakes—and your dog.”

“I’d like that,” said Alex. “And his name’s Wegener. Named after Alfred Wegener, the father of plate tectonics.” Alex patted the dog. “Du bist ein braver Hund,” he said softly into the dog’s ear.

“You speak to your dog in German?” said Katerina.

“He’s a German Shepherd.”

The next day, Alex, with Wegener running alongside, bicycled to the User’s Center where he’d meet Katerina for lunch. He swung off his bicycle, locked it, and then pulled his pants cuff free of his sock.

“Stay!” he said, pointing to Wegener.

Wegener howled.

“Stay!” said Alex again. As there was a perfectly understandable reason for the howl, there was no reason to log it. He looked absently at his dog. She wants to talk about earthquakes. And about you, Wegener. I wonder why.

He shrugged, then hand-brushed his hair, turned, and padded into the User’s Center.

Walking into the dining room, he saw that Katerina had already arrived, and had gotten coffee. She waved him over to her table.

“My dog’s outside,” he said as he sat. “Do you want to talk to him, too?”

She laughed. “You’ll do, for the moment.”

They gave the waiter their lunch orders and then, rather like the appetizer to a meal, they started with small talk.

“I gather you knew Takeo before you came here,” said Alex.

“I studied under Dr. Wakabayashi in Berlin, before I switched from physics to biology.” She toyed with her coffee, stirring it despite having taken it black. “I don’t think he’s quite forgiven me.”

“He called you Kätchen,” said Alex, reacting to her sorrowful expression. “That’s an indication of, well, endearment.”

Her lips formed a sad smile. “In this case, I think it’s more an indication of status . . . an adult addressing a child. Just as I call him Wakabayashi sama, a term of respect for his much higher status.” She wrapped her hands around her coffee cup, and stared at the black ripples on the surface. “Takeo has a theory,” she said, abruptly.

“Oh?”

“He believes that heavy particles, hadrons, moving at high speed loosen the binding of spacetime.”

“Huh?” said Alex under his breath.

“In the absence of mass,” said Katerina, pointing a teaspoon at Alex, “what is the nature of space-time?”

“Well . . . according to Einstein,” said Alex, proud of himself that he was conversant with modern physics, “it is flat.”

“But what use is space if there is nothing to put into it?” Katerina paused a few seconds and continued. “Takeo’s studies suggest—suggest strongly—that in the absence of mass, space-time becomes stochastic—essentially undefined.”

Alex leaned forward and tried to look intelligent.

“Takeo believes,” Katerina went on, “that mass binds space-time. It holds space-time together. And high-speed hadrons loosen that binding.”

“Hadrons from the Tevatron, I assume.”

“Yes,” said Katerina, “but mostly from cosmic ray bursts.”

Alex chuckled. “And what does all that have to do with my dog?”

Katerina smiled in return. “The loosening of space-time would be a new physics phenomenon—a phenomenon that I think some creatures might possibly sense.”

“What?” Alex narrowed his eyes in puzzlement. “But yesterday, Takeo seemed to be arguing against just that.”

Katerina nodded. “Oh, he was really arguing with me, over my theory.”

“Please.” Alex rubbed a hand across his forehead. “One theory at a time.”

“Yes. Yes, you’re right.” Katerina paused for a moment. “In his theory, the effect would manifest in massive objects—the Earth, for instance. He believes this loosening, these little rents in space-time, could be the cause of some earthquakes.”

“Ah,” said Alex.

“And my theory is that if there’s a macroscopic physics phenomenon, nature would have provided some creatures with a sense for it.” Katerina pursed her lips. “Wakabayashi sama thinks my theory is nonsense.”

“So that’s why you need a seismologist and a . . . a canine seismologist.”

Katerina nodded. “I’ve been looking for someone, a seismologist, preferably, with an animal that predicts quakes. But every seismologist I’ve talked to about it has said I should stick to biology.”

Alex brought a hand to cover his shirt pocket, as if about to recite the Pledge of Allegiance. “Wegener and I . . . our hands and paws are at your service. How can we help?”

“Do you record all of your dog’s howls,” said Katerina, pointing at his shirt pocket, “in that notebook?”

“All the howls that I can’t explain. Yes.”

“Do you know about the ConneXion software package?” said Katerina.

“What?” Alex, surprised by the change of subject, shook his head.

“It correlates as well as anti-correlates just about everything accessible over the Web. It correlates against a set of inputted data and restrictions on the scope of the search.” She toyed with a table knife. “I’d like to see if Wegener’s howls really do correlate to quakes, and if those quakes correlate with cosmic ray bursts . . . or even with the Tevatron being active.”

“You’d like to borrow my howl-log.”

“Only for tonight.”

Alex withdrew the notebook and handed it over. “Maybe we could meet here for breakfast tomorrow,” he said, hoping he didn’t sound too eager.

Katerina flipped through the pages. “I think I’m going to have a long night.” She closed the notebook. “How about a late breakfast or early lunch? Say at eleven?”

“Great!”

Late that night, Alex checked his e-mail.

Lieber Alex,

I have exciting news.

If you do not object, I’d like to invite Dr. Wakabayashi to our early lunch.

Viele liebe Grüße,

Katerina

The place was almost empty when, at ten of eleven, Alex walked into the restaurant. But at a table near a window sat Takeo. A leather-bound notebook and an open pocket chess set lay in front of him.

Alex, walking over, saw that no pieces had been moved.

Takeo gestured to a chair. “A game perhaps?”

Alex sat. “Sure.” He saw a flurry at the door. “Wait. No. Later, perhaps. There’s Katerina.” Katerina swept up to the table. She greeted Takeo as she sat, then without further preamble, she withdrew a file folder from her handbag and faced Alex. “Wegener’s howls correlate to earthquakes—and with a five-sigma figure of merit!”

“Hey, that’s great,” said Alex.

“And,” said Katerina, “most of the howls that associate with quakes also are correlated with cosmic ray bursts.”

“Are you serious?” said Takeo.

“I’m only reporting the data.” Katerina flourished the file folder.

“Might one examine those data?”

“Certainly.” She passed the folder to Takeo.

Alex and Katerina sat in silence as Takeo, head down, riffled through the folder. After about a minute, Takeo looked up. “These data are . . . strong.”

“Then you believe my dog really can predict earthquakes?” said Alex, trying to keep the sound of victory out of his voice.

“It is so—if these data are accurate.” Takeo’s expression clouded. “But one would like to understand what stimulus the dogs are responding to.”

“A . . . new . . . sense,” said Katerina, stressing each word. “Your binding-of-spacetime idea.”

Takeo nodded. “Just so.”

“But,” Katerina went on, “the quake we felt here had a strange correlation.”

“Oh?” said Alex. “Stranger than the dog correlation?”

“This quake correlated with both the Tevatron and also the LHC being on.”

Alex saw Takeo stiffen. “Dr. Wakabayashi,” said Alex, sensing it was not a time for first names, “what’s wrong?”

“The LHC storing particles in the ring and also the LHC,” said Takeo, as if to himself. “One must think.” He took a notebook from his briefcase and started scribbling.

“What do the Tevatron and LHC have to do with it?” said Alex after a decent interval.

Takeo nodded, then closed his notebook. “High-energy particles moving at near lightspeed weaken the bonding of the space-time through which they move,” he said. “Or so one believes.”

“What does it mean, weaken the bonding?” said Alex.

Takeo moved his hand as if drawing a horizontal line

across a blackboard. “An ultra high-energy particle leaves a wake of micro-discontinuities, rents, in the fabric of space-time. And as for the Tevatron and LHC, if the wakes intersect, a surface of discontinuity, a 2-D surface, occurs.”

“Wouldn’t it be worse near the Large Hadron Collider?” said Alex. “It’s many times more powerful than the Tevatron, isn’t it?”

“Four times,” said Takeo.

“At the moment,” said Katerina.

“It would be much worse here,” said Takeo. “Here one is in the LHC’s wake.” Takeo gave a worried smile. “It is good the LHC was only running at four Tev. Otherwise . . .”

“Otherwise?” Alex prompted.

“There might possibly have been much bigger discontinuities. One could imagine a worse earthquake.”

Alex saw that Katerina seemed worried. “What did you mean ‘at the moment’?”

“It was on the morning news,” said Katerina. “Sometime this evening, they said. The LHC is expected to go online with seven, or perhaps even nine Tev.”

“Aree!” said Takeo from deep in his throat.

Alex swiveled to look at him. “What?”

“One must do a back-of-the-envelope calculation.”

Over the next five minutes, Takeo filled many pages of his

notebook with equations and numbers.

Alex watched impatiently. Some envelope!

Then Takeo withdrew a calculator from his briefcase and did a more concrete calculation. He slid the calculator over to Alex. “This is the energy ratio . . . from seven teravolts as against four.”

Alex looked at the number. “Jeez! Are you saying that if the LHC at seven teravolts were operating at the same time as the Tevatron”—he tapped the calculator display—“this could happen?”

“It is so,” said Takeo.

“What . . . what are we going to do about it?” said Alex. “This really could be a global disaster.”

“Do?” said Takeo with a smile obviously pasted on. “Theoreticians don’t do. They theorize. And this theory is just that—a theory.”

“Don’t you believe in your theory, Professor Wakabayashi? ” said Alex.

“Believe the theory? Intellectually, yes.” Takeo gave a slight shake of his head. “Emotionally . . . one doesn’t know. The theory does imply earthquakes. It’s just that the quality of the implication is uncertain.” He seemed to deflate. “And in any case, what can be done?”

“Well . . .” Alex bit his lip. “We can’t stop the LHC from turning on with seven teravolts, but . . . but maybe we can get

them to shut down the Tevatron."

"That would stop it, wouldn't it?" said Katerina.

Takeo nodded. "Both machines must be running for there to be a 2-D contour."

"Then," said Alex. "Then I think we should go to the director and ask him to turn off the Tevatron."

"He'll laugh at us," said Katerina.

"And if there is error," said Takeo, "which is likely, then careers will be at risk."

"When exactly is the LHC powering up?" said Alex, now very conscious of time.

"If I remember . . ." Katerina bit her lip. "I think they said seven p.m."

"An odd time," said Alex.

"If it is like the Tevatron," said Takeo, "preparing takes many hours. One can not merely throw a switch."

"Wait a minute!" Alex gripped the table. "That's Geneva time, isn't it? What's the time difference between the Fermilab and CERN?"

"Seven hours, I think," said Katerina.

Alex checked his watch. "Oh my god! That gives us just over an hour." He slid his chair back. "We've got to try to convince the Director to shut it down." He stood. "Please. Let's go."

Takeo looked down at the table and stayed put. “It could be injudicious for a staff member to confront the director.”

“You mean you think he might fire you,” said Katerina.

“The thought did occur.”

“Well, I have a safe university position.” Katerina stood. “I’ll go.”

“Professor Wakabayashi?” said Alex.

Takeo toyed with his pocket chess set and did not raise his head. “With regret.”

“I understand,” said Alex, softly. “We’ll come back after our meeting and let you know what happened.”

“Thank you.” Takeo paused. “Perhaps, though, one should not mention the dog to the director.”

The director’s secretary informed them that the director was unavailable. And she would not reveal where he was at the moment. No amount of pleading and arguing from Alex and Katerina resulted in the director becoming less unavailable.

Alex checked his watch. “Come on, Katerina. Let’s get out of here.”

They stormed out of the office. On a door across the hall, Alex saw the sign,

Michael Decker

Deputy Director

“Maybe he can do something,” said Alex.

“Let’s hope,” said Katerina.

They walked in to confront Deputy Director Decker. Alex was prepared for a fight but he didn’t get one. Decker was relaxed and casual, not even wearing a tie. Apparently, he did not have a secretary.

After Alex explained who they were and why they were there, Katerina showed Decker the data.

Alex, painfully aware of the passage of time, waited impatiently as Decker unhurriedly perused Katerina’s folder.

“I’m not sure that I believe these data,” said Decker.

