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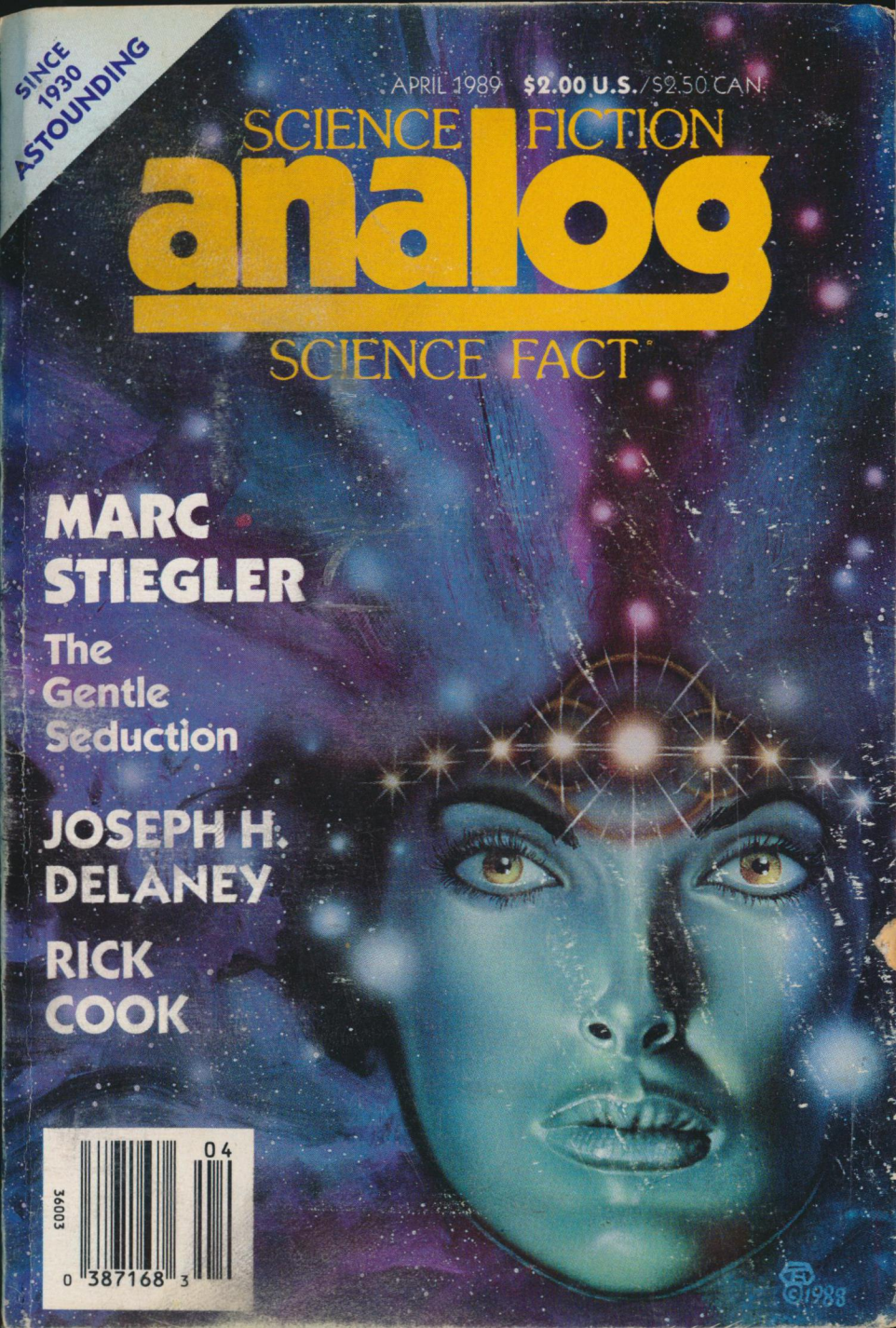

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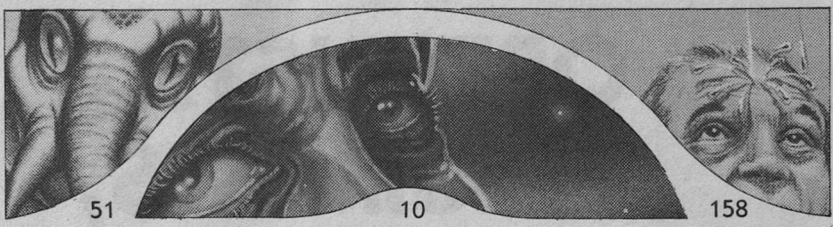

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Indicia on Page 6

Editorial

OPTIMISTS, PESSIMISTS, AND SURPRISES

Stanley Schmidt

One of the dubious pleasures of an *Analog* editor's life is the occasional irate letter from a reader complaining that we push an "*Analog* line" that happens to disagree with some aspect of that reader's philosophy. The accusation is particularly ironic since (a) they sometimes come from readers whose views are sharply divergent, and (b) *Analog* itself not infrequently publishes views that directly contradict each other —sometimes within the same issue!

In this month's "Reference Library," for instance, Tom Easton begins, "Science fiction readers all know that the world is going to hell in a handbasket. . . ." In last month's "Alternate View" (which reached my desk on the same day), G. Harry Stine concluded, "I have bad news for the environmental pessimists: we're going to live after all." You can't get much more opposite than that!

Which is "the *Analog* line"? Neither; there ain't no such animal. Which (if either) is the truth? Neither Tom, Harry, nor anyone else of my acquaintance *knows*. In a strictly literal sense, Harry's quote disproves Tom's: Harry is a science fiction reader, and he does not believe the world is going to hell in a handbasket. Q.E.D.

But that only proves that at least one science fiction reader doesn't believe it—which is not at all the same thing as proving that it isn't true. If it *is* true that the world is going to hell in a handbasket, we need to know about it, and do something about it, in time to change course before we get there. (Which, of course and ironically, would make Harry's view ultimately the correct one).

The fact is that both statements about the future are *opinions*, in the strict sense of "belief about a fact based on incomplete or uncertain knowledge." What really happens in the future will depend on what problems people will face and what actions they will take to deal with them. We know quite a bit about what problems we face and what we are doing *now*, and extrapolating that data *suggests* things about what we are likely to be up against and what we are likely to be doing in at least the near future. But extrapolation is always a tricky business, and the real world is under no obligation to cooperate with our guesses about what it's going to do next (beyond following physical laws). Tom Easton and G. Harry Stine are both intelligent men who have looked at a lot of data, but they see the data differently. Their views of the future are *informed* guesses, but they are guesses nonetheless.

If such statements about the future are no more than informed guesses, are they worth making at all? Probably so. It's frustrating to base actions on incomplete and uncertain knowledge, but usually necessary. Complete, 100% certain information is a very scarce commodity, and often it is necessary to do *something* in an effort to stave off disaster. Although Harry is right that complicated systems often find their own ways of correcting imbalances, Tom is also right that some problems will get out of hand if nothing is done about them while they're still of manageable size. (Ask somebody involved in fighting forest fires at Yellowstone last summer!) So it's only prudent to try to recognize those problems and do the best thing you can think of to deal with them, based on such knowledge as you have.

Tom laments the fact that business and government think of long-term planning in terms of months or years instead of decades or centuries. Probably most people reading this would agree that it would be refreshing, and improve our chances, if business and government would look decades or centuries down the road in making today's decisions. But *could* they, in a meaningful way, even if they wanted to?

Imagine yourself living fifty years ago and trying to lay out a long-range master plan for the next century. Already, before 1989 (only halfway through), your plan would have diverged wildly from reality. Among many other things, you would have failed to anticipate the microchip and AIDS. One is a new tool to use in solving problems (with the usual side effect of creating some new problems in the process); the other is a new problem in itself. One is a fundamental and unexpected technological breakthrough (remember, a truly fundamental breakthrough, by definition, *cannot* be deduced from preexisting knowledge); the other is a new factor introduced unexpectedly from outside. Both are *surprises*—things which could not reasonably have been anticipated at the time the long-range plan was made. Both have already had large effects on how people live, and promise to have still larger ones in the future—which would demand sizable modification of the original plan. And

they are not unique. Nature and history are full of such surprises.

How do you cope with surprises in long-range planning? To what extent is it worthwhile to try?

There's not a lot you *can* do except try to anticipate everything you can and be prepared to change the plan when a new factor enters the picture. You can't prescribe in advance a detailed solution to a problem you didn't even know could exist. You can't give detailed instructions for every possible use of a tool you didn't know could be built. But you *need* to try to anticipate as many contingencies as you can—both problems and what you would do about them, and tools and how you could use them.

There is, of course, one field of think-

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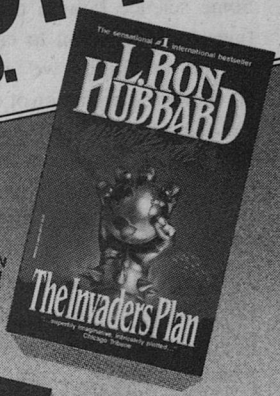
IT WON'T LET YOU GO.



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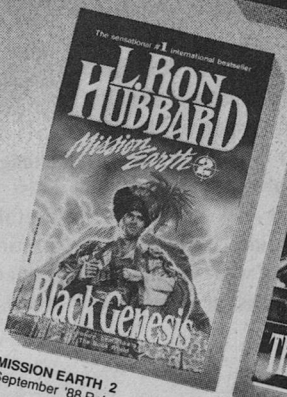

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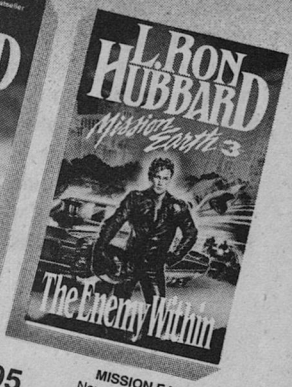

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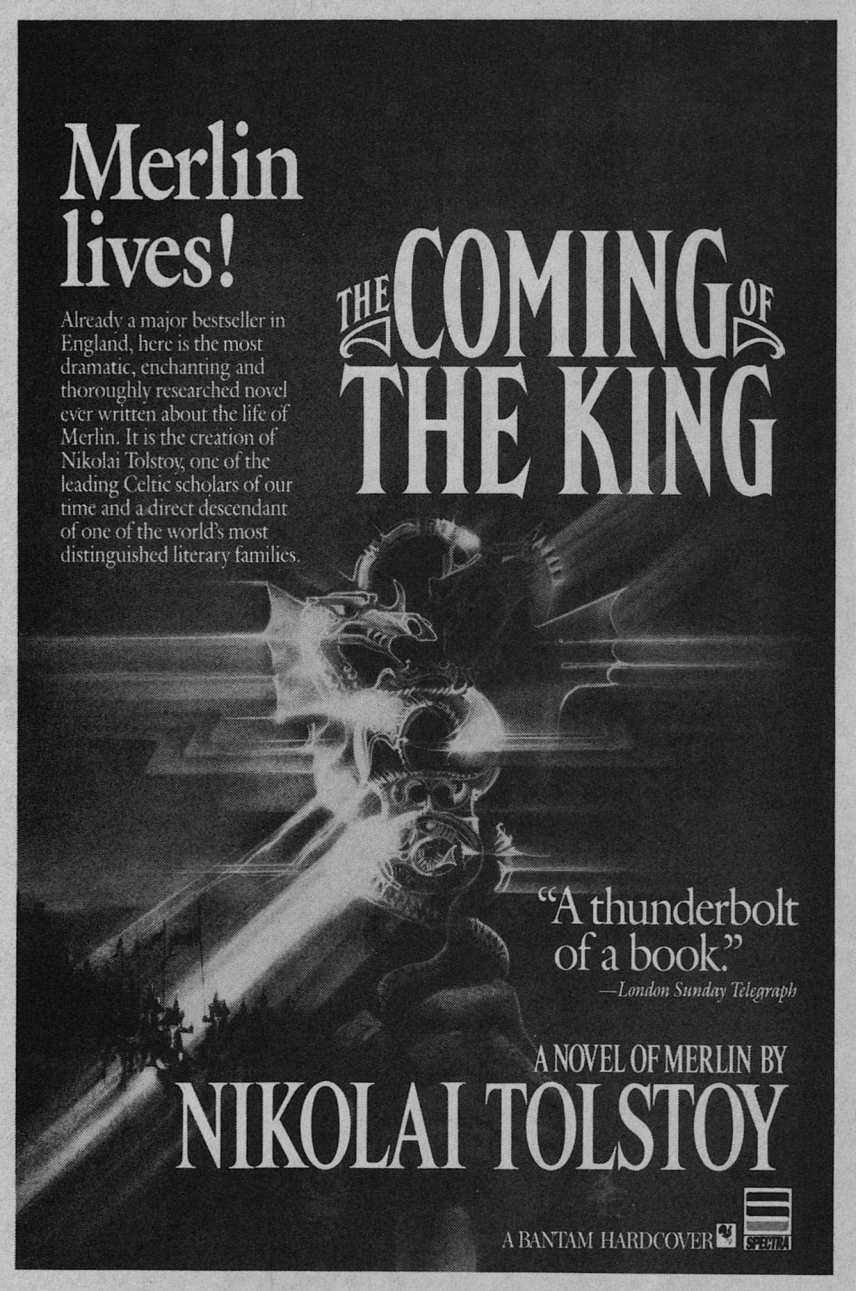
ing which can and does attempt to anticipate both problems and solutions beyond those which can be rigorously extrapolated. It's called science fiction, and it's what this magazine is all about. Some science fiction, of course, confines its speculation to careful extrapolation of things we already know about, and examination of directions our very near future might reasonably take. There are purists who would like to see it do *only* this, and avoid subjects like time travel or faster-than-light travel which do not emerge naturally from what we already know about science. But confining science fiction so narrowly would defeat one of its greatest potential benefits. Certainly it's important and worthwhile to explore the near-term consequences of what we already know—but it's also important to remember that we don't know *everything* yet, and that not only technology but science itself can and does surprise us. If science fiction confined itself only to direct extrapolations of what we already know, it would be almost as unrealistic as if it made no attempt to work within a logically and scientifically consistent framework. It is possible to postulate fundamental innovations in such a way that they do not contradict present *knowledge*, though they may contradict untested parts of present *theory*. A science fiction writer who can do so may give us not only a good piece of entertainment, but a chance to think about what we would do if we met a type of problem we have no reason to expect—but may someday meet anyway.

Despite their best efforts, though, I don't doubt that the world will continue to surprise us—sometimes with problems we had no reason to expect, sometimes with new ways to solve them. Because of that, both optimists and pessimists would do well to remember that everything they conjecture is subject to change without notice. In the last analysis, *either* optimism or pessimism is useful—a survival trait—only insofar as it stimulates efforts to steer us away from deadly futures and toward brighter ones. ■

●The most savage controversies are those about matters as to which there is no good evidence either way.

Bertrand Russell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THE GENTLE SEDUCTION

Marc Stiegler

Teaching is a form of sharing—
and it does not flow in only one direction.

Todd Cameron Hamilton

He worked with computers; she worked with trees, and the flowers that took hold on the sides of the Mountain.

She was surprised that he was interested in her. He was so smart; she was so . . . normal. But he was interesting; he always said something new and different; he was nice.

She was twenty-five. He was older, almost thirty-three; sometimes, Jack seemed very old.

One day they walked through the mist of a gray day by the Mountain. The forest here on the edge of Rainier glowed in the mist, bright with lush greens. On this day he told her about the future, the future he was building.

Other times when he had spoken of the future, a wild look had entered his eyes. But now his eyes were sharply focused as he talked, as if, this time, he could see it all very clearly. He spoke as if he were describing something as real and obvious as the veins of a leaf hanging down before them on the path.

"Have you ever heard of Singularity?" he asked.

She shook her head. "What is it?"

"Singularity is a time in the future as envisioned by Vernor and Vinge. It'll occur when the rate of change of technology is very great—so great that the effort to keep up with the change will overwhelm us. People will face a whole new set of problems that we can't even imagine." A look of great tranquility smoothed the ridges around his eyes. "On the other hand, all our normal, day to day problems will be trivial. For example, you'll be immortal."

She shook her head with distaste. "I don't want to live forever," she said.

He smiled, his eyes twinkling. "Of course you do, you just don't know it yet."

She shuddered. "The future scares me."

"There's no reason to fear it. You'll love it." He looked away from her. His next words were bitter, but his tone was resigned. "It pisses me off that you'll live to see it and I won't."

Speaking to the sorrow in his voice, she tried to cheer him. "You'll live to see it, too," she replied.

He shook his head. "No. I have a bad heart. My father died young from a heart attack, and so did my father's father. If I'm lucky, I have maybe thirty more years. It'll take at least a hundred years for us to get to Singularity."

"Then I'll be dead before it happens, too. Good," she said.

He chuckled. "No. You'll live long enough, so that they'll figure out how to make you live long enough so that you can live longer."

"You're still only seven years older than I am."

"Ah, but you have your mother's genes. She looks very young."

She smiled, and changed the subject. "I'll have to tell her you said that. She'll like it."

There was a long pause. Then she confessed, "My grandfather is ninety-two, and he still cuts the grass every week."

Jack smiled triumphantly. "See?"

She was adamant. "I'll live to be eighty or ninety. I don't want to live longer than that."

"Not if you're crippled, of course not. But they'll find ways of rejuvenating you." He laughed knowingly.

"You'll look older when you're 60 than when you're 120," he said.

She just shook her head.

Another time, as they walked in the sun along the beach of Fox Island, he told her more about the future. "You'll have a headband." He ran his fingers across his forehead; he squinted as the wind blew sand in his eyes. "It'll allow you to talk right to your computer."

She frowned. "I don't want to talk to a computer."

"Sure you do. At least, you will. Your computer will watch your baby all night long. If it sees something wrong, it'll wake you." Wicked delight widened his smile, and she knew he would now tell her something outrageous. "While you're lying in bed with your eyes closed, you'll look at your baby through your computer's TV camera to see if it's something serious."

"Ugh."

"Of course, there's a tiny chance, really tiny, that an accident could scramble your memories."

The thought made her dizzy with horror. "I would rather die." She grabbed his arm and pulled him under the bridge, out of the wind. She shuddered, though unsure whether her chill came from the wind or the fear.

He changed his tack. Pointing at a scattering of elaborate seaside mansions across the water, he asked, "Would you like to live in one of those?"

She studied them. "Maybe that one," she said, pointing at a beautiful old Victorian home. "Or that one." She pointed at another, very different from the first, a series of diagonal slashes with huge windows.

"Have you ever heard of nanotechnology?" he asked.

"Uh-uh."

"Well, with nanotechnology they'll build these tiny little machines — machines the size of molecules." He pointed at the drink in her hand. "They'll put a billion of them in a spaceship the size of a Coke can, and shoot it off to an asteroid. The Coke can will rebuild the asteroid into mansions and palaces. You'll have an asteroid all to yourself, if you want one."

"I don't want an asteroid. I don't want to go into space."

He shook his head. "Don't you want to see Mars? You liked the Grand Canyon; I remember how you told me about it. Mars has huge gorges—they make the Grand Canyon look tiny. Don't you want to see them? Don't you want to hike across them?"

It took her a long time to reply. "I guess so," she admitted.

"I won't tell you all the things I expect to happen," he smiled mischievously, "I'm afraid I'd *really* scare you. But you'll see it all. And you'll remember that I told you." His voice grew intense. "And you'll remember that I knew you'd remember."

She shook her head. Sometimes Jack was just silly.

They fell asleep in each other's arms often, though they never made love. Sometimes she wondered why not; she wondered if he also wondered why not. Somehow it just didn't seem important.

He seemed so at home in the deep forest, he so clearly belonged on the Mountain, she first thought they might stay together forever. But one day she went with him to his office. She watched

as he worked with computers, as he worked with other people. He was as natural a part of their computer world as he was a part of her Mountain world.

Working in that alien world, he was a different person. In the woods, he was a calm source of sustaining strength. Here, he was a feverish instructor. His heart belonged to the forest, but his mind, she realized, belonged to the machines that would build his vision.

One day he received a call. A distant company gave him an offer he could not refuse. So he went to California, to build great computers, to hurry his vision to fruition.

She stayed by the Mountain. She walked the snows, and watched the birds fly overhead. Yet no bird flew so high that she could not climb the slopes of Rainier until she stood above it.

He would come to visit on weekends sometimes, and they would backpack, or ski cross-country. But his visits became less frequent. He would write, instead. That too decreased in regularity. One letter was the last, though neither of them knew it at the time.

A year passed. And by then, it just didn't seem to matter.

She married a forest ranger, a bright, quiet man with dark eyes and a rugged face. They had three small children and two large dogs, friendly dogs with thick soft fur. She loved all the members of her family, almost all the time; it was the theme that never changed though she thought about different things at different times.

Her children grew up and moved away.

Erich, the beautiful red chou, went to sleep one night and never awakened.

A terrible avalanche, from a seemingly safe slope, fell down the Mountain and buried a climbing team, her husband among them.

Haikku, her mighty and faithful akita, whimpered in his old age. He crooned his apology for leaving her alone, and that night he joined Erich and her husband.

She was eighty-two. She had lived a long and happy life. She was not afraid to die. But she stood outside in the snow and faced a terrible decision.

Overnight, a thick blanket of new white powder had fallen, burying her sidewalk. Standing in the snow, she stared at a mechanical beast her children had given her years before. It represented one possible choice.

In one hand she held a shovel. In the other hand she held a small capsule. The capsule was another gift her children had given her. They had begged her to take it. Until now, she had refused. The capsule represented another choice.

Her back was aching. It was an ache that sometimes expanded, shooting spikes of pain down her legs. Today the pain was great; she could not shovel the sidewalk.

The mechanical beast was a robot, a fully automatic snow remover. She could just flip a switch and it would hurl the snow away, but that seemed grotesque; the noise would be terrible, the mounds of thoughtlessly discarded snow would remain as an unseemly scar until late spring.

She opened her hand and looked at the capsule. It was not a pill to make her younger; that much her children had

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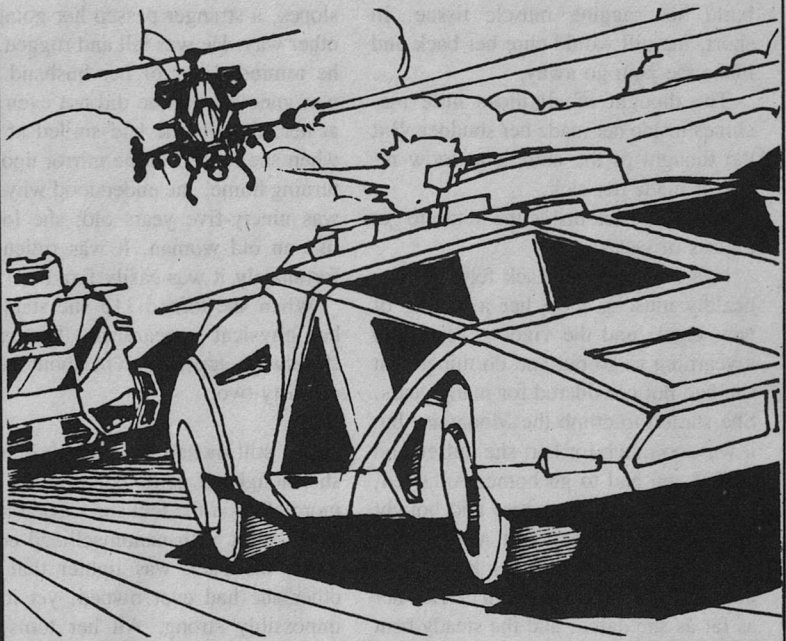

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promised her. They knew she would reject such a thing out of hand. But the millions of tiny machines tucked inside the capsule would disperse throughout her body and repair every trace of damage to her bones. They would also rebuild her sagging muscle tissue. In short, the pill would cure her back and make the pain go away.

The thought of all those little machines inside her made her shudder. But the thought of the automatic snow remover made her sick.

She went back inside the house to get a glass of water.

In a few days her back felt fine; her healthy muscles gave her a feeling of new vigor, and the vigor gave rise to a yearning to go out and do things that she had not considered for many years. She started to climb the Mountain, but it was too much for her: she huffed and puffed and had to go home. Annoyed, she went to the drug store and bought another capsule, one that restored her circulatory system and her lungs. Her next assault on the Mountain carried her as far as she dared, and the steady beat of her heart urged her to go on despite the crumbling snow.

But she was getting increasingly forgetful. Things that had happened years earlier were clear in her mind, but she could not remember what she needed at the store. One day she forgot her daughter's telephone number, and found that she had forgotten where she had misplaced the phone book. The store had another capsule that tightened up her neural circuitry. After taking it, she discovered a side effect no one had bothered to mention. The pill did not merely make her memory effective again; rather, it made her memory perfect. With a brief glance through the pages of the phone book, she found she no longer needed it. She shrugged and continued on with her life.

One day as she skied across the slopes, a stranger passed her going the other way. He was tall and rugged, and he reminded her of her husband. She was annoyed that he did not even look at her, though she had smiled at him; when she looked in the mirror upon returning home, she understood why. She was ninety-five years old; she looked like an old woman. It was ridiculous; fortunately it was easily fixed.

When she turned 115 she stabilized her physical appearance. Thereafter, she always appeared to be about the age of thirty-two.

She still owned the snug little house she thought of as home. But she slept more often in the tent she carried in her pack. Built with nanomachined equipment, the pack was lighter than any other she had ever owned, yet it was impossibly strong. All her tools performed feats she would once have thought miraculous, and none weighed more than a pound. She lived in great comfort despite the inherent rigors of the glacier-crusted slopes.

One day, she was climbing along the ancient trail from Camp Muir toward the summit, crossing the ridges to reach Disappointment Cleaver. As she stepped over the last ridge to the broad flat in front of the Cleaver, she saw a man standing alone. He was staring up the steep ice flows overhead. He stepped backward, and backward, and turned to walk briskly in her direction. She con-

tinued forward to pass him, but he cried out, "Stop!"

She obeyed the fear in his voice. He paused, and his eyes came unfocused for a moment. He pointed to the right of the ridge she had just crossed, a fin of rock rising rapidly along the Mountain's edge. "Up there," he said, "Quickly." He broke into a hobbling run across snow that sometimes collapsed under his heavy step. She followed, her adrenalin rising with her bewilderment.

A massive *Crack!* filled the air. Far above the Cleaver, an overhanging ledge of ice snapped off and fell with an acrobat's graceful tumbling motion to the flat where they had just been standing. The mass qualified as a large hill in its own right. When it landed it broke into a thousand huge pieces. Some of the pieces ground each other to powder, while others bounced off the flat, down another precipice of several thousand feet, to crash again in a duller explosion of sound.

The ice fall was an extraordinary event to witness under any circumstance; the narrowness of escape from death that accompanied it overlied the experience with a religious awe.

She heard the man panting next to her. She turned to study him more carefully.

He was unremarkable for a mountaineer; his lean form supported long straps of hard muscle, and the reflected sun from the glaciers had given him a coffee-colored tan. Then she noticed the sweatband across his head. It was not just a sweatband: she could see from the stretch marks that a series of thin disks ran across within the cotton layers. She realized he was wearing a *nection*, a headband to connect his mind with distant computers.

She recoiled slightly; he smiled and touched his forehead. "Don't be too upset," he said, "my headband just saved your life."

She stuttered. "I wasn't upset," she said, though she knew that he knew she was lying. "I've just never seen one up close before."

It was true. Her grandchildren told her that nections were quite common in space, but on Earth they were almost illegal. It was socially unacceptable to wear one, and when the police saw a nection-wearing person they would use any excuse to hassle the individual. But there were no specific laws against them.

When her grandchildren had told her that *they* wore headbands all the time, she had tried only briefly to dissuade them; she had spent more time listening to their descriptions of the headband's capabilities. Her grandchildren's description sounded considerably different from the list of dangers usually described on the news.

The man who had saved her life watched her for several more seconds, then apparently made up his mind about something. "You really ought to get one yourself, you know. Do you realize how dangerous this mountain is? And it's getting more dangerous every year."

She started to tell him that she knew perfectly well how dangerous it was —then stopped, thinking back over the years, realizing that it *had*, by gradual degrees, grown worse every year.

"With my headband, I see things better," he explained. "I confess I don't

understand why very well—I mean, it doesn't affect my eyesight. But I notice more things about what I see, and I can get a view of what the extra things mean—like how that piece of ice would fall, and more or less when."

She nodded her head, but her mind was distracted. The Mountain *was* changing! The Mountain *was* getting more dangerous! The rapid alternation of clear, sunny days with cool, misty days had become more vigorous over the course of the last fifty years, leading to more weak layers and ice faults. She had never really noticed until now.

Then the full impact of her savior's words struck her—she held her hands to her throat as she considered how her husband had died. She realized that, with a nection, his death could have been prevented.

She smiled at the man. They talked; she invited him to dinner at Alexander's.

When she returned home, she started searching through electronic equipment catalogs. If she bought one mail order and wore it only while hiking, there was no reason for any of her friends ever to know.

It was a simple white headband, soft absorbent cotton. She slipped it on her head, expecting to feel something special, but nothing happened. She started to clean the house, still waiting for something to happen. It never did. Eventually she sat down and read the instructions that had come with the headband.

The instructions told her to start with a simple request, and to visualize herself projecting the request at her forehead. She projected the request, "two times two?" just above her eyes. Nothing seemed to happen. She knew the answer was four.

She tried again, and this time she noticed a kind of echo—she knew the answer was four, but the thought of the answer came to her twice, in rapid succession. The next time she tried it, she noticed that the echo seemed to come from her forehead.

Next she projected a request to divide 12345 by 6789. She didn't know the answer—but wait, of course she did, it was 1.81838. Of course she didn't know the answer to many decimal places—but as she thought about it, she realized the next digit was 2, the next was 6, then at an accelerating pace more digits roared from her memory—she shook her head, and the stream stopped. She took the headband off, shaking a little. She didn't try it again until the next day.

A week later, she hiked past Camp Schurman and peered up the slope. She projected her view of the slope through her forehead to study the patterns of snow and ice.

It did indeed look different as she looked at it this way. She had a sensation similar to that of looking at the edges of a cube on a sheet of paper: at one moment, the lines formed a cube with the top showing. The next moment it was an alternate cube with the bottom exposed. She could flip the cube, or at least the way she looked at it, at will.

In the same manner she could now see patterns of slippage in the layers of ice crystals; then she would flip the image and it was just snow, the beautiful work of nature that she had loved all her life.

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For a moment she wished she could see it from above as well—and her heart skipped a beat as the wish came true. Suddenly she was looking down from a great height. She saw the long curves of shadows across the snow from high above, and she saw the shorter but distinctive shadow of a woman with a pack standing on the snow field. She threw the headband to the ground even as she realized what she had just seen: a view of the Mountain from a satellite passing by.

She stared at the white headband, almost invisible in the white snow, for a long time. She felt distaste, wonder, fear, and curiosity. Curiosity finally won out. She twisted the headband back on. She blinked her mind's eye, blinking from her own eyes to the satellite's eyes and back again, a moment's taste of the new sensation.

Vertigo struck her. Though the satellite was interesting, it was not comfortable. She would not look at the world from a satellite's height often, but it was yet another life-saving form of sight: From a distance, it was easy to spot a depression in the snow that might signal an underlying crevasse, even though the depression was too shallow to be seen close up. Such crevasses were invisible until one stepped through to a long fatal plunge to the Mountain's heart.

The headband was so clearly a life-saving tool; why were people so set against it? Why did some of her friends support laws proscribing it?

It didn't make any difference; she had no need of it except here on the Mountain.