Alex suppressed a grimace. Damn.

“But I think they justify shutting down the Tevetron while the LHC is live,” Decker continued, “until we can do a thorough analysis.”

Great!

“But unfortunately, I don’t have the authority. The Director will have to approve.”

Damn!

“The director’s not in his office,” said Katerina. “And his secretary wouldn’t tell us where he is.”

Decker scowled. “He’s probably in his not-to-disturb hideaway deep in the Tevatron facility.” He leaned in over his computer keyboard. “But I’d say this is important enough to disturb him—via videoconference.”

The computer monitor came live with the image of a man sitting at his desk. And he seemed angry. Alex couldn't help noticing the man's dilated pupils and sweat-glistening forehead.

Decker explained the situation and, without waiting for a response, aimed the camera at Katerina and Alex and had them give the details. As they laid out the arguments, the director fidgeted, almost as if afflicted with a neurological condition.

"You're sure all this is going to happen?" said the director when they'd finished.

"No. We're not sure," said Katerina, "not even half sure. But the risk is there."

"A very theoretical risk, I assume." The director crossed his hands on his desk. "I am sorry, but I can't justify bringing down the Tevatron on such . . . theoretical grounds."

"We're sitting on an extension of the New Madrid fault," said Alex, hoping his voice would imply an urgency that Katerina's did not. "There could well be another quake right here—this time a big one."

"Again," said the director, imperiously, "are you sure?"

"Well, no." Alex paused. "But I know what a Richter nine earthquake can do."

"If it happens."

Alex blew out a breath. "With the Tevatron up and running, especially with the two-Tev upgrade and with the LHC above

seven—”

“The LHC,” said the director, scornfully. “If we had just one-tenth their funding, we could replace our magnets with lutetium-doped units and be almost at their power.” He uttered a laugh without humor. “If by some miracle we did have some damage from this quake of yours, then, damn it, we’d take the insurance money and we would buy those magnets.”

“Please,” said Alex. “This could be a real danger to the world.” He glanced at his watch. “And we are almost out of time.”

The director gave a mirthless smile. “When you first came here, only last month,”—the director straightened one finger and pointed it at Alex—“weren’t you the one who applied Rapid-Grow in a circle on the grass above the accelerator ring?”

“I didn’t know anyone knew about that.”

“Well,” said the director, “what’s the joke this time?”

“This is no joke,” said Alex, weakly, the wind now out of his sails.

“We can show,” said Katerina, “that the earthquakes correlate strongly with the Tevatron and LHC running.”

“But you can’t say it’s causal, can you?” said the director. “Correlation doesn’t mean causation.”

“In this case, though,” said Katerina, “it’s very suggestive.”

The director looked away. “Some thought the first atomic bomb test might ignite the atmosphere.”

“Meaning?” said Alex, impatiently.

“Meaning . . .” The director swiveled sharply, directing his gaze at Alex. “I’m not ordering the Tevatron shut down on the recommendation of a postdoc.” The director tapped his desk with a balled fist. “I’d be laughed out of my director’s appointment if I did.”

Katerina made calming motions with her hands. “Look. The idea was to close down the Tevatron when the LHC came online. And it has. So why not shut it down now?”

“Not a chance. We’ve got funding to the end of the year.”

Alex saw the director move his hand forward, and then the screen went black. “As the saying goes,” said Alex under his breath, “there but for the grace of God goes God.”

“You noticed,” said Decker, his eyes also on the now blank screen. He turned his attention to Alex and Katerina. “Can’t promise anything,”—he stood, bringing the meeting to a close—“but I’ll see what I can do.”

“There’s not much time,” said Katerina.

“I know.”

Takeo glanced up from his chess set as Alex and Katerina came back into the cafeteria. It looked as if he’d been playing a game with himself.

Alex threw himself down into a chair.

“It appears the director did not agree with the proposal,” said Takeo.

“Closed-minded idiot.”

Katerina sat. “I wonder,” she said, distantly. “Once the earthquake starts, is there any way to stop it?”

Takeo stroked his chin. After a moment, he said, “If the Tevatron were shut down, the Earth should re-seal and the quake should stop.”

“Then I’m going to try to turn off the Tevatron myself.” Alex sprang to his feet. “Before the LHC powers up.”

Katerina appeared startled. “But the deputy director said he’d—”

“We can’t rely on that,” said Alex.

“Injudicious,” said Takeo. “One would not be able to gain entry to the Tevatron.”

“We’ll see.” Alex spun around, but before he’d taken two steps away, Takeo cleared his throat. Alex stopped, looked around, and saw Takeo beckoning him with his forefinger. Alex walked back to the table. “Yes?”

“How much time would there be between your dog’s howl and the possible earthquake?”

“About ten minutes.”

“So long?” said Takeo.

“The Earth reacts slowly.” Alex wanted to get on with it but was curious what Takeo had in mind.

“Might not a better plan be to wait near the Tevatron and

wait for the dog to howl? And only then to attempt a shut-down?"

"You'll come with me?"

Takeo shook his head. "Regrettably not."

Alex narrowed his eyes.

"Should the dog howl, go to the D-zero entrance," said Takeo. "If entry is possible, and one goes inside, there is a wooden door about twenty meters in—on the left." Takeo spoke softly. "The door opens to a corridor leading to a room where there once was an experiment. Inside is an inner room where a beam from the accelerator impacted geological samples. The beam no longer goes to that room. The room is empty now. All equipment has been removed. Go there."

"Why? What good is it if there's nothing running there anymore?"

"Ah. Although the equipment has been removed, the inner room is still there." Takeo leaned forward. "And so is the emergency dead-button inside that room." He leaned further toward Alex. "Push that button," he said at a whisper, "and the Tevatron will immediately shut down."

"Really?"

"And it will take two days to start it up again."

"That would give us time to take our case higher than the director."

Takeo nodded.

"Thank you." Alex turned again to go.

“Wait!” said Katerina at a shouted whisper. “I’m coming with you.”

Alex spun around, paused a second or two, then said, “I really appreciate that, but there’s no way your visitor ID would get you anywhere near the Tevatron.” He took a quick swig from his water glass, the ice having long since melted. “And I’m traveling by bicycle. And I don’t know exactly where on the ring the D-Zero experiment is.” He put down the glass.

Katerina turned sharply. “Professor Wakabayashi,” she said, “drive us, please.”

Takeo gave a throaty sigh. He paused. “All right. Fine. One has been there before.”

“You will?” said Alex.

“The Tevatron has a four-mile circumference,” said Takeo, “and the D-Zero experiment is halfway around.” He stood. “Come.” He headed for the door. Alex and Katerina followed.

As they hurried down the front steps of the building, Wegener fell in behind.

Sitting in Takeo’s car, parked in a lot near the D-Zero entrance, Alex watched anxiously as the dashboard clock inexorably crept toward noon. No one spoke. Even Wegener stayed silent.

Finally, noon came.

Alex held his breath, his arm around Wegener.

“He’s not howling,” said Katerina, almost at a whisper.

Alex checked his watch. It read the same as the dashboard clock.

For minutes, they sat as if frozen.

Then Wegener did howl—a loud howl that Alex knew portended a huge quake. He flung open the car door and sprang out. Wegener followed.

Alex pointed at his dog. “Stay! Wegener, stay!” Alex turned and headed away from the parking area. He forced himself to move at a casual pace, not wanting to draw attention to himself. Hearing the car door open again, he stopped and swiveled around.

Katerina had stepped out. “I’m coming with you,” she announced.

“That doesn’t make sense.”

“Don’t argue,” said Katerina. “We don’t have the time.”

Alex knew she was right. He turned again toward the Tevatron entrance and heard Katerina coming up beside him. “Walk as if we belong here,” he whispered from the side of his mouth.

“Look,” Katerina whispered, nodding toward a person far ahead of them striding toward the entrance. “Let’s see if we can follow him in.”

They increased their pace until, at the entrance, they were only a step behind. The man in front swiped his card, and as he opened the door, looked behind him.

Katerina, seeming to hunt for her card, smiled at him. He gave a nod that could have almost been a small bow, and held the door open for her and Alex.

Alex feigned a twist of the ankle as he started down the stairs. He uttered a mild oath with what he hoped was an expression of annoyance and mild pain. He grasped at the handrail for support.

“Are you all right?” said the man.

“I’m fine. Just turned my ankle a bit.” Alex flexed his ankle. “I always seem to trip over my feet when I come in here out of a bright sun.”

“Yeah. I know what you mean.”

Alex flexed his ankle as the man first nodded, then continued down the stairs and disappeared into the bowels of the Tevatron tunnel system.

Compact fluorescents set into recesses in the tunnel wall provided a cold, white light as Alex and Katerina descended the steps to a high-arched corridor. The smell of grass and fresh outdoor air gradually gave way to a technological odor—like the scent of distant burnt electronics. A soft thrum of air conditioning and the combined susurrus of numerous machines resonated off the concrete walls—along with the sound of receding footsteps.

“Looks pretty deserted, doesn’t it?” said Alex softly, as he and Katerina padded lightly down the corridor.

“There it is,” said Katerina, pointing ahead and to the left.

They stopped in front of a door. It was where Takeo said it would be. The door was clearly old. It had an actual keyhole rather than a card reader.

Alex tried the handle. “Damn! Locked.”

“What now?” said Katerina.

Alex regarded the door. It seemed more a notice of disuse than a conditional barrier to entry. “Looks pretty flimsy.” He put his shoulder against it and pushed. But the door held. “Damn!” he said again. He took a quick look up and down the passageway, then, with a grunt, threw himself against the door. The wood around the lock split, the sound harsh and loud in the empty corridor. He pushed again. The lock tongue stayed in the door jam while the door itself ripped away and flew open. With a loud clang, the inside handle struck the concrete wall.

“Okay,” Alex whispered as he stepped inside. He felt silly for whispering while the sound of the break-in still reverberated off the hard walls.

The opening revealed another corridor, musty-smelling and dark. There were no working lights set in the walls.

By the dim illumination from behind, Alex and Katerina made their way forward. After ten or fifteen meters, the passageway widened, becoming another room. In the darkness, it looked more like a grotto than a place for science.

At the far end of the room, a sliding door dominated the

wall, a massive protection against particle radiation.

“I think the emergency shutoff is on the other side of that.” Alex glanced above the door. “As long as that sign isn’t flashing ‘Danger,’ everything’s okay.”

He saw a recessed handle. “With no power in this lab, we should be able to use this.” He pulled hard and the door, creaking and complaining, opened enough to admit them.

“I hope the shutoff button still has power,” said Katerina.

“Yeah!” Alex looked inside—or tried to. The meager illumination from the corridor only allowed him to see a meter or so into the experiment room, and only straight ahead. “I’ll have to feel around for it. On the left, Takeo said.”

“I’ll try the right side,” said Katerina. “Maybe Takeo didn’t—”

A low rumble interrupted her words.

“I thought we had time,” Katerina called out, her voice quavering.

The ground began to tremble. The shaking grew and Alex heard crashing noises in the distance. He pushed himself against a wall to keep from falling. “Kätchen,” he shouted over the increasingly loud groaning of the Earth. “Get out! Get out, now!” He grabbed the door jam to keep his balance. “I’ve got to find that shutoff button.”

“You come, too,” Katerina shouted. “This could collapse. You could die.”

“Go!” Alex shouted as he staggered into the room.

“No!” Katerina, on her knees, crawled into the room and then, clawing at the metal door, pulled herself to her feet. As she did so, the door groaned and slid closed, leaving the experiment room in absolute darkness.

“Oh, no,” said Katerina. “I’m sorry.”

“Don’t worry about . . . Hey!” Alex called out. “Here it is, I think. It feels like a button.”

“Push it!”

“Done!”

“Nothing’s happening!”

His hand still on the button, Alex’s mind was fully engulfed in the fearful magnificence of the quake. He was both thrilled to experience a high-Richter quake firsthand and also irrationally afraid it would go on forever.