* * *

Though the fight over the headband's legal status did not at first interest her, it became an increasing impediment to her life. The headband was quite useful in a number of ways; though each individual use was trivial, in sum they qualitatively affected her life. She stopped tracking her checkbook; it was all in her head, all the transactions, the current balance, and even the encumbrances. When she awoke in the morning she could turn on the coffee pot if she wanted to, without getting up.

She wore her headband while hiking, and while working around her house; but she dared not wear it to work. One day an ecologist asked her a question about the marmots that inhabited the park. She grew angry as she had to manually root through the computer systems trying to find the answer, for she knew that the answer was available for the mere thinking about it if she could wear her headband. That night she stopped at the drugstore and bought two more capsules.

She swallowed one. This capsule was nastier than the others she had taken in earlier years. Before, the nanomachines she had swallowed had gone through her body, fixing what was not right, then flushing themselves out again. But the machines in this one would build, just under her forehead, a subcutaneous nection.

The other capsule would dissolve the nection away if she decided she didn't like it.

When she awoke the next morning she was very hungry. She felt her forehead, but there wasn't anything there.

The next morning she felt her forehead again, and it was . . . different.

She looked in the mirror; with the flickering double vision of her eyes and the analysis from her forehead, she could see on the one hand that she looked the same as always. Yet on the other hand, there were curves there she hadn't noticed before. When she went in to work, one man complimented her on her new hair color.

No one else commented until her boss arrived. When he entered the reception area and looked at her, his eyes lit up, and he laughed.

She looked at him with mild annoyance. Then she noticed, again with her double vision, that there were very shallow curves in *his* forehead.

He came up close, and put his finger to his lips. "Listen," he said.

She listened. As she concentrated, she heard soft murmurs in the background; as she focused on the murmurs, they grew louder, until she could hear that he was speaking—but not with his lips, not through her ears. She heard him through her forehead. "Welcome to the gang," he said. "Isn't it great fun, joining a rebellion? I haven't had this much fun since I was a teenager."

They both broke into laughter. Everyone else in the room wondered what the joke was about.

She talked to her children, and her children's children, more often now; though they were spread from Mars to Mercury, they were but a thought away. It surprised her to realize that the simple process of dialing the number, and the uncertainty of whether or not she would get through, had often put her off even though the cost of calling had plummeted in recent years till it was virtually free.

She became increasingly comfortable with her distant grandchildren. Through visual links like the one she had with the satellite, they took her on outings into the stunning naked beauty of their home planet Mars. When they asked her for the hundredth time to come for a visit, she agreed.

In her youth she had ridden trains across the country. She had expected the space trip to be the same, but it was not. The ship was far more comfortable than any other vehicle she had ridden; it was more comfortable than her own home, though she still did not quite like it as well.

When she arrived, she found she loved to hike across the plains and the canyons of an unknown planet. She walked amid forests of alien trees, related to the Earthly trees from which they had been shaped, yet different. Comparing the lands of Mars to the lands of Earth reminded her of watching the sun set two days in a row: though the outcome was the same, the process was nevertheless different. The strange wilderness yielded for her new kinds of solitude.

She came to know her grandchildren's children for the first time. Before, these children had represented an unspoken, uncomfortable complication in her thoughts of Mars. They were *different*. They were of her blood, but not in the manner of normal children. They had been genetically engineered.

Her grandchildren had designed them, giving them a parent's loving care long before they had even been conceived. Only the best characteristics of her fam-

ily had been passed on; she did not know how the other aspects of these radiantly happy children had been chosen. They were very different from her, but not quite alien. With time, she learned to love them as they loved her.

One day they went on a longview picnic. First they walked to the high edge of a deep canyon. She looked over the rim. The height was not great by comparison with the distances in space she had traveled to come here. Yet *this* distance impressed her. It impressed her because she could appreciate it: thousands of tiny twists and angles of rock acted as signposts, allowing her to mark off the immense distance in tiny steps. She shook her head, smiled, and stepped over the edge.

Together with her family, she descended gently on suspensors; their picnic basket and wine glasses descended with them, on suspensors of their own. They watched the planet come up to meet them as they dined and chatted.

The discussion turned to the family's upcoming expedition to Jupiter. They had asked her several times to come along, but she had refused. Now they asked her again. She watched the extraordinary scenery float past her and considered the question one last time. A trip to Jupiter would have been all right if it could have been like Mars. But it could not, and that was both the attraction and the horror.

Though humanity had made Mars Earth-like, they could not do the same for Jupiter. Jupiter's methane oceans simply were not amenable to terraforming. No one could go there in person.

To see Jupiter she would, in a sense, have to leave her body. Oh, she wouldn't have to leave it very far; indeed, in one sense she would stay with her body on Mars throughout the journey. But just as she had seen Rainier through the satellite's eyes rather than her own, just as she spoke to her friends with her headband rather than her voice, now she would have to use her headband for all her senses.

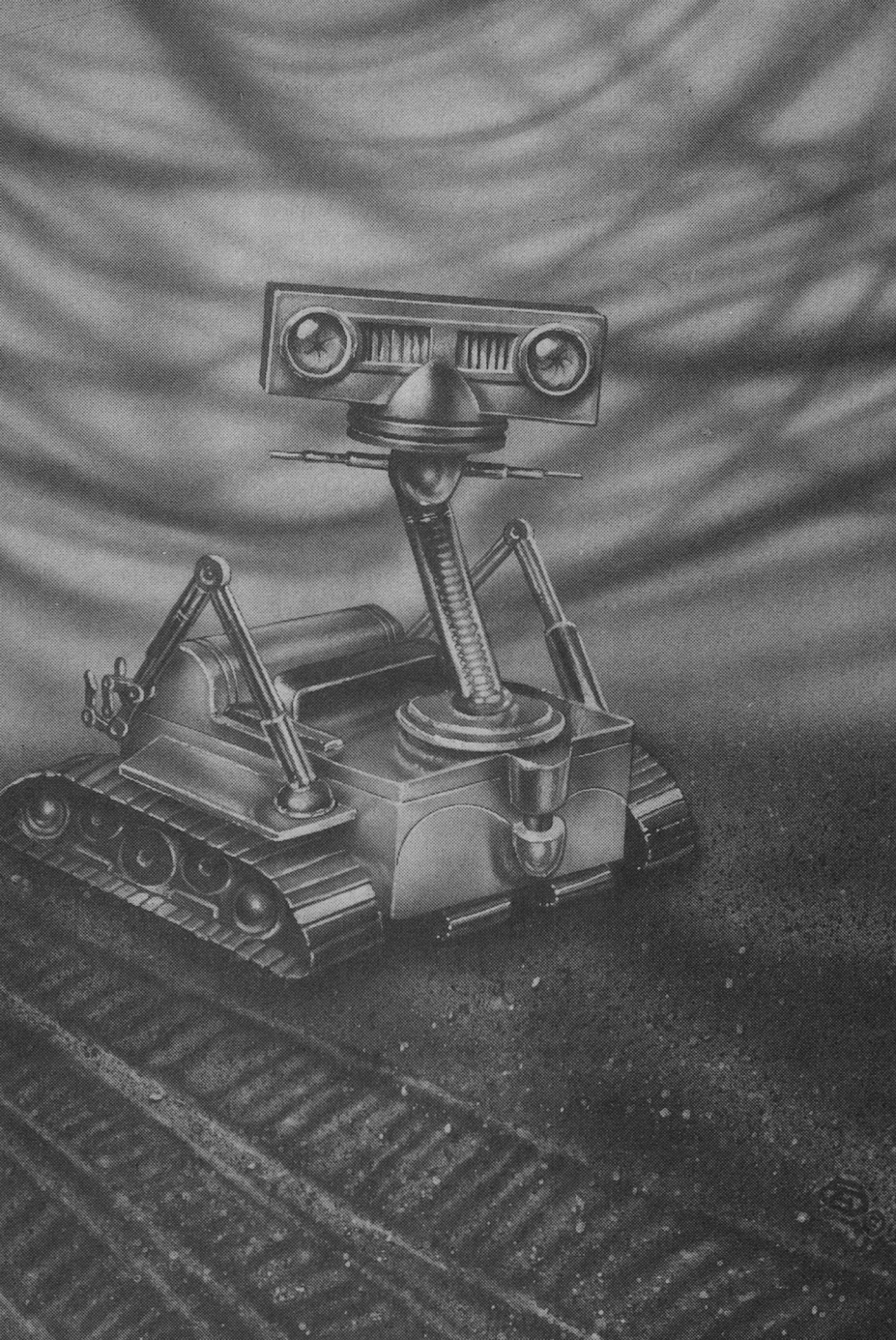
And the machine would not merely *replace* her sight, her hearing, her touch, her smell—it would *transform* them. Ordinary sight and sound did not work on Jupiter; for each of her old senses a new one would be substituted. She would see ultrasonic vibrations; she would smell ionic changes. For all intents and purposes, she would live as a being designed for the comforts of Jupiter's titanic gravity well.

Of course, she would not be marooned there: she could leave at any time.

The pleasure of her experience on Mars made her confident; the quiet exhilaration of the longview picnic made her bold. She agreed to go along.

For a moment it was dark, a moment too short to launch the panic she held in trip-wired readiness. Then there was light, a confusing light that seemed oddly related to the sounds that joined it. She held up her hands. They were metal, and she looked at them in alarm. She closed her eyes, and it was better.

The strange sounds took on rhythm. Instinctively she turned toward them, and her back feet rotated, propelling her closer. When she felt she was too close—she could smell the source of the sounds now, a tangy, pleasant odor—she



opened her eyes. Studying the shape as it wavered before her, seemingly separated by shimmering air, she realized it was another robot like herself. Indeed, she recognized it: she was looking at her granddaughter.

She looked around and had a sudden overwhelming sensation of immensity.

The hugeness of space had seemed dwarfed by the height of the Martian canyon, for she had been able to comprehend it through the tiny weathered etchings of rock she could peer at in the distance. Here on Jupiter her comprehension was even greater, for her senses ranged distance with new clarity. The ultrasonic echoes told her how far it was to each whorl of current she could see; she could see to distances very great indeed. It made her think of the way she had felt as a child, looking across a vast Kansan plain for the first time. It seemed as if infinity was right *there*, within easy reach. She reveled in it for a moment, then stepped out.

She was back in her own body again, sitting on Mars.

She dipped back in for ten minutes and stepped out again. Next she went in for half an hour. Then an hour.

She had sworn that she would not stay on Jupiter for more than an hour at a time; a longer stay required mechanical operation of parts of her body while she was away. But once she became so absorbed in exploring the Jovian landscape, she stayed for an hour and a half. The maintenance machines disconnected themselves before she returned, and their intervention didn't seem to make a difference. So she stayed longer.

Jupiter, she found, was an astonishing world, truly alien from all she had experienced before. And the new senses she acquired through her new robot required extensive exploration of their own. It was all incredibly novel, and she realized she would need at least a year to explore.

The linkage between her mind on Mars and her robot body on Jupiter had delays; to have a completely satisfying experience, she would need a temporary residence that didn't require such a commute.

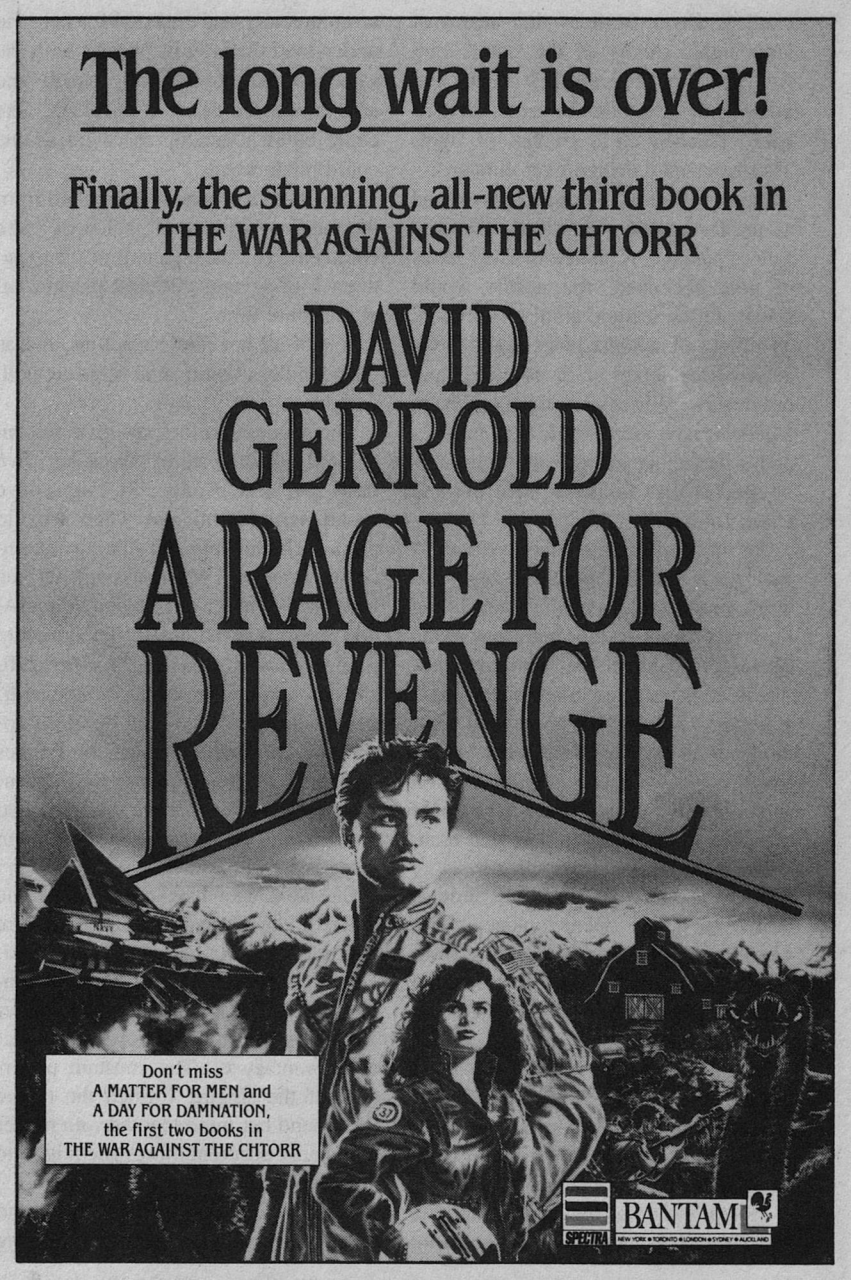
So a small cylinder, somewhat smaller than a Coke can, was launched at an asteroid that had been parked in orbit around Jupiter for this purpose. As the billions of robots from the cylinder swarmed across the asteroid, transforming it into a marvelous home, she boarded another ship. It seemed silly to spend any of her transit time stuck in the confines of her cabin; she went to Jupiter for the duration. She intended to return to her own body when it arrived in orbit.

But when it arrived, she was busy. She was learning about a new robot designed for the frozen world of Europa, with another whole new set of senses, new novelties to explore. She left her body in storage for a short time longer.

A year passed. And by then, it just didn't seem to matter.

A bubble hung poised on the edge of the solar system, a sphere pockmarked with thousands of holes, each hole the width of a pin. A bolt of light struck the sphere, a bolt powered by kilometers of molecular mirrors near the orbit of Mercury.

The bubble seemed to explode as thousands of needles leaped from their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cradles, driven forth by tiny beams of laser light, slivers of the titanic bolt from the Sun. The needles accelerated away from the bubble for years, till their speed reached close to that of light. Thereafter they drifted ever outward.

Upon occasion, a needle approached a star. The needle would shift, to ensure a close passage. If planets or other items of note beckoned, the needle would swoop in, on a tight spiral to oblivion: its billions of nanomachines would break apart at the touch of an asteroid, and build anew. Where once there had been a needle, now there would be a bubble, and a molecular mirror, and thousands of needles that would explode out and travel forever.

But in addition, the nanomachines in that system would continue to build. They would build machines and living flesh well suited to the conditions of the planet. And then the nanomachines would come back together into a single structure—not a needle now, but a communication bubble. Through the bubble and its instantaneous communication she could live across space. She could dwell at home near Jupiter yet roam among the stars.

She was often one of the first humans Called to newly opened planets. Her wisdom from Earth, her expertise from Jupiter, these made her invaluable as an explorer and a guide. As she had swum within the methane oceans, so now she swam in carbon dioxide atmospheres, or flew through liquid mercury. She imprinted herself upon organic synapses and silicon circuits light-years from home, and lived in many places.

Mentally she was bigger now than she had been at twenty-five. The meaning of complexity had changed for her; she understood the laws of physics with the same simple clarity with which she understood the rules of checkers. She could build a starship as easily as she could pitch a tent.

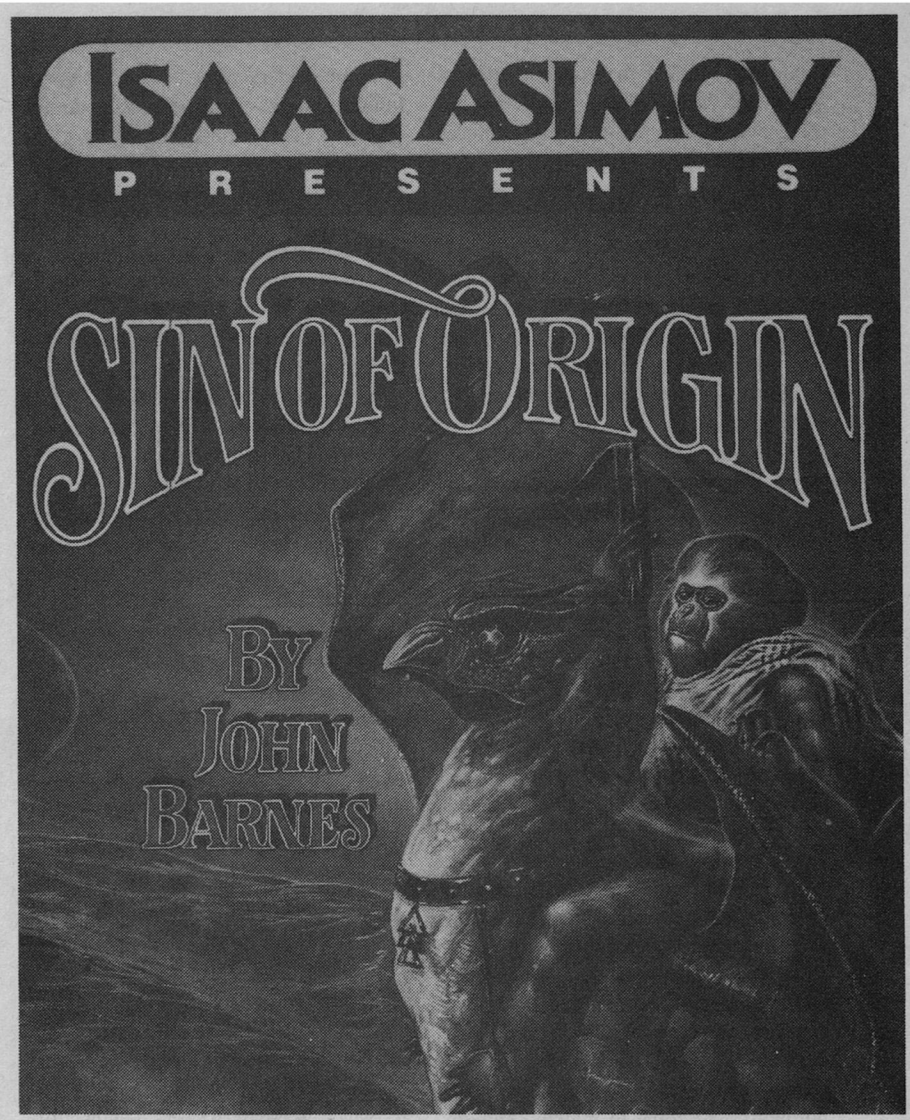
Her mind had grown and spilled from the confines of her original body. She could easily dedicate a part of her mind to each of several different planets, all at the same time.

But of all her new capacities, it was the boundless singing that filled her with wonder.

She was not an introspective person; she did not often think about her own past, and how strange she might have found her present. But when she did think such thoughts, the singing amazed her most of all. When she was 25 she had liked vintage Fleetwood Mac. At 105, she had admitted her growing fondness for Beethoven. Pressing 200, she had fallen in love with Monteverdi. In later centuries she had come to appreciate the double beat of the Echoes of Saturn and the operas of Ro Biljaan. Patterns so subtle that the unaugmented human mind could not even sense them filled her with ecstacy.

She no longer listened to one or the other of these musical masters at rare opportunities. Rather, they all played, all the time, each in a different subliminal part of her mind. They gave to her a rippling sensation of love that never quite went away. The constant undertone of the singing formed the theme that bound her mind together, no matter how many different things she might do at one time.

As the melodies suffused her mind they intermingled, sometimes playing



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upon one another in a concordance of point and counterpoint. Once, such a duet evoked from several masterpieces a harmony, which surged to drive the cadence of a grander euphony, that captured and empowered an even greater polyphony, filling her mind with a symphony of symphonies. And on a thousand planets, with a thousand bodies and a thousand voices, she leapt in the air and filled the sky with lilting laughter, a chorus of joy that spanned the arm of a galaxy.

Returning to ground on those scattered planets of distant stars, she felt surprised by her outburst. She marveled at herself. In her childhood she never would have laughed in such a way. She had once been so quiet it had been easy to think she was shy. The millennia had changed her, and she was delighted; how sad it would have been, never to express one's deepest joy!

Still, she was a woman of simple tastes. In earlier times some would have called her sturdy. Others might have called her childlike.

Yet these were not fair descriptions; better to think of her in the terms of ancient mythology. She was an elemental, almost a force of nature, with a core of simplicity that mocked overeager acceptance yet offered adaptability, that rejected panic yet always guaranteed caution.

Her elemental qualities were vital, humanity had come to realize. Though the needles traveling through space never found other intelligent beings, they had found scattered remains of what had once been intelligence. Other species had come up to Singularity and had died there.

Some had died in a frenzy, as the builders of new technologies indulged an orgy of inventions, releasing just one that destroyed them all. Others had died in despair, as fear-filled leaders beat down the innovators, strangling them, putting the future beyond their grasp. The fear-ridden species settled into a long slide of despair that ended with degenerate descendants no longer able to dream.

Only those who knew caution without fear, only those marked by her elemental form of prudence, made it through. Only humanity had survived.

And humanity had not survived unscathed. Terrible mistakes had been made, many lives had been lost. Even millennia later there still remained a form of death—or perhaps not death, but a form of impenetrable isolation. The dreams could become too strong, so strong that the individual lived in dreams always, never reaching out to touch reality. Many of her friends from the early millennia had lost themselves to these enchanted infinities leading nowhere.

She did not fear such dream-bound death. Seeing the span and deep intensity of her own dreams, she could almost understand those who wrapped themselves within and disappeared. But the new things humanity found every day were just as wonderful. The volume of space touched by the needleships grew at a geometric pace, opening hundreds of star systems. Even on days when few strikingly new systems were found, there were new planets, constructed by artists, awaiting her exploration. And the new things she learned

in the realm of the mind matched these treasures and more.

Someday, she believed she, too, would dream an endless dream. She did not want to live forever. But the beginning of that dream was far away.

The new meaning of death was complemented by a new meaning of life. This new meaning was extremely complex, even for her; life dealt with wholes much greater than the sums of their parts. But she understood it intuitively—it was easy to distinguish an engineering intelligence, good only for manufacture, from a member of the community, even though that member might once have been just an engineering intelligence as well. New members of humanity usually came to life this way: an intelligence designed as a machine or an artwork expressed a special genius, a genius that deserved the ability to appreciate itself through self-awareness. When this happened, the psychological engineers would add those elements of the mind needed for life.

In this manner had her great-great-grandchildren had been born. Her great-grandchildren had envisioned them, giving them a parent's loving care long before they had even been designed. Only the best characteristics of the minds of her family had been passed on to them. They were very different from her, but not quite alien. She learned to love them as they loved her.

The day came to say goodbye to her oldest friend. With her wonderful old Earth-born body, she returned to Earth to hike Rainier one last time: Rainier, whose surface lay so cold and eternal, was boiling within. With dawn, she knew, the boiling fury would break through, in the greatest volcanic event in Earthly centuries. She stood at the summit the day before the end and surveyed the horizon. Her feeling of appreciation grew till she thought she would burst. This was home in a sense few others could now understand.

She descended. A marmot met her on the way down; she swooped him into her arms and carried him to safety, though he fought her and cut her and it seemed her bleeding would never end. Still, the marmot could not prevent her from saving him.

She had considered saving the Mountain itself; she could, she knew. She could lace the Mountain with billions of tiny tubes, capillaries so small no living thing would notice. She could extract the heat, cool the heat.

But to deny the Mountain its moment of brilliance seemed not right: perpetual sameness was never right, though change might often be wrong.

So the next day, she and the marmot watched the eruption from afar. It was as beautiful as she had expected. And though the aftermath was gray and dreary, she knew that in a very short time the marmot's children would return to the Mountain, and a new kind of beauty would grow there.

Nor was the Mountain truly lost. Even as her Earth-born body returned to her asteroid circling Jupiter, she built an exact replica of the Mountain: an image, molecule for molecule, of the Mountain's surface the day before it erupted. When her body returned, she joined the Mountain, to walk there forever, in another part of her eternal dream.

Haikku, her loyal companion, was long dead; but she traced the descendants of his descendants. She arranged a mating. A new pup was born with Haikku's genes, in the image of Haikku. And so Haikku2 came to join her on the slopes of Mt. Rainier, on the orbit of Jupiter.

One day two needleships met in space. This was not uncommon; needles from different launchers often crossed paths and were easy to spot, with the hundreds of kilometers of molecular sensor webs they spun.

But this meeting was special, for one of the needles had no link to a human. It belonged to aliens.

Aliens! Wild hopes and wilder fears rocked the human community. She watched the hysteria calmly, confident it would pass and wisdom would rule.

The needles passed one another, too fast to meet. They swerved in long, graceful arcs to a distant rendezvous.

A sense of calm, and prudence, returned to humanity. They selected a contact team to break off and meet the aliens.

The needles closed. In their last moments they danced in a tight orbit about one another, a dance of creation: for though the needles died, a bubble formed where they met—a communications bubble.

The two communities, human and alien, reached out. They touched—but the touch was jarring. Bafflement ruled. The deadlock of confusion ensued.

She watched with interest. She felt sorrow that it was not going well, but her confidence remained.

Then from the contact team she received a Call. They needed her; they needed her elemental resilience and adaptability.

But in needing her elemental nature, they needed more than she had ever given before. They did not need the thoughts or calculations of her mind: they needed the basic traits of her personality, the very core of her being. To reinforce the team, she would have to expand her communication channels, open them so wide that what she thought, they would also think; there would be no filter protecting her internal thoughts. Far worse, what others thought, she would think; there would be no filter protecting her internal memories. It seemed to her it would be easy for her memories to get scrambled; she would rather die. And so for the first time in millennia, she was afraid. The team asked others of the community that held her special strength to come with them instead; they, too, were afraid.

Meanwhile humanity was failing. The anticipation, the yearning, the hope for contact with new beings developed a tinge of desperation.

They showed her how easy it was to open the channels of her mind—but more, they showed her again and again how easy it was to close them. They did not believe they would need her for long, thousands of milliseconds at most. They guaranteed she would be fine afterward. Reluctantly, she agreed.

She opened her mind; the shock of raw contact stunned her. A moment's near-panic like that of her first exploration of Jupiter returned.

And then she was moving, there within the team, and she grew accustomed. The sensation reminded her of

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jumping into a mountain lake—the cold plunge that blotted out all thought, the sluggish warmth of her muscles responding, the passing of the coldness from her awareness as she concentrated on the act of swimming. She swam among the members of her team.

Here she found many tasks to perform, the calming and soothing of a myriad of panicked souls as they plunged into the ice-cold lake of alien minds. She became the muscle that supplied the warmth, that allowed the awareness of the team to move beyond the cold, to swim.

As the team responded, the sensation of cold changed to one of warmth, a merry warmth, and she was a bubble floating on a wide, warm ocean, clinging and bouncing with the other bubbles, some friends, some human, some alien. Then they were bubbles of champagne, effervescent, expanding and floating away.

She floated to a greater distance; they no longer needed her; she was free to go. She closed the channels to her mind with slow grace, as would a woman walking from the sea through the sucking motions of the surf. She found herself alone again.

In those first moments of solitude, being alone seemed unnatural, as unnatural as the communion had seemed earlier; she felt the coldness that comes after a swim, when breeze strikes bare skin. She shuddered.

Was she still herself?

Of course you are. You are all you have ever been, and more.

The answer was her own, but it had once belonged to another person. For a moment she stumbled; perfect memory did not guarantee instantaneous memory, and she was seeking thoughts from her infancy. Then she remembered.

Jack!

She remembered, he had known that she'd remember.

What had happened to Jack?!

Could she have missed him all these years? She initiated a search of the community, but knew its futility even as it began; he could not, would not have remained hidden.

Yet her need to know him again grew stronger as she opened more of her long unbidden memories.

She searched swiftly back through the annals of history. Her search slowed suddenly to a crawl as she reached the early moments of Singularity: before the dawn of civilization, records had been crudely kept, with links insufficient to allow swift scanning. An analogy to cobwebs made her smile for a moment.

Only a handful of machines maintained this ancient knowledge, older machines in older places. Her search plunged to the surface of Earth. There, in a place once called California, all the remnants of prehistoric information had been collected. But it had not been collated. It would take much time to find Jack in this maze. But she had the time.

A salary report from a corporation of long ago . . . an article on accelerated technology's impact on the individual . . . a program design with its inventor's initials . . . and suddenly she found him, in a richly interconnected tiny tapestry within the sparsely connected morass. She read all of it, rapidly, as if she were inhaling fresh air after too long a stay in a stale room.

Jack had saved her life, she realized. The capsule she had taken so long ago to heal her backache, that first step on the road to the life she now knew, was his—he had designed the machine that designed the machine that designed that pill. It turned out that he had learned much from her on that day when they walked quietly amidst the lush green wilderness. And it had taken her all these millennia to learn what he had known even then.

From her, Jack had learned the importance of making technology's steps small, making its pieces bite-size. He had learned this as he watched, in her disbelieving eyes, her reaction to the world he had planned.

For those who loved technology and breathed of it deeply, small bite-size steps were not important. It would have been easy to callously cast off those who did not understand or who were afraid. But Jack had thought of her, and had not wanted her to die.

Reading these glimpses of his past, she grew to know Jack better than she had ever known him in life. With her growing wisdom, she soon understood even the clarity of organization that encompassed this lone swatch of antiquity: the clarity, too, was of his making. He had believed in her. He had believed that one day she would search for him here. And he had known that, when she arrived, her expanded powers of perception would enable her to understand the message embodied in the clarity, and in all his work.

I loved you, you know, Jack told her across the millennia.

She wanted to answer. But there was no one to hear.

It hurt her to think of him lost forever, and she had not felt hurt for a very long time. Feverish, she worked to rebuild him. The Earth-bound computers gave her all the help they had to give, every memory of every moment of Jack they had ever recorded. She traced her own memories, perfect now, of every word he spoke, every phrase he uttered, every look he gave her in their long walks. She built a simulation of him, the best and most perfect simulation she could build with all her resources, resources far beyond those of a million biological human minds. It was illegal to build a simulation such as this, one of the few laws recognized by the community, but this did not deter her.

The simulation looked like Jack; it talked like Jack; it even laughed like Jack. But it was not Jack. She then understood why it was illegal to build such a simulation; she also understood why it was not a law that needed to be enforced: such simulations always failed.

Jack was gone.

What could she do?