“Alex?” Katerina called in the darkness.

“Sorry. I’m here. Wait! The quake. It’s weakening—I think.”

A few seconds later, the shaking stopped and room went silent.

“Takeo was right,” said Katerina, relief apparent in her voice.

“Yeah.” Alex released his grip on the shutoff button’s box and pawed around until he found the door handle. “Uh-oh!”

“What’s the matter?”

Alex braced himself and strained against the handle. “The door. It . . . it won’t move.”

“I’ll come and help. Maybe the two of us—”

“No, stay put,” said Alex in grunts, pulling with all his strength at the depressed handle. He released his grip. “This doesn’t have room for two hands—much less four.”

“What’ll we do?” Katerina’s words reverberated in the silent room.

Alex noted the silence. He could hear neither the sounds of machinery, nor of the air-conditioners. My god! That means there’s no air circulating. He shuddered. Maybe it means that we’ll just be breathing stale air. Or maybe—

“Alex?”

“We’ll be all right.” Alex didn’t know if he should try the door again or sit still to conserve oxygen.

“I must admit,” said Katerina with obviously forced brightness, “that I’m beginning to be just a little frightened.”

Alex backed against the wall and slid to a sitting position. “We’ll be okay,” he said again, hoping Katerina couldn’t hear the insincerity in his voice. “Let’s just sit quietly and wait to be rescued.” He sought and found her hand, and pressed it.

“Maybe Takeo will come,” she said.

Alex pictured the diminutive Takeo. We don’t need a particle physicist. We need a sumo wrestler.

“Oh, wait!” Abruptly, Katerina pulled her hand away, and a

moment later there came light—from the display of Katrina's mobile phone.

"No service down here," she said, "but at least we have some light."

Alex, chagrined that he'd not thought of it, reached for his own phone. But he stopped as Katerina snapped hers closed. "Better not to have light," she said, softly. "I'd rather you'd not see how frightened I am."

"We'll be all right," said Alex for the third time, feeling unoriginal as well as insincere. He thought to change the subject. "You know," he said, "I bet the director actually accepts our data and wants an earthquake—so Fermilab can collect the insurance to pay for the new magnets." He shook his head, an invisible gesture in the darkness. "Sounds like insurance fraud to me."

"I did not realize," said Katerina in a voice more amused than frightened, "that you were a forensic seismologist—or indeed that there even was such a field of study."

"Yeah. You're right." Alex forced a laugh. "I'm being silly."

"Wait a minute. Shouldn't there be air circulation blowers down here?" Katerina now sounded frightened. "I don't hear them."

"You noticed," said Alex.

"Yes."

In the silent room, Alex didn't know whether to try to cheer

Katerina up or to just keep quiet. He kept quiet.

After a few silent minutes, there came a muffled pounding at the door.

Katerina flipped her phone open, illuminating the massive door with a feeble light.

Alex bolted to his feet and pounded back with both hands. He saw the door move a millimeter or two. Someone was trying to open it from outside. Alex grabbed the handle and pulled. His shoulder ached and it felt as if his fingers were being ripped from his hand. From the corner of his eye, he saw Katerina stand and move her hands to the door. But there was no purchase, not even the slightest deviation from smoothness where she could grab on. Alex closed his eyes, throwing all his strength and concentration to the depressed handle.

The door gave a shudder and, groaning, stuttered open a bit.

Wegener, with happy barking, squeezed in. Alex dropped to the ground and hugged him. Then, strangely embarrassed, he waved Katerina toward the narrow opening. “Ladies first.”

She smiled as she slid through the gap. Alex forced the opening larger and, sideways, he went through. Outside the chamber, the darkness was relieved by an array of amber, electroluminescent arrows set in the floor pointing to a way out.

Wegener padded through the gap—and then headed further into the facility, a direction delineated by softly glowing arrows receding into the distance. Alex, wondering what had

gotten into the dog, called him back.

Takeo stood waiting near the door. “Is there injury?” he said.

“We’re fine,” said Alex.

“That was very brave of you,” said Katerina, “coming after us.”

“Alex’s dog insisted.”

Alex glanced at Wegener. The dog, muzzle pointed toward the interior of the facility, was making whining noises.

“What is the matter with the dog?” said Takeo.

“I don’t know.” Alex patted Wegener, but that didn’t calm the animal. “He was a drug sniffer dog, but who knows? He might have also been trained as a disaster rescue dog.”

“You think there are people trapped in here?” said Katerina.

“What?” Alex was puzzled. Katerina sounded different. Her voice was thinner and higher pitched. Then he understood. “Crouch down,” he said almost at a shout, “and breathe close to the ground. We’re breathing a lot of helium.” He crouched. Katerina and Takeo did so as well. Low to the ground, they made their way slowly toward the exit.

“If the liquid helium line has ruptured,” said Takeo, “then the magnets are destroyed. The Tevatron is dead.”

“Such a lot of destruction,” said Katerina.

“It would have been much worse had it not been shut down when it did.” Takeo looked back at Alex. “One assumes it was you who annealed the tear in the spacetime fabric.”

“I did hit the button.”

As they neared the entrance, a shaft of sunlight shone down the staircase. Alex blinked in the brightness, and he noticed that their voices had returned to normal. “I guess the helium’s dissipated.” He stood upright. Katerina and Takeo did as well.

They’d taken a few more steps when the shaft of light vanished, replaced by animated shadows from the entrance. They stopped as another beam of light, this time from a flashlight, found them.

As the light grew close, Alex saw that it was wielded by a police officer. Behind him walked another individual.

“Is that the deputy director?” Katerina whispered.

“Decker?” said Alex, squinting past the beam. “Yeah. I think so.”

At about the same time, Decker seemed to recognize them. “Have you seen the director?” he called out, without preamble.

“No,” Alex called back. “Why?”

“I was on the phone with him.” Decker stopped as he reached Alex and the others. “The line went dead. He might be trapped in his hideaway down here.” He glanced over at the

police officer. “I didn’t know what to do. I called 911.”

“Where is that hideaway?” said Katerina.

Decker stared down the corridor. “Don’t really know. I’ve never been there.”

“Well, come on,” said the police officer. “We’d better hunt him down.”

Again, Wegener whined, and pointed his muzzle towards the interior.

Alex glanced at him. “My dog seems to want to hunt him down as well.”

Katerina cocked her head. “How could Wegener have possibly gotten to know the director’s scent?”

“I don’t know,” said Alex, letting Wegener have his way. “I just don’t know.”

Nose to the ground, Wegener padded down the corridor. The officer, his flashlight serving as the headlight of a locomotive, followed—and the others followed him.

A few minutes later, after running a convoluted route through many corridors, Wegener stopped at a door. Opening outward, the door was made non-functional by an equipment rack overturned in front of it.

The officer pounded on the door. “Anyone in there?”

“Get me out of here,” came a voice, the director’s, from inside.

Alex and Decker lifted the rack upright and shoved it out of the way. The door opened and the director, seeming unsteady on his feet, came out. Wegener, though, darted inside and started barking.

Alex, puzzled, followed his dog into the room. The room lay completely in darkness. “Excuse me,” Alex called over his shoulder to the police officer. “Could you shine your light in here?”

“Yeah. Sure.” The officer directed his beam into the room and then he took a couple of steps inside.

Alex saw Wegener on-point, his muzzle aimed at a small glassine envelope and a straw-like tube next to it on a table.

Staring at the items, Alex shrugged. “I have no idea what this stuff is.”

Decker walked into the room, glanced at the table, and scowled.

“I’m afraid I know what it is,” said the officer in a grave voice. He stepped up to the table, shined his light on the items and, almost in the way Wegener would, sniffed at the envelope. Then he stood erect, swiveled around, walked out and up to the director, urging him away from the others.

“Wonder what’s going on,” said Alex as he and Wegener left the room.

“I imagine,” said Decker, following behind, “that our esteemed director is about to be arrested for drug possession.”

Alex swiveled around. “What?”

“No surprise,” said Decker, including Katerina and Takeo in the conversation. “The board’s suspected it for some time. But there’s been no proof.” He glanced forward at the police officer, who seemed in a heavy dispute with the director—“Until now.”

The officer and the director walked toward the entrance. Alex and the others followed at a respectful distance.

“This isn’t exactly good publicity for Fermilab,” Alex whispered.

“No, it isn’t,” said Decker, softly.

As they emerged into the sunlight, Alex saw the officer ushering the director into a police car.

“What do you think will happen with Fermilab?” said Katerina.

“I suspect the board will replace the director,” said Decker, his eyes on the police car, “with me, I suppose.” He looked back toward the entrance. “I don’t know if we will rebuild with the new magnets,” he said, almost to himself. “The baton is passed to CERN.” He swiveled around and smiled at Alex and Katerina. “But I assure you,” he said, “I’ll make certain that the LHC and the Tevatron are never powered up at the same time.”

“Wonderful,” said Katerina. She also looked back at the entrance. “I wonder if everyone’s gotten out safely.”

“It is likely,” said Takeo.

Alex, though, was preoccupied with worry. “I can’t tell,” he said, softly, thinking aloud to himself. “I can’t tell if there’ll be aftershocks.”

“There is nothing to be gained here,” said Takeo, abruptly. He turned to Alex. “Better might be a return to the picnic table.”

Alex waited for more.

Takeo smiled. “Perhaps now, that nice game of chess?”

“Now? You want to play chess now?”

“If one worries about aftershocks, a weighted chess set can be provided.”

Alex marveled at the man’s monomania. “Later, perhaps.”

Takeo nodded at Alex and then to Katerina, and then walked away toward the village.

Katerina leaned down and ruffled Wegener’s fur. “I guess there is such a thing as a forensic seismologist.” She stood upright and laughed.

“What?” said Alex.

“Oh . . . Nothing.”

“Tell me.”

“I was just thinking.” Katerina pursed her lips. “Wegener sort of fits your definition of a good seismologist.”

“Oh?”

“By getting rid of the director,” said Katerina with a sly smile, “Wegener has actually averted a big quake.”

Alex threw a glance at his dog—at his competitor.

“So the dog is a seismologist,” said Katerina with a dismissive wave of a hand. “So what?” She touched Alex gently on the upper arm. “One doubts, as Takeo might say, if the dog can play a good game of chess.” She paused. “Do you understand my meaning?”

For a moment, Alex stood there, puzzled. Then he smiled with the revelation that he himself was as monomaniacal as was Takeo. “Yes,” he said. “I think I do.” Alex bent and scratched Wegener between the ears.

Next Article

Outbound

Humans can be exceedingly rough on themselves and each other—and they can also be exceedingly resilient.

Brad R. Torgersen

Illustrated by Mark Evans

I was eleven years old when the Earth burned.

I can still remember Papa running into the hotel room on the space station, screaming. What he said, exactly, I can't recall. But there was fear in his eyes when he picked me up and threw me over his shoulder. He did the same with my little sister, Irenka, and then he was back out the door—both of us bouncing

across his deltoids like sacks of potatoes.

Papa didn't stop for luggage, or any of our toys.

Not even my special chair.

I remember the curved corridor being filled with adults: screaming, fighting, and yelling.

One of them got in Papa's path, and Papa literally kicked the man out of the way.

Papa had never hurt another human being in his whole life.

Irenka, who was just four, kept calling for Mama. But Mama had been at a conference on the other side of the station, and we didn't see her anywhere.

I kept thinking about my chair. If whatever was happening was bad enough for Papa to forget my expensive new chair, then it was really, really bad.

When we got to the hatch of the ship, there were big people with guns and they wouldn't let Papa onboard.

Papa yelled at them. They yelled back.

I remember Papa slowly putting Irenka and me down on the deck and hugging us both very closely, his big hands stroking the backs of our heads while he spoke.

"Mirek, you're the oldest. You have to take care of Irenka. And Irenka, I want you to be good for your brother and do what he says. Because you both have to leave this place and I can't come with you."

The big people with guns moved aside and other people, wearing crew jumpers, came through the hatch and tried to take Irenka and me away from Papa.