What did she have to do? Suddenly she realized how silly the simulation had been: how could she have hoped to get closer to him, than to live his vision of the future?

Only one small action, one appropriate action, remained that she could perform. She could remember forever.

And so, just as a part of her lived forever on the Mountain, just as a part of her lived forever singing, so now she maintained a part of her that would spend all its moments remembering her earlier moments with him. She became in part a living memorial to the one who brought her here.

And though no one could hear, the essence of her memory would have been easy to express: *Jack, I love you.*

She turned her attention to the living members of humanity. There were many other places in the community, she realized, where the techniques she employed in contact with the aliens could help; there were many places where they needed her elemental force invested with the fullness of such expanded communion. She was eager to go. But still a question remained.

Would she still be herself?

The answer Jack had wrought so long ago welled up from within, her rightful inheritance of his understanding. Part of the answer, she knew, lay within another question:

Are you still yourself, even now? Were you still yourself, even when you were twenty-five?

She looked back with the vision that perfect memory brings. She remembered who she had been when she was twenty-five; she remembered who she had been when she was just ten. Amusingly, she also remembered how, at twenty-five, she had erroneously remembered her thoughts of age ten. The changes she had gone through during those fifteen years of dusty antiquity were vast, perhaps as vast as all the changes she had accepted in the millennia thereafter. Certainly, considering the scales involved, she had as much right today to think of herself as the same person as she had then. Expanded communion would not destroy her; she was her own bubble no matter how frothy the ocean might become.

At least, this first time she had remained her own bubble. Would it always be so?

She dipped into communion, and withdrew to ask the question. She found the answer, and it was good. She dipped again, for a longer time; and still the answer was good, perhaps better.

She dipped much longer still and asked one more time. This time she understood. The answer was so simple, so glorious, so joyful, that she did not ask the question again for a billion years.

And by then, it just didn't seem to matter. ■

●Of all the self-inflicted wounds the human race has suffered, the most dangerous and deadly is the burning of books. It is a lobotomy that cuts off our own past and offers nothing, literally nothing, in return for the loss.

Ben Bova

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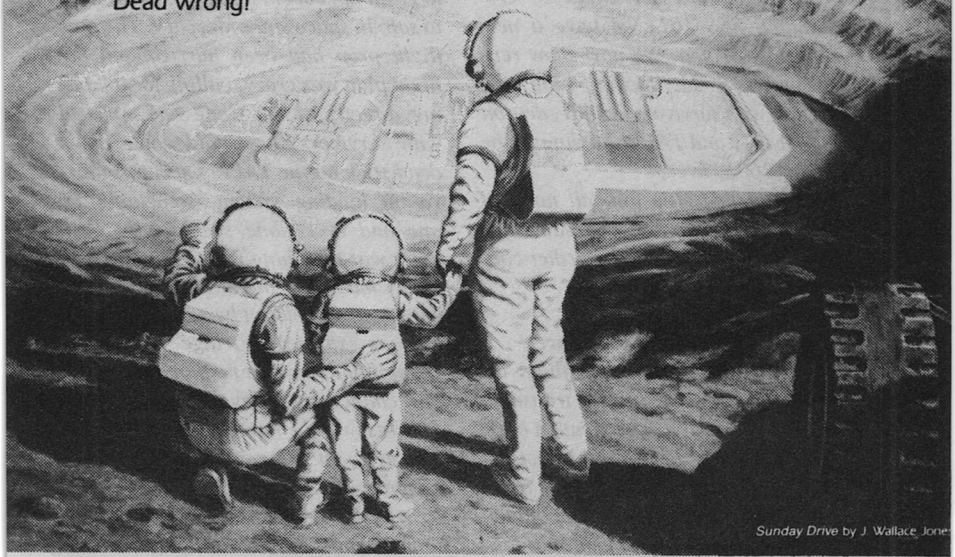

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ZERO GRAVITY AND THE IMMUNE SYSTEM: A CHALLENGE TO MAN'S SURVIVAL IN SPACE

Dr. J. Kevin Steele

One of the biggest hazards in space appears to be tiny, internal, and not yet well understood.

– *Shuttle flight 161, this is Houston Control. We show you right on the beam, altitude 104, relative speed 1410, with an ETA of 36 minutes. Over.*

– *Ground, this is 161. It's been four hours since last contact. Do you really think there is a chance—*

– *Standby, STS 161, we have a new schedule for you. We now show rendezvous at 1321, docking 1335, departure with survivors at 1401, deorbit burn 1421, and TAEM landing at the Cape, 1601, over.*

– *Acknowledged Houston, all three of my on-boards show the same for once. Has there been any further contact or news about—*

– *Open line, Challenger III.*

– *Damn it, Bill, I need an answer!*

– *Challenger III, this is the flight director. Confine all further transmissions to required communication only. This is an order from the highest authority. Our next contact will be at 1315, when you make visual contact. Houston Control, over and out.*

And that was that. It had been only 48 hours since the frantic calls for help had been received from America's first permanent space station. In that time, ground crews had performed the miracle of getting Challenger III *on the pad weeks ahead of schedule. Her commander had volunteered to go, despite the enormous risks. Because of weight and flight plan considerations, he had to go alone, becoming the first astronaut to solo in space since Mercury. The preflight prep had been hurried and the flight plan was crazy, calling for a landing directly at the Cape and, packed with survivors, he would come down dead stick on the TAEM energy conservation landing system, something no one had ever done successfully. And there was one thing more. Though hurriedly modified, the mid-deck of* Challenger *would hold, at best, ten survivors. He was expected to triage, to pick the ten station crew that he thought had the best chance for survival to go with him. The rest would have to be left to die. However, at the rate this plague had progressed, it might turn out to be the least of the commander's problems.*

His shuttle shook a little, perhaps in empathy with his apprehension. Behind his ship, the blue ribbon of Earth, still visible, was fading to black as the Sun fell below the far horizon. The darkness

ahead served only to intensify his feeling of isolation. The commander glanced at the chronometer. There was twenty minutes left before he had to decide which of his friends were to live, and which to die.

In less time than that, radar contact with the station was made and then the visual sighting, dead on schedule. Challenger *approached slowly, from the sunward side of the station. Her commander searched the Station's view ports for signs of welcome or of life, but they were empty. Then the hum of a carrier wave pushed aside the random static of space in his headset: Houston was back.*

– *STS-161, this is Houston. You are cleared to dock and enter. Set your helmet filters at 0.10 microns for best screening. Remember, you have to push off in twenty-five minutes or you lose your reentry window. Good luck. Houston out.*
– *Roger, Houston, this is 161. You can tell the world that I've arrived (knowing of the total news blackout surrounding his flight, the commander was grimly paraphrasing the famous Apollo line). I'm completing final approach to docking. What was it George said—that he'd be waiting for me by the hatch?*
–
– *Houston?*
– *STS-161, cleared to dock. Over and out.*

A few minutes later, the commander stepped through the main hatch into the station. His filters could screen out the disease, but not the awful odor that slammed into his brain. Huddled by the hatch was the thing that had been his friend, waiting for him as promised. He was too late. They were all dead.

Introduction

We now stand at a historical juncture between briefly visiting space, and making it a permanent second home of the human race. There is an immense difference between the two, and the more forewarned we are about the hazards we will face, the fewer tragedies our nation will have to absorb. However, the dangers of space are not always dramatic and obvious, such as hard vacuum, sleeting radiation, or meteorites, but can be more insidious and subtle, with the same potential for lethality. One such danger might be posed by zero gravity, and its biological effect on key systems of the human organism.

The effects of zero gravity are clearly not immediately fatal. Between them, the U.S. and the USSR have launched 128 astronauts and 76 cosmonauts into space (as of July, 1988) in 27 years of spaceflight. Some of these 204 privileged men and women are now dead, but only due to clearly defined engineering or technical failures, and among retired astronauts the incidence of cancer and other diseases are not (so far, at least) above expected rates. However, a problem with this sort of evaluation of space-associated risk to health is that most of these astronauts have averaged only a few days in zero *gee* (the U.S. has so far accumulated space-flight time of only 1,805 man-days) over their entire careers. Among Soviet cosmonauts, who have achieved much lengthier stays in orbit (a total of 5,032 man-days so

far), important medical data on their post-flight lives has not been forthcoming, Glasnost or not. Another problem in looking strictly at mortality among retired astronauts is that space has always been virtually the exclusive province of highly trained military personnel in exceptional health and in the prime of youth, a situation which will radically change with the industrialization and colonization of space.

However, while there have not yet been any deaths, there is already clear and increasing evidence that exposure to zero gee can have serious physiological consequences. Our latest space missions, especially those of the space shuttle, tend towards an increasingly shirt-sleeve environment in which radiation exposure, stressful crowding effects, and exposure to toxic chemicals have been eliminated; only zero gravity, which cannot be guarded against, remains. The damage caused by zero gee has been the subject of extensive study; so far, it has been found to include damage to the heart and vascular system, bone demineralization, changes in the functions of the inner ear (possibly the source of chronic space motion sickness), altered calcium ion metabolism, and a massive loss of red cell (the cells that transport oxygen in the body) volume.

The Soviets have repeatedly discovered the hard way about some of these effects in their long-term orbital missions. Their latest Cosmonaut casualty developed heart trouble and had to be rescued from the MIR space station in July 1987. Upon his return to Earth, he made the apt comment that "space was not to be trifled with." He had left Earth the preceding February in apparent perfect health.

There is, however, one more zero gee effect on human physiology which has immense potential, perhaps more than any previously mentioned, for a fatal result: an apparent paralysis of the body's immune system.

We live in an environment packed with microorganisms of all kinds; most ignore humans, but there are thousands of species which are deadly enemies of man, or would be if they had the chance. What keeps them at bay is our complex immune system, which evolved early in the history of life and is now standard issue for all of Earth's higher life-forms.

Primitive sponges appear to have evolved the first type of immune system four hundred million years ago: it took the form of cells designed to identify and attack foreign sponge colonies that attempted to crowd out the parent colony. Today, this type of immunity, termed cellular immunity, protects us against cancer and viruses and, ironically, prevents us from accepting organ transplants. Another form of immunity is the antibody molecule, which the sharks and their relatives were the first organisms to have evolved, perhaps one third of a billion year ago. Today, modern mammals can make five different types of antibody, each type serving to protect a different area of the body from microbial invasions of parasites, viruses and bacteria.

This system, designed to destroy cells, exists in an uneasy symbiosis with the other cells of its host body, and thus the immune system is allowed to operate only under very tight control. The smooth functioning of the immune sys-

tem thus depends upon an unusually large number of complex cellular processes: leukopoiesis (the process by which immune cells are made), differentiation (resting immune cells become active), and cellular regulatory interactions, until the synthesis and release of active molecules such as antibody occurs.

Understanding this involved process is best accomplished by examining the immune response to a hypothetical invading virus (Figure 1). The central cell of the immune network is a kind of lymphocyte (white cell) known as a T-helper (Th) cell. Its name is apt, for the helper cell acts to help all the other cells of the immune system to function. When a cell of the body is invaded by a virus, new proteins generated under the direction of the viral DNA start to show up on the infected cells' surface. These foreign proteins stimulate specific T-helper cells which then begin to grow, multiply, and release two important factors which drive the immune system forward. A factor called B-cell growth factor (BCGF) stimulates B-cells (another type of lymphocyte) to produce anti-virus antibody, while another factor, T-cell growth factor (TCGF or Interleukin-2 [Il-2]) stimulates anti-virus killer T-cells to multiply and attack virus infected cells. It is the activity of these killer cells, blowing up cells, releasing debris and cellular enzymes into the bloodstream, that poisons the blood and causes the symptoms of the common cold.

The immune network is unique among the body's systems in its requirement for such a multilevel series of controls, all designed to regulate immune cell

FIGURE 1. STANDARDIZED VIEW OF THE IMMUNE RESPONSE TO VIRUS

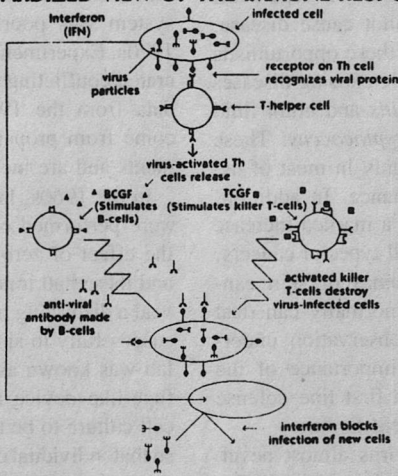

FIGURE 1: A standardized view of the immune system. Shown is a response to a hypothetical virus which has infected a cell. Helper T-cells identify the virus-infected cell and release growth factors, required for B cells to make anti-virus antibody, and for killer T-cells to destroy virus-carrying cells. Infected cells can also produce a warning substance called Interferon, which serves to warn cells as yet uninfected of the presence of a virus. Cancer cells also express novel proteins on their surface, which activates the immune system in the same way. To date, experiments run in orbit have shown that all of these essential functions are impaired at zero gravity.

activity, especially of activated killer cells, and to keep the immune cells from attacking the body, as well as the invaders. Most of these events require cell-cell contact and communication, and since they all evolved in a field of one gravity, it is possible that in its absence, cells cannot interact with each other and the immune system fails to function properly. More on this later.

The best evidence for what is in store for those who lose their immune function is now being provided by the victims of AIDS, or Acquired Immune Deficiency Syndrome. As the name suggests, the disease operates by destroying the host's immune system. The causative agent of AIDS, the HIV virus, zeroes in on and destroys the T-helper cell, thus completely dislocating the immune system. Without the protection of the immune system, the body is then attacked by all manner of organisms which normally cannot cause disease. Predominant among these opportunistic raiders are pneumonia-causing diseases such as *Pneumocystitis* and brain fluid invaders such as *Cryptococcus*. These organisms live benignly in most of us, unless they get a chance. In addition, AIDS patients show a marked increase in susceptibility to all types of cancers, especially rare sarcomas or skin cancers, that the body normally can deal with readily. This observation underscores the extreme importance of the immune system as a first line defense in eliminating incipient tumors.

Thus, the AIDS virus almost never kills its host directly but, through its paralysis of the immune system, allows bacteria the host normally lives with to cause a fatal disease, a process that may take many years to manifest itself. Zero gee may do the same thing. The data NASA and the Soviets have gathered on the effects of zero gee on the body indicate that a hypogravity induced immune deficiency syndrome—HIDS for short—may lie in store for our astronauts. The effects of HIDS, like AIDS, will have an inherently lengthy time lag before disease becomes apparent, but are potentially as serious.

EFFECT OF HYPOGRAVITY ON EACH COMPARTMENT OF THE IMMUNE SYSTEM

I. The Effect of Zero gee on T-helper Cell Function.

Intense examination of the effect of zero gee on the immune system has begun only recently with the STS-Spacelab missions of the 1980s. Prior to this, experiments run by both American and Soviet investigators have typically lacked essential controls, because the immune system was poorly understood in the 1970s. Experiments therefore often generated conflicting data. However, some data from the 1960s and 1970s have come from properly controlled experiments and are included.

In the 1960s, laboratory experiments were performed on Earth to determine the effect of zero gee on human cells, and these had immediately begun to reveal a disturbing trend. The device used successfully to simulate zero gee in the lab was known as a clinostat, a centrifuge-like device that rapidly spun the cell culture to be tested in all directions so that individual cells could not become orientated with respect to the Earth's gravitational field. Cells grown this way ended up in an effective gravity field equivalent to only 1.8% of normal. T-cells tested for immune function in this

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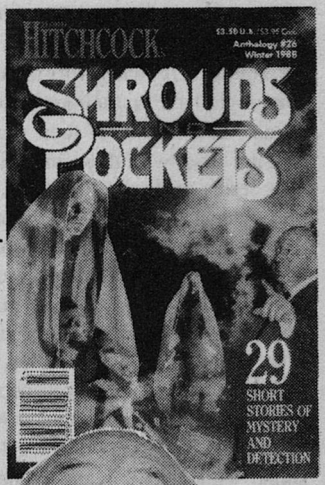

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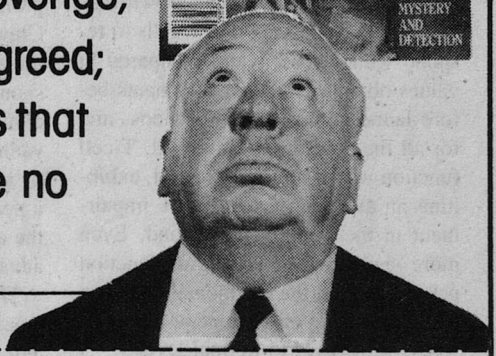

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hypogravity field were found to become rapidly less than 50% as responsive as untreated cells, an effect that was also found to be long-term.