Panic gripped me.

I wouldn't release him.

Irenka kicked. I shrieked, because I couldn't kick.

We hung onto Papa's shirt for dear life.

Ultimately, Papa yelled at us so loudly it made us silent, because we'd never heard Papa say such words to us before, or in such a loud voice.

He apologized and kissed us both. We let go of his collar.

"Remember me," Papa said when the crewpeople took us away. "Remember your Papa and Mama. We will always love you!"

The ship was crammed with people. Other children, mostly.

When the heavy banging noises came through the cabin, some of the kids screamed. I knew better, though. We'd undocked from the station because I felt all the gravity go away.

This was a good thing. No gravity meant I didn't need my chair.

The crewpeople who'd taken us away from Papa didn't even speak to us. They hurriedly found a two-person gee couch, strapped us into it, and moved on.

Irenka was sniffling and sobbing while I held her hand and

looked out the window, perhaps too dazed to really feel what had just happened to our family.

The big rings of the station rotated beautifully while our ship thrust away from it. The gee from thrusting tugged at my stomach, then shifted ninety degrees. I was being pushed sideways, the view in the window spinning just as the station began to disintegrate. I couldn't tell what happened, other than that there was a sparkling cloud that seemed to envelop the station for an instant, and then a white flash so brilliant I had to cover my eyes.

When I could see again, the station was gone, and the gee pressing me into my seat was so strong I had a hard time breathing.

Irenka's sobbing had quieted to a whimper and she gripped my hand so hard I thought her little tendons would snap.

Our ship was moving. Fast.

The Earth's night side was covered with huge splotches that glowed dull red, like a giant, angry rash.

Occasionally, flashes could be seen through the massive, roiling clouds.

An adult, clad in a spacesuit and with a helmet under his arm, shuffled past our couch. I tapped him on the arm and pointed out the window.

"What's going on?"

The man paused just long enough to lean over us and look

outside.

"Orbital stuff's been hit," he said in American English. "Now they're using antimatter warheads in-atmosphere. Jesus almighty . . ."

The man bolted aft while I kept looking out.

Somewhere down there, I knew my cousins and grandparents were in trouble. The smoky clouds were too thick for me to see the continents clearly, but I looked for Europe anyway. Poland was by the sea, and I thought that, maybe being near the sea, it wouldn't be so bad.

Until I saw the day-side limb come up, and wherever the glowing splotches touched the ocean, the water exploded into hurricanes of white vapor.

The angry splotches also expanded visibly, like the sped-up films in school that show how mold grows in Petri dishes.

Then the ship rolled over and I could see nothing more, the additional gee shoving me back into my seat.

I looked away from the window to see Irenka slumped against me, exhausted and eyes closing.

Her little breaths became regular and gentle, and before long I also felt my eyes close, and then there were only memories of Mama and Papa, gone forever.

Irenka woke up crying, and the adults in crewpeople jumpers had to come and get her and take her to the bathroom. When they brought her back she was in night pants and nothing

else. They said she'd had an accident, and her clothes wouldn't be clean for an hour. My sister's eyes were puffy and wide and she now looked at everything as if it might bite her.

I asked if it was okay if she sat in my lap, and after some conversation, they told me yes, as long as we both stayed buckled in together. Being unbuckled in zero gee would be dangerous. But I already knew that.

Irenka snuggled into my lap, the night pants making a gentle crackling sound. I had us both buckled up and I wrapped my arms around her.

I put my head back and closed my eyes, hoping for additional rest. I felt more tired than I'd ever felt in my life.

"I want Mama," Irenka said in a low voice.

I opened my eyes and looked down into her small face.

"I want Mama too," I said. "But I think Mama and Papa aren't alive anymore."

My sister stiffened and began to whimper again, burying her face in my chest.

I hugged her tightly, feeling the lump move into my throat. I wasn't sure who I felt sorrier for: my little sister, myself, or my parents.

I fought back the swell of grief and tried to stay calm. I could still feel Papa's hand on my head when he looked me in the eye and told me to take care of Irenka—because he'd known Mama and he wouldn't be around to do it anymore. Papa had looked

resigned when he'd said those words to me. Resigned, and yet full of dignity. While the other adults on the station had panicked, he'd made sure Irenka and I were safe.

Now, my sister needed me to be the strong one. And I needed me to be strong for us both.

I swallowed thickly and let my tears be silent tears while I gently stroked Irenka's golden hair.

An hour later, an adult appeared near our seat. She was older than many of the other adults we'd seen onboard, with short hair that was going gray. She seemed motherly and smiled at my sister and me, patting our shoulders.

"Do you speak TransCom?"

"Yes," I said.

"Good. Can you please tell me your names and ages?"

"Miroslaw Jaworski. This is my sister, Irenka. I'm eleven, she's four."

The kindly crewperson noted our names on her PDA.

"Do you know where your parents are?"

"Yes. You wouldn't let Papa come onboard. He's dead now."

The woman's mouth sank to a frown.

"I am sorry, honey. The captain wouldn't let us bring any more adults than we already had. The ship was full."

Her words were small comfort. But I worked to remain

strong. Something told me that my childhood had suffered an abrupt ending, and the sooner I acted like a man, the better.

"What happened?" I asked.

"Ummm . . . Did you watch the news these past few months?"

"No."

"There was . . . They . . . No, maybe it's better if I don't explain it. Honey, someone started a war. A very terrible war."

"Why?"

The woman paused, her eyes un-focusing and her frowned lips beginning to tremble.

"I have no damn idea," she whispered.

Then the woman seemed to remember who she was speaking to, apologized for cursing, and went back to recording information. She took down where we'd lived, the names of extended family, what we liked to eat, if we had any favorite videos we liked to watch, and if we had anything special the adults on the ship would need to know.

"I don't have my chair," I said.

"Pardon me?"

"On the ground, I can't move without my chair."

I pantomimed using the little joystick that commanded my electric chair, without which I couldn't move except to drag myself across the floor with my arms.

“You’re a paraplegic?”

“Yes.”

The woman’s lips quivered again, and she reflexively reached out and stroked a lock of hair off my forehead.

“I’m okay,” I said. “When there is no gee, I don’t need legs. It’s one of the reasons Mama was at the conference. She thought she’d get a job with one of the settlements in the asteroids, where I’d probably never have to worry about a chair again.”

“Of course. I’ll pass it on to the captain. Can you handle your sister, or should I see if one of us can take her?”

“I want Mirek,” Irenka said, not looking at the woman and reflexively wrapping her arms so tightly across mine, I thought there was nothing more that needed to be said.

The woman stood up, her special shoes gripping the floor, and affectionately stroked my hair one more time.

“If you need any help, press the blue button on the seat in front of you. My name is Elaine, and I am one of the crew. Otherwise, the screen below the button is a computer you can use to look at shows or play games.”

“Thank you,” I said. “But what I really want to know is, where are we going?”

“We’re not sure. The captain has to decide. The war didn’t happen only at Earth.”

Our ship was a common interplanetary liner. The kind that

is so common, they don't have names, just numbers. The captain did his best to inform us of what was going on, but I don't think he was used to talking to kids, so I had to keep asking Elaine to explain it to me. She said that the captain had decided to take us to Jupiter, where we might find other refugees at the Jovian space settlements.

There was near-constant thrust because we had to go as fast as we could to get away from the war satellites that were still hunting between Earth and the moon.

This meant I had to spend the first half of the trip on the couch to which Irenka and I were assigned, which would have been fine except that I needed Elaine's help whenever I had to go to the lavatory. Some of the younger teenagers laughed and called me a baby when Elaine carried me up and down the aisle. I could handle that. You don't live life as a child cripple and not get used to the fact that a lot of other kids are always mean.

But when they started picking on Irenka, I knew I had to do something.

I waited until we were at mid-point, when we got a few hours of freefall before deceleration. It was the one time during the trip when the other kids were awkward, and I felt comfortable. I'd spent the previous months onboard our station using the zero-gee exercise rooms in the station's hub, in preparation for Mama's hoped-for assignment to the asteroids. Now I used these skills to maximum advantage.

A few black eyes and fat lips later—both theirs and mine

—and the troublemakers and I reached an understanding.

When Elaine found out, she scolded me hotly, of course. Adults always have to do that, so that it seems to everyone like they're not taking sides. But when we were thrusting again and I was back to needing Elaine's help to use the lavatory, she quietly told me she was glad I'd stuck up for my sister, and that some of the rowdier kids had stopped being so rowdy.

There was no more teasing, and the people who had been bothering Irenka didn't say another word.

Which was good enough for me.

Jupiter was gorgeous outside our liner's cabin windows. The huge planet had hung there for a week now, growing steadily larger while we adjusted and burned in order to drop into a rendezvous orbit with one of the Jovian stations the captain had spoken of shortly before we fled the inner system.

I'm not sure what all of us were thinking. The Jovian settlements had grown into a sort of mythic destination in our minds, and we'd all begun to place various—and later, I would think, unrealistic—expectations on the place. Irenka especially seemed fascinated with Jupiter.

I felt bad, having to keep reminding her that Mama and Papa wouldn't be there at the door to greet us when we got off the ship. Every time I did it, Irenka got mad at me and told me she hated me because I was happy that Mama and Papa were dead, so that I could take Papa's place and boss her around. At which point she'd take off for the little indoor playground the

crew had built in the lower cargo hold, and I wouldn't see her for an hour. Then she'd come sulking back to our couch, apologize for being mean to me, and we'd end it with a great big hug.

Irenka was up front using the lavatory when the lights in the cabin went red and the klaxon sounded over the speakers.

The captain's voice roared, temporarily drowning the screams of the other kids.

"WE ARE UNDER ATTACK BY AN AUTOMATED DEFENSE SATELLITE! BUCKLE IN AND PREPARE FOR SEVERE GEE!"

My immediate thought was of Irenka, stuck in the bathroom. I used my arms to propel myself out of my seat, but was promptly shoved back down from behind by Elaine's hands on my biceps.

"Do as you're told!" Elaine yelled at me.

"But my sister!"

Elaine looked to where I stared wide-eyed at the lavatory, then nodded once and said, "You stay here, I'll go get Irenka!"

The older woman almost ran down the aisle, her grip shoes making rip-rip sounds as she went. I managed to get my harness buckled around me when the gee kicked hard. We all slammed from side to side, up and down, screams and shouts and crying filling the cabin. Elaine stayed upright through all of it, and I saw her reach the lavatory door and use the special key card on her lanyard to open it. She vanished inside for a

moment, then emerged with Irenka, whose eyes were searching frantically while her legs kicked in the air. Elaine was yelling, “Calm down! Calm down, honey!”

Another series of violent maneuvers battered the occupants of the cabin. I saw one girl come loose from her partially-buckled harness and crash into the ceiling. She floated limply for a moment before being catapulted over my head and out of sight, followed by a sickening thump.

Elaine held Irenka tight, however, and began making her way back to my couch when there was a horrific concussion that made my teeth rattle, following by groans and shrieking from beneath the floor.

My ears suddenly felt like they might pop, and in an instant I realized that the ship had been hit. Elaine and Irenka simply looked at me, their mouths forming twin O-shapes while their hair ruffled in the rush of escaping atmosphere.

Then the orange decompression shield slipped out of its compartment on the headrest of my couch and dropped down over me like a shroud, sealing at the edges.

I screamed Irenka’s name and fought to undo the chest buckle on my harness, watching through the shield’s small window while the cabin became a nightmare of flashing red lights and debris exploding from the floor. My little sister and I were able to exchange one final look, her little mouth shrieking, Mirek! Then the world tilted over and I was crushed into my couch, the decompression shield flapping and billowing.

When I came to, I was numb to the core. My ears hurt a lot and my nose had bled all over the front of my shirt. I didn't care. For the longest time I just sat and kept my eyes closed tight, re-watching the image of my little sister noiselessly screaming my name.