The above observation made it imperative for the space agencies to look for any effects that zero gravity exposure might have on their astronauts. The Soviets scored one of their near-Earth mission firsts with these investigations; in a series of *Soyuz* flights (6, 7, and 8) they examined the T-cell function of the cosmonaut flight crews involved. In these experiments, T-helper cell division was stimulated with a "mitogen" (this is a sticky molecule which binds to the T-helper's virus receptor, fooling the cell into believing it has encountered a virus) and their subsequent growth was evaluated. The ability of the cells to respond while in orbit was compared to values obtained for the cosmonauts before launch; in all three missions, and for all the cosmonauts involved, T-cell function was severely depressed, exhibiting an average of 18 to 60% impairment in their ability to respond. Even more significant, this loss of function persisted after the cosmonauts' return to Earth, taking on average at least two weeks to recover to normal levels.

These results were confirmed in the 140-day *Salyut 6* mission, in which it was found that T-cell numbers in the bloodstream of the orbiting subjects fell precipitously. As in the *Soyuz* flights, the remaining T-cells's ability to respond to stimulation (formally described as "blast transformation") was markedly reduced.

The U.S. answer to *Salyut* was *Skylab*. Three early *Skylab* missions, II, III, and IV, ran experiments along similar lines to the Russians: T-cells from the astronauts involved in each flight were studied for their ability to be stimulated by mitogens. The results obtained from these studies were similar to the Soviets's: T-cells at zero gee were found to be impaired in their ability to make RNA (a first step in the production of Il-2 and BCGF); also, recovery time after landing required at least ten days.

More advanced experiments were run in the first four shuttle missions. In these studies, the amount of mitogen required to stimulate T-cells maximally (this was established by watching the rate of T-cell division at various increasing mitogen doses) was calculated. Again, the ability of T-cells to respond to stimulation was found to be severely compromised after only a few days in space. Crewmen required four times as much mitogen to generate a good T-cell response in orbit than on the ground. In clinical terms, this means that an invading virus could multiply in the blood of a person in orbit four times that of a person on the ground before drawing the attention of T-cells, perhaps a fatal advantage.

The best controlled experiment of this type, one that adequately took all factors into account, was run in December 1983, on STS-9. This experiment, IES031, was carried aboard the first Spacelab mission. The experiment required a large expenditure of resources: three hours of payload specialist flight time and 5.5 kgs. of payload (mostly for the cell incubator which was installed in the middeck of the shuttle *Columbia*). Like its predecessors, IES031 assessed the ability of T-helper cells to respond to mitogens at zero gee, but, even more than in previous experiments, all other variables were strictly

controlled. The cells to be tested were drawn from a healthy donor before takeoff, eliminating any effects such as astronaut stress from the equation. The cells isolated from the donor were divided into two groups, one going on the flight, the other staying on the ground. Both groups were kept at identical conditions of temperature, oxygen, and carbon dioxide partial pressure, in identical incubators. Once the *Columbia* was in orbit, precisely the same amount of mitogen was simultaneously added to both cell cultures. The cells were allowed to divide for 48 hours and then frozen for later study. Once *Columbia* was back on the ground, both groups of cells were evaluated, using two precise parameters. First, the rate of DNA synthesis was examined as an indication of how rapidly cells were dividing: stimulated helper cells divide very quickly. Also examined was the rate of glucose consumption per cell, which tests to see if the normal metabolism of the cell was damaged by the flight, an important control.

The results were gratifyingly straightforward, at least from a scientific standpoint. Glucose consumption in the cells flown in space was virtually identical to those kept on the ground. This indicated that the conditions of the flight, the takeoff force and the conditions of the incubator, were quite acceptable to the orbiting cells, which continued to metabolize normally. On the other hand, the response of the T-helper cells in orbit to mitogen stimulation was a minuscule 3% (!) compared to that of ground controls. All other conditions, such as exposure to radiation, were kept

FIGURE 2. T-CELL RESPONSIVENESS IN SPACE

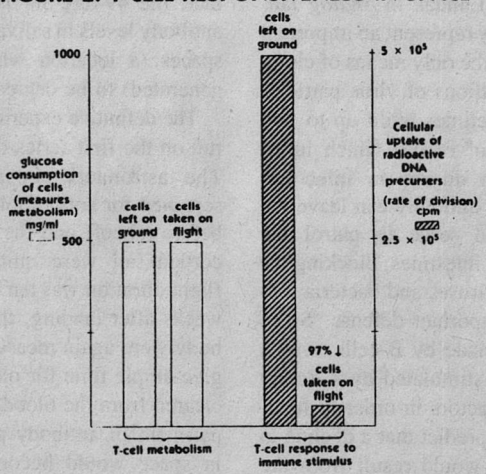


FIGURE 2: The STS-9 flight attempted to demonstrate the impairment of T-cell function under conditions of zero gee. First, normal human cells were studied for their metabolism of glucose. Both the cells taken on the flight and the cells left behind showed normal metabolic consumption of the sugar, a result indicating the conditions of flight were not damaging directly.

However, when the cells were tested functionally, for their ability to respond to Con A (a molecule which binds to the cell's virus receptor, simulating virus), cells at zero gee had only 3% of the response compared to cells left at home. Thus there is a selective impairment of immune function of T-cells at zero gee.

identical, and so clearly zero gee was the culprit that had affected the ability of helper cells to respond. The scientists conducting the study have hypothesized that helper T-cells have an internal "gravity sensor" which does not allow them to function in hypogravity, a point to which we will return.

Since helper cell function is so central to the immune response, these hypogravity effects cannot be underestimated in importance. The loss of these cells' participation in the immune network is exactly the phenomenon responsible for the AIDS syndrome.

II. Antibody Production in Zero Gravity

Antibodies are proteins which seek out, bind, and inactivate viruses, bacteria or blood parasites. (For a more detailed description, see "The Hybridoma Horizon," by Daniel Basil Lyle and Dr. Robert Lundak in *Analog* January 1982). They represent an important defense and are the only means of clearing away the billions of virus particles (levels can sometimes build up to 10^{10} viruses per ml of blood) which infest the bloodstream during an infection. Some classes of antibody can leave the bloodstream and serve to patrol the mouth, eyes and intestines, blocking the initial entry of viruses and bacteria into the body, an important defense. Since antibodies are made by B-cells, which must in turn be stimulated by T-helper cells and their factors in order to function, one might predict that a decline in antibody levels would result from the loss of helper cell function which accompanies any length of time in orbit.

Prior to the detailed shuttle-carried experiments, however, the results were confusing. Many measurements of antibody levels in astronauts' blood serum had shown no decline, especially in earlier short-duration flights. In fact, in some U.S. missions, the levels of antibody class A—the class of antibody that blocks pathogen entry to the body—were found to be elevated, an observation now taken by NASA physicians to indicate that the astronauts may have been suffering from multiple sub-clinical infections, a situation which mobilizes stores of this type of antibody.

The problem with these early tests lay in the unrecognized fact that antibodies, once made, are quite stable and will persist in serum for long periods of time. Their serum lifetime can be months, so if antibody synthesis came to a complete halt early into the flight, levels would not begin to fall for three weeks or more. Long-term missions should therefore be better able to detect a difference and in fact, the 49-day *Salyut 6* flight found antibody levels in saliva and in the tonsil spaces (a location where antibody is generated) to be decreased.

The definitive experiments were again run on the first series of shuttle flights. The astronauts aboard STS-9 were screened for antibody levels thirty days before takeoff and the results were recorded (all were quite normal). The flight duration was ten days and so, two weeks after landing, the levels of antibody were again measured. This would give ample time for old antibody to be cleared from the blood, so that any impairment of antibody production while in space would become obvious. All four crewmen tested showed 25-30% drops in their blood's antibody concentration (Figure 3). Antibody synthesis had indeed shut down soon after achiev-

FIGURE 3. ANTIBODY PRODUCTION IN SPACE

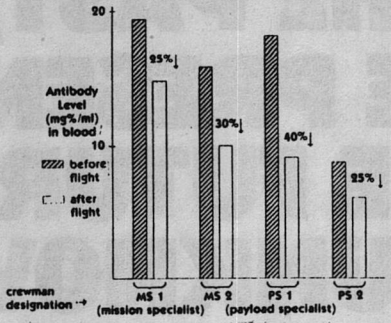


FIGURE 3: Delayed effects of zero gee on the body's levels of circulating antibody are shown above. Values for each astronaut (here designated by their role on the mission MS—mission specialist, etc.) were recorded long before liftoff to get a base value. Upon return to Earth, antibody levels were normal, but the effects of zero gee become more apparent in the following weeks, and, as old antibody was lost, the levels fell 25-30%. These results are consistent with a shut down of antibody production soon after orbit was achieved.

ing orbit, and was manifested as this delayed effect.

The consequences to long-term health resulting from a decrease of the immune system's ability to inactivate and clear virus from the blood, as well as the loss of the ability to prevent the entry of bacterial and other pathogens into the body, are clear.

III. Cancer Resistance and Zero Gravity

AIDS patients have demonstrated to us the extreme importance of a functioning immune system as a protection against cancer. The immune system attacks a tumor on several different fronts: antibodies specific for tumor proteins can destroy cancer cells, and anti-cancer killer cells are mobilized.

The first of these are the T-killer cells from Figure 1. In the absence of Il-2 from helper cells, these cannot function; this was established on the flight of STS-9 (see section IV). However, there is another major type of killer cell that defends us against cancer called the Nk, or natural killer cell. These cells seem to be independent of the T-helper loop and are poorly understood at present. They do not appear to be either B or T cells and certainly to do not seem to require the usual sort of helper cell stimulation to go after cancer cells. They do this very well, seeking out and selectively destroying tumor cells when the cancer first appears, and as such represent an important first-line defense. Exactly what Nk cells are, and how they can recognize and kill cancer cells without any helper cell participation, is an intense area of immunological research. When first identified, there was hope that these cells might retain their activity in space, but this does not appear to be the case.

To date, many experiments have been run, but the most properly controlled evaluation of Nk function after zero gee exposure has been performed by the Soviets. Prior to the launch of the *Salyut 6* mission, Nk cells from the cosmonauts involved were collected and tested for their ability to kill cancer cells. The day after landing, upon the mission's completion, Nk activity was again evalu-

ated. In all three cosmonauts tested, the ability of Nk cells to destroy target tumor cells was drastically reduced, leaving all three wide open to cancer growth, should one arise or was just getting started at the time of flight (Figure 4). Since many scientists believe that incipient cancers are continually arising and being destroyed in the body, it might only be a matter of time before a clinical result from this sort of impairment becomes tragically apparent. In the case of these cosmonauts, how long it took for restoration of Nk function was never followed up, nor has any data on their current health status been released.

IV. Virus Resistance at Zero Gravity

Ordinary cells of the body, when infected by a virus, can send out a warning signal just before the virus takes over completely. The signal is a protein called interferon. IFN will seek out and enter uninfected cells, informing them of the presence of a virus; these cells then set up membrance blocks and take other defensive measures to prevent the virus from entering and taking over the cell. The mechanisms by which interferon accomplishes this are not yet fully understood, but the protein is the essential first line of defense in fighting a virus. Unfortunately, the production of interferon seems drastically impaired at zero gee.

In the December 1983 flight of *Columbia*, a study of the ability of the astronauts involved to respond to virus infection was undertaken. The virus used for the test was the Newcastle Disease Virus (NDV), a disease known to cause blinding ulcerative conjunctivitis (a severe eye infection) in humans. Cells drawn from the astronauts in flight were tested for their ability to make and release interferon upon virus infection. In some astronauts' cells, this ability was lost after only a few days in orbit. In a parallel experiment, the ability of T-killer cells from these astronauts to kill NDV-infected target cells was evaluated, and all astronauts involved showed a marked decline in both the number of killer cells and their efficiency. The net

FIGURE 4. SALYUT 6 RESULTS: CANCER RESISTANCE AT ZERO GEE

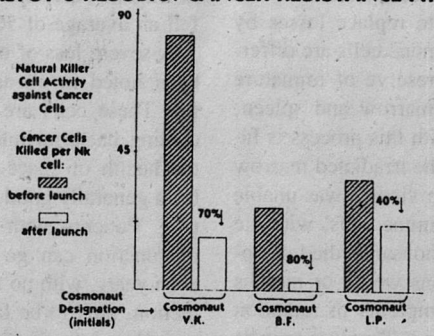


FIGURE 4: Soviet space science has revealed that the body's best first-line defense against newly forming cancers—the natural killer cell—suffers a severe impairment of function in zero gravity. Values illustrated above represent the rate of cancer cell killing caused by Nk cells drawn from each cosmonaut before and after the *Salyut 6* spaceflight. As shown, Nk values between individuals show in Nk activity after exposure to zero gee.

result was a complete impairment of the ability to defend against a virus attack. Similar results were noted from the Russian side, aboard the *Salyut 6* space station. Experiments performed on cosmonauts V.K. and B.F. also demonstrated that they showed a marked decline in interferon production. The Russians have also performed experiments as part of their space science project codenamed "Interferon" on rats maintained in space, and these animals show an average of 82% decrease in Interferon blood levels, as well as long-term loss of anti-viral activity.

V. The Production of Immune Cells and Zero Gravity

So far, we have seen how zero gee can affect the numerous limbs of the immune system by rendering them insensitive to stimulation. Zero gee does not appear to destroy these cells, but acts by causing them to become unresponsive to stimulation. There is, however, another means of blocking immunity which has now been linked to zero gravity: a block of leukopoiesis. Leukopoiesis is the process whereby the B-cells, T-cells, Nk cells and all the rest are manufactured to replace losses by attrition. Fresh immune cells are differentiated from the reserve of immature cells in the bone marrow and spleen, and interference with this process is fatal. For example, the irradiated marrow of Hiroshima bomb victims was unable to replace their immune cells, with the consequence that thousands died of opportunistic infections weeks or months after any acute symptoms of radiation poisoning had passed. This was seen as the so-called "bi-modal mortality curve" that is typical among radiation casualties.

Therefore, whether or not zero gee has a similar effect is a critical issue. The results obtained to date are clear-cut. On the Soviet mission *Cosmos 605*, both the astronauts and the rats they took along showed deleterious changes in the spleen including: decrease in DNA synthesis, a marked decrease of cells in the white pulp of the spleen (the site where white cell production occurs) and a fall in erythropoiesis (red cell production). Similarly, cosmonauts on the *Soyuz 11* visit to *Salyut 1* and on the two *Soyuz* visits to *Salyut 4* showed post-flight leukopenia and lymphocytopenia (a fall in the numbers of several types of white blood cells).

In eleven *Apollo* flights, three *Skylab* and four STS missions (33 astronauts), American astronauts have been shown to exhibit similar effects. All show post-flight lymphocytopenia (a decrease in lymphocyte number which averages 30%+), a decrease in RNA production, and a drop in total blood leukocyte count. In addition, in STS missions I through IV, the astronaut's eosinophil (this type of white cell provides protection against invasion by parasites) count fell an average of 50%.

A severe loss of neutrophils has also been noted in all astronauts tested so far. These cells are important in controlling bacterial infections and, while the health of space crews has to date been generally good, this can be deceptive. Patients with severe neutrophil dysfunction can go for long periods, even years, with no advent of major infection, only to be fatally overcome by a virulent infection at a later date. Gingivitis was reported in the *Skylab* series—an indication of neutrophil failure.