Eventually I felt the rumbling of a terrible cry struggle up in my chest. Once it broke the surface, I howled for many minutes, snot and tears and blood caking my face and hands. By the time I went silent I was so spent physically and emotionally, I could only muster a few last sniffles, and then I was back to simply feeling nothing much at all.

Hours passed. I didn't move until my bowels complained, and I used the small LCD in the armrest of the couch to read the emergency instructions. The decompression shield had snapped taut as a balloon, affording me some elbow room. So I unlatched myself from the harness and, per direction, pulled the seat cushion up to reveal the orifice for an emergency zero-gee toilet, which I used. Then I simply sat and stared out the shield's window, watching the blackness of space and the stars beyond roll slowly past.

I figured I'd been blown free of the wreck during the decompression, or the couch was designed to eject in an emergency. It didn't matter, really. Irenka had died five meters from me, and all I'd been able to do was watch.

I'd failed Irenka. And I'd failed Papa, who'd told me to take care of her.

I wished very much that I could cease to exist.

Another cry rumbled, but I didn't have anything left for it.

I fell back asleep.

I came awake with a start.

The decompression shield was slowly deflating around me.

I hurriedly punched at the LCD on the armrest, wondering why the system hadn't sounded an emergency alarm, only to find the decompression shield lifting back up into the headrest on its motors.

I flinched for an instant, expecting the vacuum of space, but instead found the illuminated, metal-ribbed interior of . . . another ship?

There were no people present in the high-ceilinged, rectangular space. It dwarfed the passenger cabin of the ship Irenka and I had originally escaped on.

Irenka. A wave of sudden depression washed over me and I brought my useless knees to my chest, burying my face. The repeating images of her frantic death began to replay across my mind, and I slowly beat my forehead on my kneecaps, unable to make the horror stop. Would it be like this forever? Always seeing Irenka, dying a million deaths, with me unable to help her?

There was a clanking sound from across the large compartment, and I snapped my head up. I saw a circular hatch swing open.

My heart began to beat rapidly in my chest. I stayed put on the couch, watching a small figure in white, flowing, pajama-like clothes float through and attach to the deck with grip shoes.

To my surprise, it was an old woman.

Her skin was wrinkled and coal-black, and her eyes were wide with dark irises.

She looked at me, unblinking. Then she quickly walked rip-rip-rip across the deck.

"Boy's a mess, Howard," the old woman said, but not to me. Her speech was American English, but heavily accented in a way I'd never heard except on television. When she drew near I noticed the tiny device in her ear—a headset. I just looked at her while she knelt down slowly near the couch and examined my face, the dried blood on my shirt, and the way my balled fists gently trembled while I hugged them over my knees.

"You got a name, son?"

"Miroslaw," I said, the dried mucus and blood in my nostrils making it sound as if I had a bad cold.

"That's . . . Russian?"

"Polish."

"Well, you can thank the Lord that your little lifeboat here crossed our path, Miroslaw from Poland. The killsats didn't leave much when they hit Jupiter. Howard and I kept the observatory dark until the killsats moved on. Then we did a slingshot burn, and now we're away."

“What does that mean?”

“Everything has gone on automatic. The military doesn’t exist anymore, but their machines do. To the killsats, everyone has become a target. So Howard and I decided it would be best to cut loose and go.”

“Where?”

“The Kuiper Belt, boy. Only place left. We’re going to find the Outbound.”

Outbound. There had been stories about them in school: privately-funded deep space missions that had been sent to determine if the space beyond Neptune provided fertile ground for colonization. None of them had ever sent back any data, once they passed the orbit of Pluto. Common sense said the Outbound had perished.

But had they really?

As long as Irenka’s death was foremost in my mind, the Outbound didn’t matter to me. I kept hugging my knees and stared past the old woman, looking at nothing.

“I’m Tabitha,” the old woman said, sticking out her hand.

“Thank you for finding me,” I said, weakly shaking it.

“You don’t seem too happy about it, Miroslaw.”

“Mirek. My sister called me Mirek. She’s . . . She’s . . .”

I couldn’t say it, but it didn’t seem like I needed to. Tabitha just put a gnarled old finger to my lips.

“Hush, child. You’ve survived the Devil’s Day. Come on, let’s get you cleaned up.”

I let her grab my arm and pull me up off the couch. Using the grip shoes, she towed me back to the hatch she’d used to enter the large bay.

She noticed that my legs trailed behind me, and I used only my arms to maneuver through the hatch on its hand rails.

“Can’t walk?” Tabitha asked.

I nodded. She immediately flipped me over to check for injury, but I pushed her hands away. “Not hurt. Paralyzed. Since I was born.”

“Mercy,” Tabitha breathed. “Well, Mirek, we’ll just have to do the best we can, you and I.”

“What about Howard?” I said.

“He’s my husband. You’ll meet him soon enough.”

Howard and Tabitha Marshall were originally from Virginia. Assigned to one of Jupiter’s six original Humason-series mobile space telescope platforms, they’d served as technicians when they were young, and moved up to take over their observatory when older.

We talked while Tabitha helped pull my shirt off and began washing my face.

“NASA told us the telescope was too old and ought to be decommissioned, but Howard and I liked it out here so much, where we could be close to God’s quiet grandeur, when the

astronomers and other staff packed up and left, we stayed. In protest at first, but eventually NASA gave up and let us keep working. We sent data back right up until the war."

Howard, I'd learned, had actually died a few years earlier, but they'd recorded him into the computer, and now he ran the observatory as its brain. I'd heard of that being done for some of the very long deep space missions, using volunteer pilots who'd grown too old or sick to fly. It was an experimental thing, and lots of people back on Earth still hadn't been too sure about it. Talking to Howard was a little like talking to an imaginary friend, since he seemed to exist everywhere and nowhere at the same time.

The observatory itself was a sprawling complex built into the side of a tiny piece of ore-rich rock that had been blasted off one of Jupiter's trailing Trojan asteroids. When the hunter-killer satellites from the inner system had reached and attacked the Jovian settlements, Howard had turned off every piece of active equipment he could, going "dark" in the hope that he and Tabitha wouldn't be detected.

Pure chance had sent my couch spinning across their path, and when Howard's passive sensors picked up my vital signs, Tabitha demanded that I be brought aboard, in spite of the risk.

I didn't know what to say, so I mostly kept quiet and let Tabitha—Tab, she insisted—do most of the talking.

She literally flowed with stories and spunk and an irrepressible good cheer, such that I almost forgot the

depression that had sunk its teeth into my heart since Irenka had died. But the dual loss of my sister and my parents remained like a toothache—always there, and always painful.

We got me bathed and dressed in an oversized smock similar to the one Tab wore, and then she took me on a tour of the facility. Most of the compartments were sealed and cold, since the observatory's automation did most of the upkeep and Tab herself only needed a few rooms in which to work and live. She moved like a fish in water when she maneuvered in zero gee, and she showed me the spin room where she spent at least a couple of hours every day, doing exercise and letting her body experience centripetal gravity so that her muscles and bones didn't wither away.

"I know you can't use your legs, Mirek," Tab said, "but we'll find a routine for you. Meanwhile, we can open one of the other compartments and get you a room set up. You're going to be our guest for a while, I think."

I stopped.

"What if I don't want to?" I said.

Tab looked at me with a raised eyebrow, her steel-gray, close-cropped hair poking out in a mass of springy ringlets.

"Boy, you think you got any choice at this point?"

"Papa used to tell me there are always choices."

Tab opened her mouth to argue, then stopped and looked at me carefully.

“Fair enough, child. The Lord gave free will, and it’s not mine to take away. We could put you into one of the observatory’s dories. You could take your chances on your own.”

I stared at my host. Staying here wouldn’t make the pain go away, that was for sure. But then, I wasn’t certain anything would.

Hot tears began to well up in my eyes again, and I ferociously jabbed at them with the billowy sleeve of my smock.

I cursed in Polish.

Tab sighed, and lowered her floating self down until she was looking at me eye to eye. When she spoke, her Southern Black accent was especially thick.

“It’s a damn shame any of this had to happen, Miroslaw. Your family. My family. All our people, gone. The Armageddon came, and it went, and we’re still here. Which tells me the Lord still has work for us. It ain’t an accident your couch came floatin’ by Howard and me. That much I’m certain of. I don’t know what else your papa ever told you, but let me tell you something my papa told me when I was your age. He told me that there was never any way of gettin’ out of pain in this life. Adam and Eve saw to that. Because the Lord needs us to know pain. That’s part of the test. So while I can’t make your pain go away, I can tell you that we’re all gonna be judged by how we bear that pain, and use it, and do the Lord’s will because of it. Do you understand?”

I didn't. Mama and Papa had been physicists. Our family never went to church. Tab's talk sounded like something out of a history book about the days when people thought religion was more important than science. It was foreign in my ears and made me uncomfortable, but I couldn't deny the earnestness with which Tab had spoken. Nor could I deny the heartfelt kindness in her expression.

My tears flowed like a river, and I stopped trying to wipe them away.

Irenka would have liked Tab. It was a crime that Irenka wasn't here.

I blubbered something to that effect, and then I felt myself whisked up into Tab's arms, almost crushed by the woman's surprisingly strong embrace.

It was the first time anyone had held me—really held me—since Papa.

I bawled into Tab's shoulder, and she just kept holding me, singing a soft song under her breath that I would later learn was a hymn.

I chose to stay, of course.

And Tab and I talked about the Outbound.

"So where do we start?" I asked Tab. "We can't just search blindly."

"The largest group of Outbounders was said to have followed in the wake of Pioneer 10. Can we do the same,

Howard?”

“Let me see if I have the file on that,” Howard’s voice spoke from the speakers in the ceiling. “Oh, here it is. Yes, I think we can do that. It’s lucky for us we came out of the slingshot when we did, or we’d be going in the totally opposite direction. We’ll have to wait a while longer before I can risk a second burn. We’re not far enough away from Jupiter yet.”

“No problem,” Tab said. “I think time is the one item we’re not going to run out of.”

She wasn’t kidding. Even with constant thrust, it took two months to cross the orbit of Pluto, and another eight to get as far as the inner limit of the Kuiper Belt. The observatory was well suited to long voyages. A plentiful fuel reserve, in the form of antimatter, provided power while a large hydroponics facility kept the air clean. Tab trained me to service the various automated and manual life systems of the observatory, and we inventoried and reinventoried all the consumables and spare parts. With Howard’s help we drew up graphs and charts to see just how far we could stretch our resources.

Barring damage to the observatory, and with regular burns for course correction, Tab and Howard estimated we could go twenty years before running out of anything important. Even if the main reactor failed, a backup radioactive decay generator could provide full internal power for another ten.

Shutting down everything but the bare minimums increased these time frames by a factor of three. Which meant all we had

to do was keep the hydroponics farm healthy, and Tab and I would have enough food to eat and air to breathe for decades.

Decades. My soul chilled at the thought of such a long, lonely voyage.

Howard stopped monitoring the inner solar system at sixteen months. There were no more human cries for help. All that remained were the automated signals of the few surviving death machines, each acting out its programmed orders regardless of the fact that the men and women who had given those orders were gone.

No other automated ship-to-ship communications were intercepted either, though if anyone else had survived and fled, they had likely done so in the same manner as us: deliberately silent.

Several times, Tab and I debated turning back.

But as the kilometers between Earth and the observatory grew, the very thought of going home became abstract. We were now well beyond the confines of the planetary system proper—the Sun having become just another pinpoint in the star-filled sky. What chance did we have, in going back? How would we look for anyone while avoiding the robot killers?

Better to forge on.

For my thirteenth birthday, Tab told me she would teach me to be an astronomer.

It was easy, since everything I needed to know was in

Howard's databanks. And it helped pass the time, keeping my mind off things I still didn't want to think about. Mama and Papa and Irenka were still there, like deep sores newly scabbed over. But somehow, day by day, Tab and I grew closer. And the hurt got a little bit less, and a little bit easier to carry.