Among patients with neutrophil failure, similar symptoms are reported, followed by death at some later time. It may be that no astronauts have been in space long enough for us to observe a result from this loss of immune system function.

Conclusions

After today's generation of explorers will come the colonists. Historically, colonists have very often been driven by motives of financial gain, as they seek to profit from the unique assets of a new territory. Activities like mining asteroids or the Moon's surface are not likely to be cost-effective in the foreseeable future, unless our abilities change radically. However, space does have one priceless asset which can be more immediately exploited: zero gravity. It is certain that zero gee manufacturing processes will revolutionize the production of drugs, fine alloys, crystals and chips for electronic applications, etc. A Massachusetts-based company, Payload Systems, Inc., will be among the first conventional entrepreneurs in space; a device for growing ultrapure protein crystals in zero gee for use in human drugs and therapy will be given trial runs in the Soviet MIR station.

These new colonists, by the very nature of their business, will be required to spend long stretches of time in zero gee. The usual plans for near-Earth colonies involve some form of artificial gravity, generated centrifugally. However, no one envisions replacing anything over a fraction of Earth's gravity by this method. Additionally, any colonies established on the Moon or Mars will also exist in hypogravity fields of 1/6 gee. Experiments in the laboratory, with the clinostat, have indicated this is sufficiently low to inactivate the immune system. Transit time from Earth to these colonies will also be in zero gee and data has indicated that very brief exposures to zero gravity are sufficient to inactivate. The effects of zero gravity on human physiology are thus of paramount interest.

As far as the immune system is concerned, its functions are clearly incapacitated by exposure to zero gee. Poiesis, the process by which immune cells are made, slows to a stop. T-helper cells, the central driving cells of the system, cannot respond to stimulation, and as a consequence, the levels of antibody and T-killer cells in the body crash. Infected cells cannot produce interferon as a warning and cancer-hunting Nk cells become quiescent. The sum effect is an immune deficiency state analogous to AIDS.

So far, we have been lucky and there have been no serious consequences reported as a result of this loss of immunity, and any in-flight infections have so far resolved without incident. But as the human occupation of space changes, from brief visits by space specialists in perfect health to a more broadly based permanent colonist population, any loss of immune function could be expected to have severe consequences.

Similarly, as the space population grows, the chance of the introduction of a pathogen that could not be handled would also grow. Experiments conducted aboard *Spacelab 1* have indicated that many of Earth's worst bacterial killers are not in the least bothered by

the conditions of space. *Bacillus subtilis*, for example (this organism can produce many exotic and deadly toxins, and can invade the lungs), can survive in the conditions of free space, and the rate of their mutation into new, potentially lethal forms increases tenfold. Even under the full solar spectrum of ultraviolet light, over half of *B. subtilis* spores survived as their parent bacteria produced novel and exotic chemicals like TDHT to block out the UV radiation. The ability of this and other diseases to survive and mutate in space will be trouble enough to a colony of normal humans, but if they are immune-depressed, the problem is compounded.

Why does zero gee exert such a selective paralytic effect on the immune system? Time and time again, experiments have indicated that zero gee does not directly damage cells. For example, human WI-38 embryonic lung cells taken aboard *Skylab 3* continued to grow and metabolize normally. The same T-helper cells which were inactive to stimulation aboard *Spacelab 1*, continued to metabolize glucose equivalently to ground controls. At present, research focuses upon the possibility of a gravity "sensor" within cells, especially T-lymphocytes. That cells can detect gravity is clear; in the laboratory, cells respond better in hypergravity (i.e., if centrifuged, to create artificially high gee) and not at all in low gee (a clinostat). Why such a gravity sensor might exist predominantly among the cells of the immune system might reflect the need for cell-cell contact to bind viruses, to transmit signals between immune cells, and to allow T-helper cell regulation of the generation of an immune response. The immune system has to have these controls if it is to keep the potential killing effects of its own cellular warriors in check. An immune system running wild, out of control, can have fatal results, causing autoimmune diseases like arthritis, lupus, diabetes, certain types of encephalitis, and perhaps Alzheimer's syndrome. Even mounting an attack on cancer cells, which are 99% identical to ordinary cells of the body, is a tricky business, one that can easily get out of control if the participants are not closely regulated. Since these complex cell interactions evolved in a field of 1.0 gee, it is possible they cannot operate without it. If mankind can find some way to live in space for millions of years, perhaps the human race will evolve, as Eric Frank Russell once wrote, into a *Homo nosipaca*, or space-voyaging man, perfectly adapted to the conditions of space, but this hardly addresses the problem for the near future.

NASA has given this question high priority among the biological experiments to be run when the shuttle flies again. Many scientists have profferred ideas on the subject, including suggestions such as artificially replacing Il-2, interferon, B-cell growth factor and the rest, now that many of these factors have been cloned into bacteria and are commercially available. This would be incredibly expensive, but would do as a stop-gap until the primary goal of discovering the nature of the gravity sensor in immune cells is realized. Finding and understanding the origins of the immune systems' sensitivity to gravitational fields

(continued on page 191)

NASTY, BRUTISH, AND . . .

Harry Turtledove

Experimenters and experimental subjects, of course, have quite different ideas about what constitutes good technique!

Only humans, and not many of them, know why my favorite bar is called Hobbes's. That doesn't mean humans are the only people who go in, though, not by a long shot. Humans are spread thin out here, a couple of thousand light-years from home. The night I'm thinking of, I was the only one in the place.

"What'll it be, Walt?" Raoul Lévesque's number two bartender asked me when I came in. (No, Hobbes's isn't named for the owner, obviously.)

"Something nasty, brutish, and short," I told him. (*That's* why it's called Hobbes's, and knowing it's worth a free drink.)

"Tequila and *mor*-fruit?" Joe suggested. He knows me. He reached for the tequila with one hand, the *mor*-fruit (it's called that, I suppose, because it's *mor* or less like lime) with another, and the saltshaker with another. That left one free to wave at somebody who'd come in behind me. (I told you I was the only human in the place.)

While I was licking the salt off the web of my thumb, I looked around to see who—or what—was in Hobbes's this time. There were three or four tables full of Joe's people: not surprising, since Rapti, the planet under this space station, was Joe's home world. It was early yet, but a couple of them looked about ready to slide under their tables. (That's what they get for being four-fisted drinkers.)

An Atheter was already swinging from the chandelier. She was good at it. Atheters live in trees when they're at home, and they have prehensile tails. This one waved an empty glass at Joe and screeched for a refill.

A couple of Egnants put their credit cards in the music machine, one after the other. Raucous noise started blaring, loud enough to drown out even the Atheter.

I walked over to the machine, saw how much they'd paid, and used my own plastic to outbid them for quiet. They let their lips skin back from their teeth, but cheered up again when I bought them drinks. Egnants aren't hard to deal with unless you try to talk about religion.

I sneezed when I sat back down at the bar. Joe's ears twitched in surprise. "What kind of noise is that?" he asked.

"I've got the edge of a cold—a small sickness humans get," I said, disgusted at the way the worlds work. They keep saying they'll have a cure for colds Real Soon Now. I'll believe it when I see it; they've been saying that since before humans got off Terra. Greenbelly fever is dead as smallpox now, because it killed people and they threw research money at it till it went away. Colds are just nuisances. It's hard to get excited enough about a nuisance to get rid of it.

I ordered a beer to chase the tequila, took a sip, looked around some more. What would have been the second sip stopped halfway to my mouth. Off in a corner by him/her/itself sat a person whose species I didn't recognize, and I've seen a lot of them.

"Where's that one from?" I asked Joe. (Bartenders know everything. It's part of their job. If you don't believe me, just ask one.)

"Who?"

"The big blue one back there over my right shoulder." I didn't point at the

person. You never can tell what gesture will offend somebody.

"Oh, him? He's a Foitan."

"No kidding!" Now I really had to work to keep from staring. "I thought they were extinct."

A lot of worlds in this part of space, Rapti among them, had Foitani artifacts; they were on the edges of what had been a really big Foitani empire, maybe thirty, fifty thousand years ago. Then the really big empire fought a *really* big civil war. There are a lot of dead worlds in this part of space, too, and the Foitani killed most of them.

"So did we, until maybe fifty years ago," Joe said. "Then they started showing up every so often, traders mostly but archaeologists, too. They only have a few planets now, and they're interested in their glory days."

I shivered a little. "Where's their home-world? Do you know?"

"About as far from here toward galactic center as yours is away from it."

I shivered again, not a little this time. If the Foitani empire had reached across thousands of light-years, how big *had* that war been? How many more dead worlds lay inside that sphere? More than I wanted to think about, I was certain. Not even humans were stupid on that scale.

I found myself walking back toward the Foitan. Tequila always makes me reckless. "Excuse me," I said. "May I buy you another of whatever you are drinking?"

The Foitan had a bug by its ear. It looked like a Rapti bug, which meant it ought to handle Spanglish. It did. The Foitan said something in a language I didn't recognize, but my own bug did. I heard, "Thank you, if I may do the same for you."

I waved to Joe, pointed at my beer and the bottle in front of the Foitan, held up a finger. Joe waved back; he'd seen me. "May I join you?" I asked the Foitan, nodding toward a chair across from him.

By way of answer, he pushed the chair out with his foot so I could sit. My legs wouldn't have been long enough for that, but then, what I could see of the Foitan was a lot bigger than I was. He looked more or less humanoid, but only the biggest battleball players would have seemed like anything but children next to him. His face reminded me of what people might have looked like if they'd come from bears—blue bears—instead of apes: nasty, brutish, and tall, you might say. Actually, that's not fair. He was pretty impressive.

"My name is Naplak Naplak Kap," he said. "I have not seen your kind before. Is it polite to ask what you are called?"

"I'm Walter Harbron," I answered. "Walt will do."

"Walt," Naplak Naplak Kap said gravely. Just then Joe came over with our drinks. I took a pull at my beer; the Foitan half-emptied his new bottle. "Walt," he said again. He studied me. His eyes were large. They didn't seem to blink. "May I ask about your species? I do so only from curiosity, and mean no offense."

"Yes, go ahead. May I ask about yours as well? I've never met any Foitani before; I'd like to learn more about you."

Naplak Naplak Kap's shrug was massive. "I came to this world to learn more

myself. I am by profession a recoverer of the past, and we Foitani have much past to recover. What does your race call itself, and why are you here?''

''We're *humans*. As for me—'' I shrugged. ''I travel from star to star. I buy things, I sell things: sometimes material things, sometimes information. I haven't starved yet.''

''Ah. Profit.'' The bug's flat translation didn't give me any feel for how Naplak Naplak Kap felt about profit. Then he rumbled, ''*Humans*. Yes, I've heard of you people. You're widespread these days, aren't you?''

''We've done well for ourselves.'' I shrugged again. I didn't want to tell him that humans ranged as widely now as his folk had at their peak. Sure, we're just one species among many, but I still didn't want him to take it the wrong way. He was too big to risk riling.

''*Humans*,'' he repeated, this time, I thought, more to himself than to me. Suddenly he seemed to remember I was there. ''Excuse me. I seem to recall something about your species in a database from our ancient days that the Raptics showed me. My computer did a better job of reading it than the locals could. May I check?''

''Go ahead,'' I told him. (What was I going to say?)

His computer looked like a computer—not like what we build, but it couldn't have been anything else. He talked with it in a language my bug couldn't handle. I suppose it was his own. He finished his bottle, almost absent-mindedly. ''Yes, here we are,'' he said at last.

He spent long enough reading that, had he been a human, he would have been a rude one. Every so often he'd grunt. I didn't know whether he was surprised or angry or curious or what. Finally I got bored waiting. I said, ''May I ask what your records show?''

Once more, it was as if he had to remind himself I was sitting with him. ''Oh, yes, of course. I apologize.'' He put the computer back out of sight; by the way he fumbled about, my guess was that he wore it in a belt-pouch. Then his eyes found mine again. ''According to this database, your species should not exist.''

''We've tried to do that to ourselves a few times,'' I said, laughing. ''Hasn't worked yet.'' I drank some more beer. It was good. I could feel the chair pressing against my behind. ''I'm real enough. We're all real.''

''But you should not be,'' Naplak Naplak Kap said. He didn't have much in the way of a sense of humor. Whether that goes for Foitani in general I couldn't tell you. ''Let me explain.''

''Go ahead,'' I nodded. (One more time: What was I going to say?)

''You know we once ruled in this part of space, yes?'' (I nodded again.) ''We explored further yet, and once we touched on what I think must be your world.'' He dug out the computer again, did some quick figuring. ''In the coordinates the Raptics use, the location of the planet's star was—''

I pulled my own computer out of my pocket, turned Raptic numbers into my kind . . . and felt my jaw drop. Those numbers worked out to just over a light-year from Sol. I rubbed my nose, which was starting to get numb. I said, ''I guess that has to be my star, but the location's not quite right.''

"You forget," Naplak Naplak Kap said, "these records are 28,000 of my years old."

I felt like an idiot (not for the first time). Stars don't move fast, not compared to light, but they do move, and in umpty-ump thousand years Sol had gone a good ways. "Yes, I did forget," I said humbly. "Tell me about my savage ancestors."

"They were," Naplak Naplak Kap said. "They were vicious, too, and clever. One tribe managed to kill a Foitan despite his armor and weaponry, and was in the process of roasting him when my people took vengeance—from the air, at long range. We had learned."

"And so?" I asked. (What I wanted to do was cheer for those poor doomed cavemen.)

"And so we decided that even savage humans were dangerous, and that they should not be allowed to live to develop technology: we decided to destroy them." The bug in my ear put no expression into the words, which made them doubly chilling. Naplak Naplak Kap went on, "My species, it appears, did this often enough to have developed a protocol for it. We knew what we were about, I assure you."

"Go on," I ground out. Humans aren't innocent of such things, not while we were still on Terra and, sadly, not always after we got off, either. But having someone calmly talk about strangling us in our cradle—

"We prepared a respiratory virus genetically tailored to ensure that your species would not become immune to it, then disseminated it widely throughout your planet's atmosphere. In a few generations, you should have disappeared, and your world would have been there for the taking. But our own Suicide Wars started soon after, so we never went back."

"And we never died out." I felt like crowing.

"So you didn't." Guessing aliens' expressions is a fool's game, but Naplak Naplak Kap's seemed to say he thought it was my fault. "So far as I know, yours is the only species of which that is true."

In the middle of my triumphant chuckle, I sneezed three times in a row.