She and I manipulated the observatory's sensors and equipment, cataloguing various large and small objects in their path.

Tab told me that, contrary to popular conception of centuries past, deep space was not a total void. The Kuiper and Oort regions were actually a combined debris field that bled inexorably into the sparser debris that populated the interstellar medium—where the planemos ruled.

Planemos. Planets without stars. Worlds unto themselves.

Perhaps the Outbound had ultimately reached and settled on one of them? After a voyage spanning centuries?

Howard diverted our course on several occasions in order to investigate anomalies that showed up on the observatory's impressive sensor array.

In each case, we found nothing, even if the comets and icy worldlets themselves were interesting.

Mostly, they were rocky bodies that had accrued a shell of water and gas ice. Perfectly routine, once you got out beyond Pluto.

On only one of these did we find something that indicated

humanity.

It was a smallish snowball of a world, irregularly shaped, yet giving off radioactive emissions from one of its many craters.

Closer inspection with the telescopes revealed signs of mining, long since abandoned.

It was enough to make Tab whoop and spin, shaking her hips side to side while she floated through the observatory's control center and Howard jabbered with as much excitement as his computer-cooled mentality could muster.

We matched with the ice body and Tab and I went outside in one of the observatory's two dories. Landing, we then took suits—one of which I'd helped Tab extensively modify to fit me—and we were disappointed to find only ice-crusted garbage and a small pile of spent fissile material.

No messages. No clue to how long the Outbound had stayed, or where they had gone.

There was no sign of Pioneer 10 either.

We returned to the search.

Twice more in two years, we found similar pit-stops on similar worlds. The Outbound had needed hydrogen isotopes and reaction mass for their fusion drives. It must have taken them many decades to travel as far as we had gone in just a few years on antimatter drive.

Tab risked active communications, tight-beamed to the

fore.

For weeks we waited for a reply, and nothing came.

The longing to see other living humans became like an itch to me. Beyond missing my family, I also missed the wide open plazas and parks of home, where I'd been able to race my electric chair between the fountains and startle the pigeons and laugh like a boy ought to laugh.

At ship's night, I began dreaming of home, and . . . other things. It was embarrassing to talk about with Tab. I had an easier time talking about it with Howard, who had been a man once, and before that, a teenaged boy.

Howard said he was surprised that I was getting the kind of physical response I was getting, even though I had never felt anything below my hip bones my entire life. When our conversations turned specifically to women and women's bodies, Howard hesitantly uncorked a database of pictures he'd been keeping—pictures that my mother would have been scandalized by, had she caught me looking at them on my laptop back at home.

"Don't tell Tab," Howard had warned in a fraternal fashion. "She's liable to erase me if she finds out I've shown you this."

I promised Howard I would not tell, and was actually grateful to have something I could share with another male, even if he was just a computer recording. We talked more and more, Howard and I, while Tab and I remained close, if gradually more separate. One evening when Tab thought I was asleep, I

slipped out of bed and moved silently through the air to the doorway to her room, where I heard her and Howard talking. Pillow talk, my mother would have called it, made strange by the fact that Howard was not actually in the bed with his wife.

"He's going to be a man soon," Tab said sadly.

"He became a man when his daddy died," Howard replied.

"Probably true. But you don't know how happy I've been, finally having a young one around to look after. We tried so hard, all those years, you and I. And nothing. Then, like Sarah, God sends me this boy in my old age. Only I never got to have him as a baby. He was mostly grown up when he came, and now . . ."

I felt a lump form in my throat while Tab quietly wept.

"He's a good boy, Tabitha. We can both see that. And I think he loves you. He won't say it when I talk with him, but I can feel it."

Tab barked out a mocking laugh. "Hah! A computerized man who can feel!"

"You know what I mean, woman. Now hush up. My sensors tell me the boy is lurking at your door. He's probably heard everything we've been saying."

"Sorry," I said, letting myself in, sheepishly smiling.

Tab was there, wiping tears from her eyes. "Don't be, Mirek. I'm just a sad old lady who never had a chance to have any children of her own. Don't mind it if I've become too

attached to you."

In fact, I didn't mind it. I didn't mind it at all.

Using my arms, I launched from the hatch and grabbed Tab in a bear hug, squeezing her as tightly as I remembered her having squeezed me that first day I decided to stay with my new family and seek the Outbound.

She wept anew, for joy this time, and I told Tabitha and Howard Marshall how much I did love them, and how thankful I was that they'd found me and given me a home when the world had taken all such things from me.

By the time I was sixteen, I suspected that the full burden of humanity's self-annihilation had yet to settle on my shoulders. Some crucial part of me remained numb to the idea that everyone had ceased to exist, and that all the artifacts of humanity on virtually every world had been antimattered to dust. How ironic that perhaps the only surviving tokens of human intelligence were the final remaining warbots that continued to prowl the solar system, seeking targets and enemies that did not exist. Such thoughts were depressing, and depression again became a common companion.

I'd have liked very much to have a young woman around to talk to, to touch, and to hold in my arms at night. But the way things stood, I might not ever see another woman again, besides Tabitha, and this grew to be an irritant like no other.

With Howard's surreptitious help, I began to distill spirits from the grains grown in the farm domes.

Shortly after, Howard began to worry that he had an alcoholic on his hands.

But how else was I supposed to bear it? I had a dead past and an unknown future. The only living young man left in the universe!

Homesickness and abstract horniness accentuated my depression, giving it a melancholy flavor.

I began to drink daily. Alone. In the private module I'd built out on the face of the observatory's foundation, where Tab couldn't touch or talk to me. I neglected my daily exercise in the spin room. Why bother? What future awaited me now? I'd been young when I left Earth, and young I would remain for many years. But what was youth without joy? Without a girlfriend? I found myself daydreaming endlessly about all the older girls I had ever been attracted to: their faces, their expressions, the way they laughed or got angry, how their bodies had moved under their clothes. It got so that I thought I would be ecstatic to see even a single, other breathing female, regardless of her state. Just someone I could hug and who could hug me back, and who wasn't old enough to be my grandma.

I grew distant from Howard and Tabitha both.

I got sick of them, and I think they began to grow sick of me.

We began to go days or even weeks not speaking to each other, and eventually I retreated to the privacy module almost entirely, forcing Howard to monitor and tend to the observatory

all by himself, with Tabitha's declining help.

Which was fine, at first, because Howard had always done most everything anyway.

Then, one day, there came a beacon.

It was faint. No more than a weak radio signal, sending binary.

Howard couldn't make sense of the message, which seemed truly random—ones and zeroes in an endless stream, without pattern.

That was okay. It was a sign that we were still on the right path. It was also enough to shock me into a forced detox.

By the time we reached the comet from which the transponder was sending, I was sober enough to take out a dory, and human enough to actually be pleasant to Tab for the first time in too long.

On the surface of the comet, I found a tunnel.

At the bottom of the tunnel, I found a grave: sixty-eight bodies, all perfectly frozen, and arranged with dignity.

I spent days examining the site for anything that might indicate where the other survivors had gone. They were of mixed racial heritage and gender, and if I'd had to guess, I'd have said they were Americans. Whether or not they came from the group of Outbounders that we'd been specifically pursuing was uncertain, but their presence was the first absolute proof that humanity had survived to that point, so far from its now-

dead home.

And that was enough. I reverently went among the dead, recording their names from the steel tags attached to their bodies and taking digital pictures.

When I ultimately got back to the observatory, I was calm.

Almost too calm for Tab's taste.

But the dead of the Outbound had helped me cross a threshold I hadn't known needed crossing, and at once filled me with renewed resolve.

Quickly, I flushed out the privacy module and dumped every last drop of grain alcohol.

Next, I began an exhaustive catch-up on all my neglected duties, interspersed with profound and heartfelt apologies to Tab and Howard alike. I couldn't tell whether or not the man inside the computer could feel pain, but I knew my behavior over the last few months had scared and hurt Tab. Certainly I'd treated them both badly enough. I hoped that I could make it up to them, given time. And they certainly seemed grateful and relieved to see my renewed sense of purpose.

"Forgive?" I finally said one day, when the observatory was back in order and Tab and I were sharing a meal for the first time in ages.

A very long silence.

"Forgiven," Tab said, slightly smiling so that the corners of her eyes wrinkled warmly. She reached out a shaking, gnarled

hand, and I took it gratefully, squeezing.

During the tenth year of our flight, we found the first ship. It was abandoned. Ransacked. Every last usable part taken. A skeleton of a vessel, accompanied by another mass grave.

At year fourteen, we found three more ships, also stripped, and also serving as a memorial to more people who had apparently lost—or given—their lives for the cause.

This time, I also found children, each far too young to have been born on Earth. The sight of those little ones brought up disturbing memories. They reminded me far too much of Irenka.

For Tab, who had become so old that she never left the observatory anymore, the children were actually a sign of providence.

"The day God takes away our ability to make babies, that's the day when we know we're truly cut off from His grace."

I pondered Tab's words and watched her gently maneuver through the kitchen, wrapped tightly against a chill in the air that did not exist. She'd tried over the years to bring me to Christ. Oh yes, she'd tried. Especially when I came off my bender with the grain alcohol. But somehow, I just never found the spark. I heard the words and I grudgingly listened when she read scripture, but while I respected and even admired the old woman's faith, I could not feel it likewise.

Where Tab felt certainty in God's purpose, I felt . . . nothing. In my teens I'd often questioned myself on this, suspecting some kind of internal moral failure. But now I just resigned

myself to the fact that I was too much like my parents—unable to set aside the rational long enough embrace the fire and "get religion."

As so often happened when Tab and I failed to see eye to eye, I discussed it with Howard, who had always seemed to support his wife's belief without necessarily going great-guns himself.

"Tab's pops was a pastor," Howard said one night when he and I were having a quiet conversation in the observatory's control center. "God was mighty in her family, from the father down to the youngest child. It was kind of scary, when we first got together. She'd drag me off to meetings and bible study and I went along with it because my moms had read me bible too, and it didn't bother me any. And Tabby, well . . . She was just so damned attractive, I think I'd have walked into a pool of piranha if it meant I got to sit next to her and hold her hand.

"She was furious with me when she found out about you learning to distill. Almost as furious as when she found out about the pictures from the men's e-zines."

"Tab found out about that?" I said, laughing. "I swear, I didn't tell!"

"I know, son. It was me. I never could keep a secret from that woman, not in my entire life."

We shared laughter, one old man and one young man.

I sighed, and was silent for a long time.

“Howard, do you think I’ll ever get to have a wife?”

The speakers were quiet. Pondering.

“If we can ever find these Outbounders we’re on the trail of, I’d say, yes. Absolutely. Girl’d be plum crazy not to get with a handsome young guy like you.”

“But I’m still a paraplegic.”

“True. But let me tell you something: for women, a man being tall and macho ain’t the end-all, be-all. Especially the older a woman gets, and the longer she goes learning how hard it is to find a decent man, she appreciates the good ones when they come along. Don’t worry about it, son. Your woman is out there.”

“But what if I can’t make her—”

“Let that part of it take care of itself, son. Don’t fret over it now, especially when we ain’t even found these folk yet. You hear me?”

“Yessir,” I said, clamping up on the subject, even if it remained heavily on my mind.

Another lengthy silence.

“Howard,” I said.

“Yeah, boy?”

“Does it hurt?”

“Beg pardon?”

“When they recorded you. And moved you into the

computer. Does it hurt?”

“Not really.”

“What does it feel like?”

“Impossible to describe.”

“You can’t even try?”

“If I did, it would probably just confuse you. But for the sake of argument, imagine going to sleep one night, and when you wake up, your body is huge, has a hundred new arms, a hundred new eyes, a hundred new mouths . . . It really takes some getting used to. But no, it doesn’t hurt.”

“We’ll have to record Tab soon, won’t we?”

“No. Tabby made me swear to never do that. She’s afraid it will interrupt her soul going to Jesus.”

“But you were recorded.”

“That was different. And believe me, Tab’s only reason for allowing it was because she feared being alone more than she feared my soul getting lost in space between this world and the next. I think in the long run she’s stopped worrying about me. Though she still insists that when it’s her time, nothing will stop her.”

“Does she really believe she’ll go to Jesus?”

“You know she does, Mirek.”

“How about you? Do you really believe it?”

Pause.

“I want to believe, Mirek. Whether or not that counts . . . I dunno.”

Disaster came suddenly, almost fifteen years after leaving Jupiter.

A micrometeoroid storm, composed of dark carbons so black and so thinly diffused we never saw them on the telescope, or the radar. One moment I was helping Tab get dressed and get her room cleaned up, the next the observatory was trembling and a sound like hard rain echoed through the corridor outside.

“Howard, what’s happening?” Tab shouted.

When no reply came, Tab and I both looked at one another in alarm and rushed to the door to look out. Sparks lit from the ceiling and tiny rays lanced down and into the floor. The cosmic dust—moving at several tens of thousands of kilometers a minute, relative to us—was penetrating through many centimeters of steel and polycarbonate plate. Tab gripped me as we stood in the doorway, not daring to move, while the eerie light show continued for several minutes, until finally it ended, and I was able to rush out to the nearest computer access panel and bring up a status report on the station.

It was grim. Half the observatory was either off-line or red-lined. Worse yet, the workstation was operating on local software only—cut off from Howard’s direct control. We were also gradually losing air pressure, though the level had not yet dropped enough to be dangerous.

Tab and I floated frantically down several hundred meters of corridor until we reached the access hatch for the main computers buried down in the basement. I noted that the hatch had numerous almost-too-tiny-to-see holes in it, then dropped legs-first into the bowels of the main computer core, where Howard's mind—and perhaps his spirit—had dwelled for over two decades.

The databanks were a mess. Whole arrays were dead. The computer center had been hardened against cosmic radiation and solar flares, but never something like this. I worked frantically to trace the logic paths of the failsafes while Tab gripped a handrail and sobbed uncontrollably, saying, "Howard . . . Oh, Howard . . ."

It was no good. Too many arrays were damaged or down. Even if I could load backups, the constant synergy between the databanks that was necessary for Howard Marshall to exist, as a person, had been disrupted. If we got something back, it probably wouldn't be Howard.

Tab needed no one to tell her the reality of what had happened.

She simply stared at the arrays, many of them blinking red warning lights, and kept repeating her husband's name.

She took to her bed later that day, not seeming to care about the thousands of microscopic punctures that were leaking our air away into space. Nor did she care about the other damaged equipment—repairs to which were now going to be

near-impossible without Howard's help. I had not realized how totally dependent Tab and I were on the man until he was gone.

In a frenzy, I booted up as many of the dummy programs as I could, running them on local workstations or servers so that life support and other vitals didn't close down. Then I spent the next three days securing the hydroponics farms and the cycler machinery and the other life necessities, without which death was certain.

Not that it mattered much for Tab.

Every time I checked on her, she'd gotten worse.

The final time I looked in on her, she was curled—floating—near her bed. An old framed photo of her and Howard from when they were young was pressed tightly to her chest. The same hymn she'd once sung to me, when I was breaking down, drifted from her lips.

I almost had to shout at her to get her to pay attention to me.

"It doesn't matter anymore, Mirek. The Lord has taken Howard, and it's time for me to go now too."

"You can't just quit!" I screamed. "You told me once that God would judge us by how we bore our pain and burdens, right?"

These words seemed to bring her back to herself for a moment, enough that she replaced the photo in its holder and pushed off to drift down to me.

The slap that came was unexpected, and the first and last time she ever laid a hand on me in anger.

I was too shocked to be angry.

“Don’t quote God at me, boy!” Tab said sourly. “I’ve spent my last years trying too hard to open a door into your heart, through which Christ might step through. But you’ve rejected Him, and a part of me too. Now go away and leave me be. I’m too old to help anyway.”

There was nothing to say, so I left, and got a few hours of harried sleep before returning to Tab’s room.

Her body was suspended in the zero-gee bed. She was dressed in her white smock, and her eyes were closed, though her mouth hung slackly open while her chest drew no breath. A little roll of paper was held in one cool hand.

I shakily reached for it, and when it unrolled, it said, in Tab’s handwriting, “You are a good soul, Mirek. Thank you for letting me have you as my boy.”

I couldn’t think for the rest of the day. Only the seriousness of my predicament kept me moving. But my mind and heart were as empty and cold as the space through which the observatory now lamely traveled.

I eventually put Tabitha’s body next to her husband’s, in the tomb they had made for themselves on the far side of the observatory. There was no ceremony, no words of eulogy. There had been none for Papa, nor Mama, nor Irenka after them. There seemed none appropriate now, and I felt anything I said

that even remotely touched on the spiritual would be almost profane. Tab had been right. My heart was deaf to God. If God even existed. I stared at the closed doors to the final resting place of my second set of parents, and doubted very much that Jesus, or any other saving deity, existed. There was only the harshness of life, followed by the silence of death, which came suddenly and without warning, and always took those who least deserved it.

That month, my work on the observatory was purely mechanical. And ultimately futile. Too much had been ruined in the micrometeoroid storm. Without the expanded capacities of Howard—his ability to be everywhere and see and feel and "think" the observatory all at once—there was no way for a single person to manage.

The local software kept things going for a time, but when three months had passed, it became clear that the hydroponics were failing, along with the waste cyclers. Even with the stores that had been kept safe down in the many cellars we'd dug into the rock, within a couple of years, I was going to be out of both air and food.

I went back to the main computer core and considered my options. There were enough good arrays to try and reassemble a new master program using the original factory defaults that were kept on disc, but since everything I knew about computers I'd learned piecemeal from helping Howard and Tab, I didn't have the expertise to make more than a half-assed attempt.

I tried anyway, and created a computerized retard whom I promptly erased.

I didn't even think of messing with what was left of Howard. Those arrays I kept isolated, in case there was still some chance of sieving data from them which might prove useful.

Days I spent wandering alone through the halls of the observatory, wondering just what in the universe I was even doing here, and why I should keep trying to extend a life that seemed to have amounted to futility.

Whether by luck or design, that was when the next beacon revealed itself.

Like the other, it was very faint, but it called softly from directly ahead, in the belly of the Kuiper Belt, like a siren beckoning a lonely sailor.

I went to it. Dumping more antimatter than I should have into the reaction, I thrust viciously, pushing the observatory up the relative velocity scale, not caring if I was risking more micrometeoroid storms. If there was going to be any point to this entire journey, any way at all of giving the deaths of Howard and Tabitha meaning, then I had to reach that beacon, which lay an indeterminate way off, but appeared to be growing just a little bit stronger, day by day.

Weeks later, I found the buoy.

It appeared to be the first piece of whole-cloth Outbounder technology I'd yet discovered. Incredibly small, and apparently operating on a store of antimatter—which the original

Outbounders had never had—the device pinged happily at the observatory while I used the remaining functional thrusters of the station to pull alongside and match course and speed. My radio query sparked a message laser that shot towards the observatory. I had to fiddle for a few minutes to bring the correct receptor dish into place—something Howard could have done reflexively, with a mere thought—and then the main audio-video channel was alive with a recorded message.

It was a head shot of a young woman against a bluescreen. She was of Asian descent, and spoke TransCom with an accent I suspected to be Chinese.

"If you are seeing and hearing this message," she said, "then you are halfway to us. We know about the war, and we know that you would not have come this far unless you sought refuge. Be aware the Quorum has decided to grant asylum to all refugees from the governments of Earth, the independent satellite localities, and all colonies of the asteroids and the Jovian planets. Provided that you can reach us. We regret that we can offer no further assistance at this time. We also regret that we cannot offer you precise coordinates to follow, but if you have come this far, you already know the rest of the way. Good luck."

The message repeated, and I was both elated and crushed.

So far. I'd come so far. Tab and Howard had sacrificed so much. And this was only halfway?

I went back to my calculations, regarding stores and the upkeep of the hydroponics. There was no way I'd squeeze out fifteen more years, even if I thought I could last that long alone without going insane as a result. Even if I dumped the entire antimatter reserve into one, long, drawn-out burn, I'd have nothing left to slow myself down with when I neared the endpoint.

I stayed near the buoy, and debated at length.

The girl in the message had obviously intended for refugees to keep following the last known trajectory of Pioneer 10. Following that jellybean trail was a snap. How I could do it and still be alive upon arrival was another matter entirely.

It took me three days of thinking and tinkering to come up with a plan.

It terrified me, because it seemed so much like suicide.

The room with the recording equipment hadn't been touched in a long, long time. Tab had sealed it in a low-density, pure nitrogen environment after she'd helped put Howard into the computer, so that all the machinery and the consoles remained pristine and in good working order. It was also one of the few rooms the micrometeoroid disaster had not touched, and this gave me a hint of comfort while I set about preparing to download myself into the observatory's database arrays.

I'd spent a few weeks carefully creating a new, hardened shelter for those arrays, then painstakingly moved each one of them from the old core down to the new location, finally

powering them up and synchronizing them, with triple-redundant electricity I'd snaked down from the antimatter reactors.

If the observatory got hit again, I didn't want to suffer the same lobotomized fate as my old friend.

The instructions for recording were fairly simple. The device itself was like a compact PET scanner that lowered over the skull like a hair dryer.

The catch was that the process could not be aborted or re-tried. The recording process took days, and was so electromagnetically intensive it destroyed neural pathways as quickly as it stored them in the databanks. Once the recorder lowered itself over my skull and began scanning, I was on a one-way trip. And since I didn't have any help, and had never done anything like it before, there was a very good chance I'd wind up nothing more than a mindless piece of meat, my entire life hopelessly scrambled inside the computer.

I prepared carefully. In the event that I did not survive, I programmed an automatic course into the guidance system. Having come this far, it seemed worth it to make sure my remains had at least a chance of arriving at my destination. I also networked the life support servers and crossed them with the recording monitor, so that if the recording process completed and I did not awake and assume full control over the observatory, the contents of the observatory would be gradually deep-frozen.

My brain would be empty at that point anyway, and I didn't

like the idea of leaving my body to slowly rot on the recording couch.

Once I was satisfied that I'd tended to the necessary details, I sat down and considered my final words. In my entire life, through everything I'd experienced, I'd never really thought about what I'd want to leave behind for the future. It had always been someone else leaving something behind for me. I had always been the one to have to pick up the pieces and carry on. It frustrated me to sit there in front of the computer, finger poised over the button that would begin audio-video storage, and not have a damned thing to say.

After ten minutes I finally tapped the button and spoke—in TransCom, so that the people who might recover the recording would understand.

"My name is Miroslaw Jaworski. I might be the only survivor to have escaped the destruction of planet Earth. If you are viewing this message, it means that I am dead. If it's not too much trouble, I'd like somebody to put up a placard somewhere, for myself and my family."

I slowly repeated the full names of my sister, mother, and father, as well as my grandparents, and several extended family who had been alive when the antimatter bombs wiped out the Earth. It seemed like a good idea to include them, since we were all victims and I wanted our lives to be remembered somewhere, by somebody.

"I don't really care what happens after that. Tabitha and

Howard Marshall are entombed on the other side of this facility, and I think they should stay there. My body, and the entire contents of this observatory, are yours to do with as you see fit.

"Out."

I punched the stop key, made sure the file replicated through my crude daisy chain of stand-alone workstations, then stood up and walked to the recording room, where I slowly shut the door, set up the IV system—I'd need fluid put into me during the process, or I'd dehydrate to death before recording was complete—then sat in the recorder's attached chair.

The recorder "crown"—which is how I'd come to think of it—was poised just centimeters above my skull. I'd detached the activator toggle from the control station and put it on a cable that allowed me to hold the toggle in my hand.

I thought about how Howard had once had to do this, with only Tab to monitor his progress.

Swallowing hard, I flipped the toggle with my thumb.

And the universe vanished into a swirl of sounds and color.

Nothing could have prepared me for what happened next. One moment I was bathed in an endless sea of shifting and chaotic images—sounds echoing across the cosmos from one side of my mind to the other—and the next moment I seemed to snap back to a state of utterly cold and solid reality.

Only I was seeing the observatory through at least fifty different eyes, and hearing with fifty different ears, and I couldn't

blink or turn off the input. So I was trying to scream, but that just made things worse because my scream bellowed from fifty different speakers, which overloaded fifty different microphones. Within my head a feedback squeal like a migraine peeled across my consciousness.

It was Howard who saved me. Or, rather, his memories.

On the chance that I'd be able to access what was left of Howard's intellect, I'd networked his old arrays in a cluster adjacent to the main set of blanks I'd set up for myself. In desperate panic, I mentally reached for Howard, and felt a quick jolt of information flow across the link. Suddenly I was on solid mental ground again, my field of vision rapidly narrowed to one camera view, and my ability to hear narrowed down to a single, neutered computer voice that simply said, "Command access granted, Mirek. Awaiting further instructions."

The system knew my name.

I'd made it.

Only, I couldn't feel excited about that. Intellectually, I think I was relieved. But the glandular feeling of satisfaction, of triumph, that should have been mine, was absent. All that remained was the coolness of pure, rapid thought. Thought so fast, I felt staggered by the implications. And capability. No mathematical calculation ever need be beyond my grasp again. The moment I could conceive of a problem, the answer was in my mind at the same instant. Memory recall proved similarly rapid, and I took a few moments to ponder this reality, which

brought on a further jolt of data from Howard's banks, which were actively integrating with my own, now that they had a reliable cerebral matrix to map to.

It took me only a few minutes to master the network, and another few to access and test all the remaining, functional systems in the observatory.

At once, it became obvious how sloppy and haphazard I'd been. Total facility efficiency was down to 42 percent, with a list of yellow, orange, and red-lined items stretching into the hundreds. While I scanned and prioritized, I received continual jolts of data from Howard's arrays. One moment, I'd be wondering how to fix a certain problem. The next, the knowledge would be there, as if it had always been, as if I'd done it a hundred times before.

Though his personality was barely perceptible in the data, like a tiny aftertaste on the tongue, Howard was still, for all intents and purposes, gone. I sent numerous mental thank-yous to the man's memory, then made ready to depart the buoy, and begin the downhill leg of my journey towards the Outbound.

One thing about being a computerized mind: I could make time go as fast or as slow as I wanted to. Weeks and months evaporated in a blink while I made necessary fixes to reactors and set up a schedule to ration the fuel supply, all the while thrusting gently up the relative velocity curve, being careful to have more than enough fuel left over at the endpoint for braking. I had no idea what might be waiting for me there, but I knew it'd

probably be bad manners to go speeding past the Outbounders like a semi that's lost its brakes on a steep hill.

I turned my radios forward and began gently peppering my flight path with greetings for whoever it was that would meet me.

I suppose there was always a chance that nobody would meet me, and that the buoy, for all its promise, could have been a deception, or even a relic from an effort that had since failed. But my computer-dictated intellect didn't have the capacity for real fear. Such strong emotion, I found, was purely a residual memory—like a stimulus response, now delayed. I knew I should be afraid, but this was largely a past-tense knowledge, and did not affect my overall progress, or my determination to reach my goal.

What happened when I got there . . . Well, I purposely tried not to wonder about that. What use would the Outbound have for a computer mind like me? It wasn't like I could just put myself back into my own head again. Nor, I began to think, would I want to. The expanded capacity of the neural arrays was almost intoxicating, and after a couple of years had passed I suspected that if ever I had to be restricted again to one set of eyes, one set of ears, one set of senses, I might feel so claustrophobic about the whole affair, I'd go mad.

With the main telescope mostly wrecked, I deployed the backup and used my idle cycles to scan and chart the narrow sliver of the Kuiper Belt through which I passed.

It really was amazing to see so much debris in an area of

space that most humans still thought of as empty, even up to and through the twenty-second century. Only the Outbound had had the forethought to see this region for what it truly was: a refuge from the catastrophes that were sure to strike the planets of the solar system—be they comets or asteroids, intense solar flares, or as had actually happened, the competitive stupidity of humanity itself.

Out in the Kuiper Belt, there was room enough to get lost. Like a hermit penetrating deep into the wild, seeking resources enough to survive and distance enough to avoid the madness of other people.

I found two more buoys, each with a similar message to the first.

My antimatter fuel passed the point of no return, making it totally impossible to go back to the Jovian region of space. But I paid little attention. I was Outbound now, and there would never be any going back.

Another decade's worth of time elapsed in surreal ease, and at the end of that, another micrometeoroid shower hit. But I'd secured the vital systems before putting myself into the computer, and the effort paid off. Nothing important was damaged, though the hydroponics and other life support systems would never operate again—too many micro-holes.

I wondered why my messages, which I had been casting ahead of me like rocks across a pond, garnered no response.

Maybe that was just the nature of being Outbound—never

reveal yourself until it's absolutely necessary.

At the twenty-ninth year since leaving Jupiter, I should have felt excited and nervous with anticipation.

I felt only lingering ghosts.

I never saw the other ship.

One moment I was alone in space. The next moment a fifty-meter-wide wedge was matching course and speed—which was no small feat.

I politely lobbed radio hellos at the wedge, anticipating a reply. But all the wedge did was spit out a dozen, tinier wedges, each of which fell on the observatory like fleas on the ass of a fresh dog, and suddenly I was struck by the notion that I'd been baited into a colossal trap.

Each of the small wedges touched down and disgorged a series of spider-like drones that began scrambling into the observatory's interior, cutting through metal and rock as easily as a hot knife through butter.

My hello calls became pressed, and then frantic. The spiders blindly ignored my efforts and sped towards the hole where I'd stashed the memory arrays. My cameras and other senses followed them, and I'd have screamed if I'd still felt the kind of visceral panic necessary.

I remember one last camera view, overlooking the arrays. I watched a spider that climbed on top of my databanks, hungrily rubbing together its claw-tipped forelegs, then I sensed my

mind fissioning into separate parts—which seemed like the worst kind of insanity imaginable—then merciful blackness.

Reactivation was bothersome, because they wouldn't let me see, hear, or sense anything. Not at first. All I got was the impression that someone needed me to be patient, so I waited, tasting the quality of my thoughts and finding them . . . truncated. Limited. The absolute speed and precision of the observatory's databanks was missing. It felt like . . . It felt like?

When I finally opened my eyes—?!—I was greeted by several different faces, all of which appeared concerned. I sat up and looked at the Outbounders, each of whom was dressed in what I took for medical gowns, though the room in which they'd placed me was remarkably warm and free from anything even approaching a scalpel or other menacingly surgical object.

"I'm Doctor Hastel. How do you feel?"

That was one of the women, who looked about forty.

"I'm not sure yet," I said. "How did you . . . put me back?"

"It's a long explanation," said one of the men, an Asian fellow in his thirties who identified himself as Surgeon Chow. "Here, I'll make it simple for you."

He never moved, but there was a sudden mind jolt, like the ones I'd gotten from Howard's memory array. In the space of a single second, I suddenly understood everything about the Outbounder procedure. They'd cloned me, using tissue from the frozen corpse they'd found in the observatory's recording room. Inside my clone brain they'd installed a new organ: a direct-

connect interface. They'd used it to slowly trickle my cerebral matrix into the clone brain while the clone body grew.

Now that I was awake, the direct-connect would allow me to access their public network—once they deemed it safe for me to do so. I still had a lot to learn before I could get out of the hospital.

All of this knowledge arrived in my consciousness with a cool surety, as if I'd always known such things. But I felt a tight thrill run down my spine while I looked down at my legs.

"Fully functional?" I asked.

"Yes," Hastel said, with a small smile. "Were they not before?"

"No," I said. "Paraplegic."

"We've gotten a few of those," she said. "Easily fixed."

I dared to try to move my legs, which had been useless my entire life, and discovered I didn't really know how. If I concentrated, though, I could feel the sensation of the air cycler's gentle current across my thighs, such that it created tiny goose bumps.

I felt delirious with sudden joy, tears leaking from the corners of my eyes while I smiled broadly.

My mind began to burst with questions.

"All in good time, Mr. Jaworski," said Chow. "We're sorry we had to keep you off-line for so long. Even with advanced gen, it takes years to grow a clone body to the decanting stage.

You were put into the queue as soon as possible."

One of the other women, a younger and freckly redhead, asked the next question.

"I'm Surgeon's Assistant Keilor. What would you like to know first?"

"Can I . . ." I stopped to really think about it. Then I said, "Can I get something to eat, please?"

The entire group smiled widely.

I looked around. "Is that the right answer?"

"You bet," Keilor said, taking my hand.

Another mind jolt, directly from her.

I slid off the table and discovered I knew how to walk.

The Outbound were far more numerous and sophisticated than I'd expected them to be. While the solar system had gone about its myopic, self-centered business, the Outbound had secured great whacks of the Kuiper Belt, both for mining and colonization. Eventually they'd erected a monitoring network that had, at first, been designed to keep an eye on the rest of humanity that lived "down in the hole," as I'd learned they called everyone who lived inside the orbit of Neptune.

It was this grid that had first detected the Others, who had apparently erected a monitoring network of their own, dating back to the twentieth century.

Things sort of snowballed from there.

Exchanging information and technology with the other sentient species of nearby star systems, the Outbound rapidly outpaced those of us “down in the hole,” so that the Outbound were able to easily mask their gradual takeover of the Kuiper.

None of the Outbound had been surprised by the outbreak of war. They’d seen it coming for many years. The wedge-shaped ship that had intercepted the observatory had been one of numerous, automated picket craft designed to intercept anything sent from the solar system, and determine if it was friendly or hostile. Had I been one of the killsats or any other hostile entity, I’d have been destroyed. But once they found my memory arrays and determined that I was benign, they pulled the arrays, sampled tissue for cloning, returned both the arrays and the sample to a safe harbor, and the rest was history.

The observatory, along with the bodies of Howard and Tabitha, was allowed to continue on its eternal journey towards the vastness of the faraway Oort.

I bided my time as just another adolescent Outbounder: lounging around in the public spaces, getting used to my new body and its revelatory mobility, and playing on the direct-connect system. Hundreds of thousands of minds, most human, a few alien, all feeding into and interconnected by a vast, peer-based sharing system that was serverless and extended as far as communications equipment could make it go. Not quite a pooled mind, since everyone kept up their privacy barriers, but there was enough crossover for us to learn and access so much information that it was like digesting an entire college semester

every day of the week.

I also managed to stay in touch with the freckly redhead from the clone center. Physically, Colleen Keilor was a good bit older than I was, but age didn't seem to matter much to Outbounders.

Col and I got along quite well.

A couple of years after I awoke among the Outbound, their Quorum announced its intention to begin reclamation of the solar system. The Quorum asked for volunteers to spearhead the effort, which would involve not only cleaning out all the killsats that still prowled between the planets, but a partial terraforming of the wasted Earth.

It would be a protracted effort—the greatest challenge of the Outbound Age.

Col and I signed up immediately.

Irenka Elaine Jaworski-Keilor was born in the midst of the Inbound flight of the First Reclamation Flotilla. Bright-eyed, and with a face and smile that seems eerily familiar, she brings my wife Col and me a great deal of joy. Once, Irenka would have seemed an impossibility. But through the years of changing diapers and teaching her to read and write and do math and use direct-connect, I gradually accepted the fact that impossibilities are routine in my new, expanded reality.

We reached Jupiter, and found the scorched remains of the old settlements. The killsats were waiting too, but we made short work of them, radioing our progress back to the Second

and Third Flotillas that were launched in our wake.

There's work aplenty for the new inhabitants of the solar system.

I hope that some day I can take Irenka down to Earth and show her a world I once called home, and which, hopefully, with a lot of fixing, might be called home again.

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