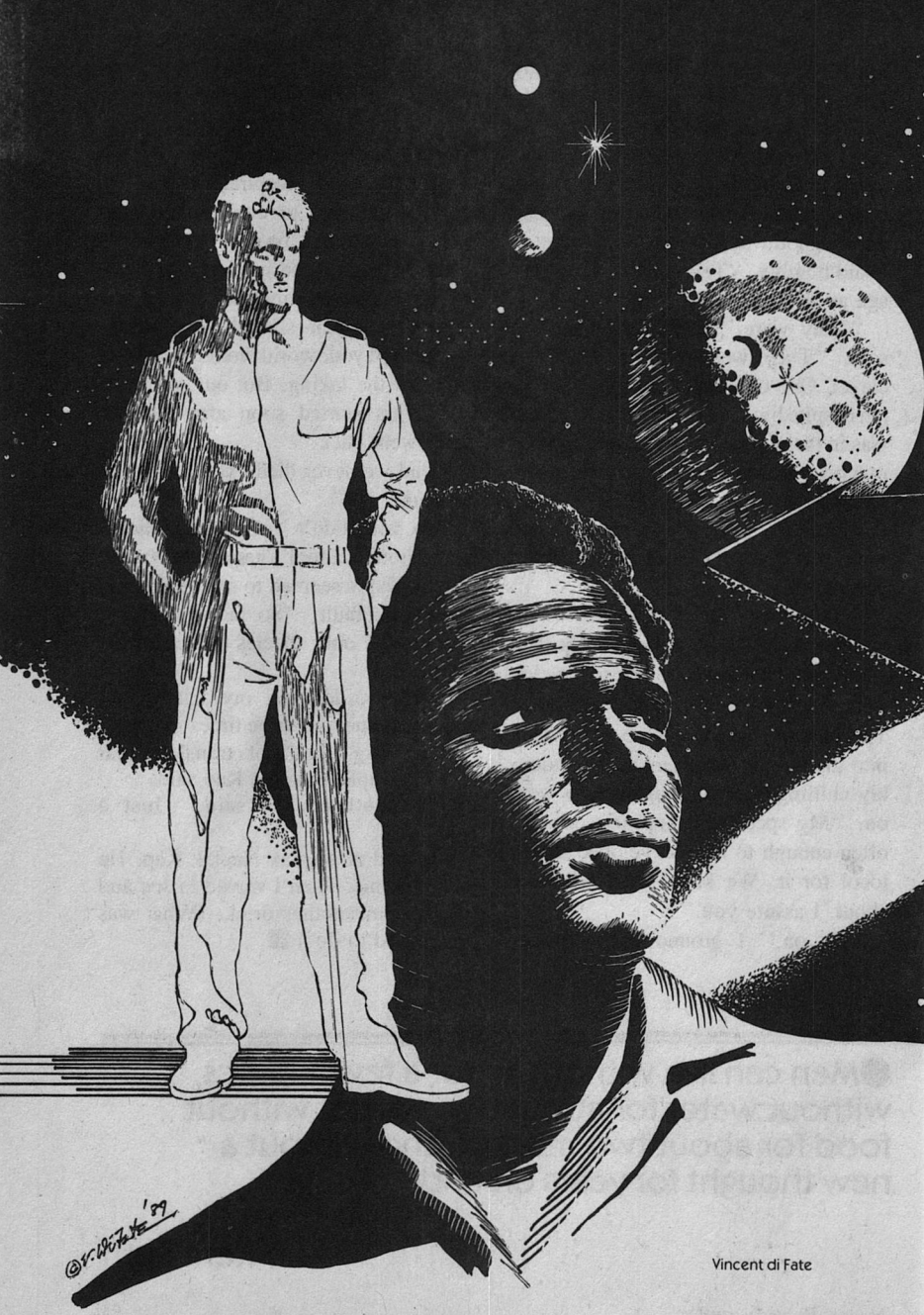
"My bug does not translate that noise," Naplak Naplak Kap said.

"It's nothing," I said. "Just a cold . . ."

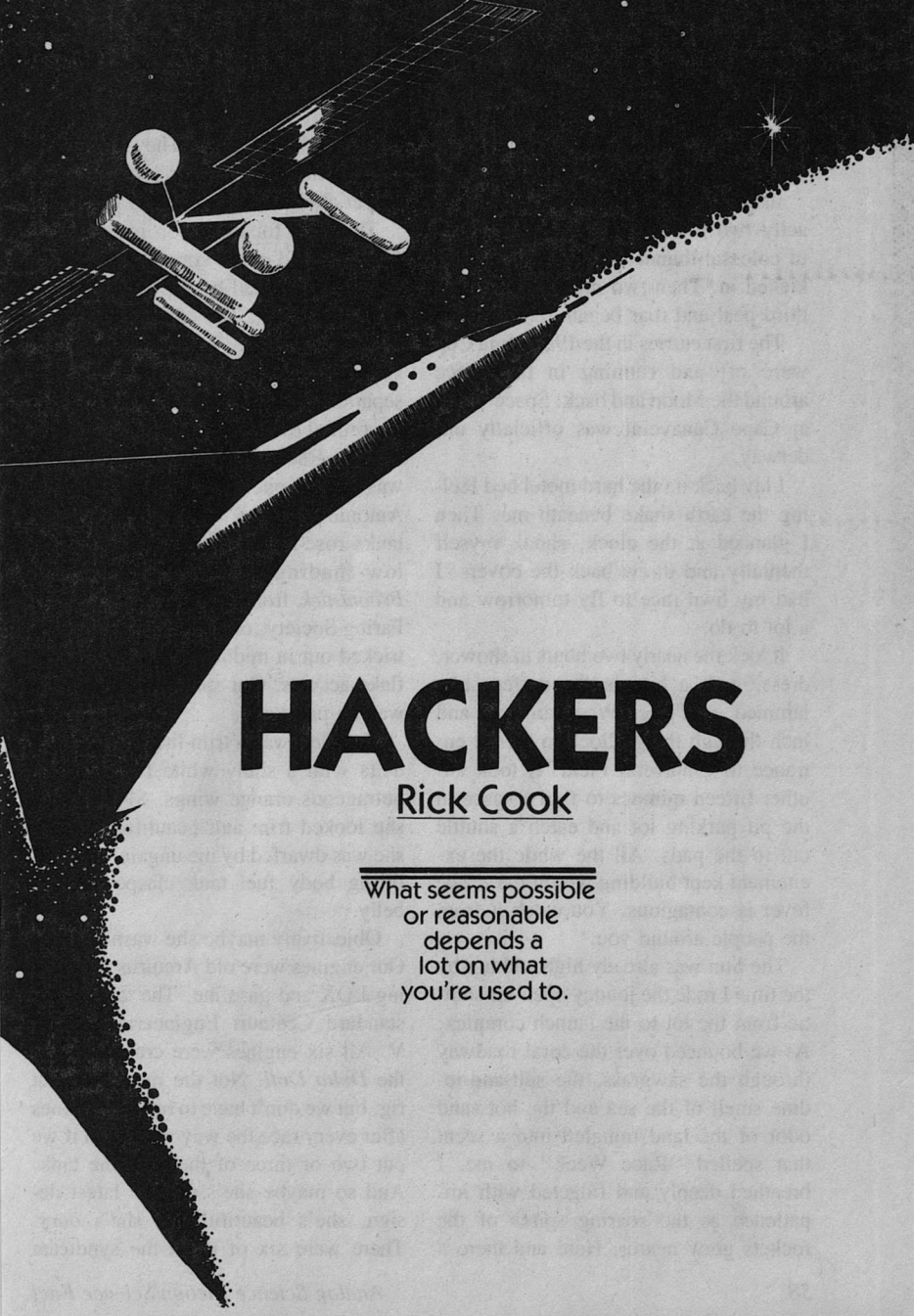
I looked at Naplak Naplak Kap. He looked at me. Then I waved to Joe and bought him another drink. (What was I supposed to do?) ■

●Men can live without air for a few minutes, without water for about two weeks, without food for about two months, and without a new thought for years on end.

Kent Ruth



Vincent di Fate



HACKERS

Rick Cook

What seems possible
or reasonable
depends a
lot on what
you're used to.

I awoke to thunder.

I rolled over and reached out, but the other half of the bed was empty. *Damn!* After that I didn't bother to try to go back to sleep.

Instead, I counted the seconds. Exactly two minutes after the first wave of colossal thunder hit, the second one kicked in. Then two minutes later, the third peal and roar began.

The first entries in the 1989 Luna Cup were off and running in their race around the Moon and back. Space Week at Cape Canaveral was officially underway.

I lay back on the hard motel bed feeling the earth shake beneath me. Then I glanced at the clock, shook myself mentally and threw back the covers. I had my own race to fly tomorrow and a lot to do.

It took me nearly two hours to shower, dress, grab a bite in the coffee shop jammed with Race Week crowds, and inch through the gridlock to the pit entrance to Canaveral Field. It took another fifteen minutes to find a space in the pit parking lot and catch a shuttle out to the pads. All the while the excitement kept building within me. Race fever is contagious. You catch it from the people around you.

The Sun was already high and hot by the time I rode the jouncy open-air shuttle from the lot to the launch complex. As we bounced over the coral roadway through the sawgrass, the salt-and-iodine smell of the sea and the hot sand odor of the land mingled into a scent that spelled "Race Week" to me. I breathed deeply and fidgeted with impatience as the soaring spires of the rockets grew nearer. Here and there a rabbit hopped nervously among the sawgrass, still excited by the morning's launches. Even the ducks seemed to have caught the spirit. They burst from the marshes with a flurry of wings to wheel above us as we jolted past.

The pads for the moon racers are at the north end of the complex, just three of them separated by a mile and a half of open ground. The other six pads are only a mile apart. The club events use smaller ships and they don't need the separation. Three of the pads were for the orbital events and three were for the Rescue Race. The *San Antonio Rose* was on pad one. I noticed that the San Antonio Rocket Club had painted their tanks rose-red to complement the yellow-shading-to-pink of the *Rose*. *Broomstick*, from the Los Angeles Space-Faring Society, on pad three was neatly tricked out in midnight blue with silver flake accents. Our ship, the *Delta Doll* was on pad two.

The *Doll* was a trim little Schweitzer delta with a shiny white fuselage and outrageous orange wings. Sitting there she looked trim and beautiful, even if she was dwarfed by the ungainly deltoid lifting body fuel tank clasped to her belly.

Objectively maybe she wasn't much. Our engines were old Arcturus IIs burning LOX and gasoline. The tank was a standard Centauri Engineering Model V. All six engines were crammed into the *Delta Doll*. Not the most efficient rig, but we don't have to rebuild engines after every race the way we would if we put two or three of them on the tank. And so maybe she's not the latest design, she's beautiful and she's *ours*. There were six of us in the syndicate

that owned her, and between us we could keep her flying.

And in spite of her limits she was a solid contender to win this year's Rescue Race.

In case you've been mesmerized by the Luna Cup or some of the other high-visibility events, let me explain how the Rescue Race works. It simulates carrying 2,000 pounds of emergency cargo to a space station in LEO. Your launch velocity and maneuvering delta-V are limited. You've got to make at least one orbit change to get from the launch orbit to the space station's orbit. You don't know what that orbit change is going to be until Race Week. All you know is it will be reachable with the allowed amount of delta-V, although sometimes just barely. Once you reach the station, you simulate docking, reenter, and land at the launch site. Design of the ships isn't important. It's piloting, pure piloting.

I spent a busy two hours going over the ship and conferring with Bill Rogers, our crew chief. When we're not competing Bill is my attorney. But he learned rockets in the Air Force and he's never lost his touch. I expected everything to be in good shape and I wasn't disappointed.

The gasoline had been loaded while I slept. The LOX wouldn't go into the tanks until this evening, just before the liquid hydrogen tankers fueled the ships that used LOX-LH2. You don't have fuel and LOX tankers on the field at the same time. Besides, even at the prices Linde charges racers, LOX is expensive and loading later minimized boil-off.

After satisfying myself that things were going properly, I caught a tram back to the main complex for the pre-race meeting.

The shuttle let me off near the exhibit area, just a short walk from the VIP tent. I strolled along nearly oblivious to the booths and pavilions around me. There were engines, tanks, electronics, even complete ships on display. Everything needed to build anything from a basic trainer that would barely make it once around the Earth, to a fancy but not-very-competitive Moon racer.

At the far end of the exhibits was a display of historic amateur rocket engines. It started with a group of the little liquid-fueled "basement bombs" of the 1940s and 1950s, and pictures showing some of the biggest names in amateur rocketry turning them out in home machine shops, or posing proudly on crude test stands. Further along were the larger engines developed in the sixties as amateur interest soared in the wake of the ICBM program and the Vanguard Earth satellite.

There was the 1965 Jove, the first amateur engine to power a manned ship. Next to it was the 1968 Gryphon, the larger later development that was the mainstay of the first orbital flights. I looked at it and shook my head. It took twenty of those things, in three stages, to get a tiny one-man ship up for just a few orbits. A little further down was the Iron Dragon 100, the first commercially available amateur rocket engine.

That one had really opened up the hobby, I reflected fondly. With Dragon you didn't have to have a machine shop to be a rocket amateur. Next to it was the Dragon II, bigger and more powerful. And there was the Dragon III, the engine that powered my first ship. I

reached out to pat the bell of the nozzle. With the ol' Drag Cubed you could build a ship that would not only let you reach orbit, it would let you take some cargo along. The first non-military space stations had been built using ships and cargo drones powered by Dragon IIIs.

And there, at the very end of the row, was Crazy Eddie. I shunted by, being very careful not to catch his eye. Wasted effort. He was standing there looking at the engines with tears in his eyes.

Over in the VIP tent the Moon Jockeys were living it up. At the bar, the Mayor of Luna City, wearing his trademark bush jacket, was discussing something with a couple of race officials at the top of his lungs. The thing must be a decade out of style, but I guess he figures every time he comes to Earth he's making an expedition into the wilderness.

The grand old men of the Luna Cup, Stine and Bozlee, were drinking together and probably swapping good-natured threats. A little ways away Vanderbilt, the youngest of the three-time Cup winners, was sitting at a table sipping something tall while about four lovelies hung on his every word.

I felt a twinge of jealousy. OK, the Rescue Race doesn't have the prestige of the Luna Cup, but it takes skill and nerve to win, not just some overstressed bundle of gold-plated high technology. Besides, it doesn't cost a fortune to build an entry. Ordinary guys like me, and the other members of my syndicate, could afford to compete.

Over in a far corner the other Rescue Racers had congregated. Professor Paul was pounding out something bluesy on the piano, his black hair a wild mop as he shook his head in time to the music and muttered the lyrics into his beard. Knowing him, the words were probably obscene. Shadow Jackson and the Wizardess, the LASFS pilots and the only female team in this year's event, were leaning against the piano with drinks in their hands. Everyone was wearing flight suits, naturally, and as usual the Wizardess had hers unzipped to somewhere below piano level. Did I mention the piano was a baby grand and the Wizardess is fairly tall?

Sitting behind the women, watching intently with an idiot grin on his face, was Sam Wilson, my partner and pilot. Unlike the others, he was drinking iced tea. They had either failed to qualify or were on later in the week. We were on early tomorrow.

Launching early has its advantages and disadvantages. The advantage is you're still fresh and race nerves don't have a chance to get you. Then you don't have to drink iced tea all week. The disadvantage is that if you're good, you set a mark for the others to shoot at.

There is also the chance that a team running last will come up with some clever little wrinkle that will give them an advantage in the race. Not likely, though. The orbital mechanics of a Rescue Race are pretty straightforward and so are the most effective courses. It all comes down to piloting.

Sam turned to me as I slid in next to him. "Howdy Hoss," he boomed over the din. Sam was born in Dallas and does this Texan/pilot schtick.

"Hi Sam." I signaled the waitress and she brought over the iced tea

pitcher. She knew we were up tomorrow, too.

"Son, you look lower than a snake's belly. What's the matter?"

"Nothing. I just ran into Crazy Eddie outside."

Sam nodded and said nothing. Crazy Eddie was a fixture at race week.

Some people love space and you have to be a bit of a monomanic to be a rocketeer. (I can hear LuAnn saying "a bit?") But with some people it becomes an obsession. Eddie was obsessed with the races. Or maybe he was just obsessed and the races were a convenient focus.

Anyway, Eddie was a fixture. He seemed to do nothing but travel to race meetings, sleeping in his battered old camper, living on nothing much and working odd jobs around the fields to support himself.

That wasn't that unusual. What really set Eddie apart was the weird disjointed stories he would tell when he got drunk. Get enough booze into him and he'd babble on about a government conspiracy to run a space program and a lot of other crazy stuff.

"Heard from LuAnn?"

I shook my head. "Still at her mother's. Still trying to make up her mind."

Two months ago my wife had moved out. No big fight, no major scene. Just a lot of little things, I guess. I had even offered to drop out of the syndicate and quit racing. LuAnn said she didn't know. So I was hanging and hurting.

Maybe that's why I was so sensitive to Crazy Eddie. He seemed to radiate a palpable sense of loss. Usually he was just a little pathetic. Now he was disturbingly resonant.

"Well," Sam said, "If there's anything I can do. . . ."

"What do you make of ol' Eddie?" I asked, trying to change the subject.

He shrugged. "A nut case."

"I suppose," I said and tried to turn my mind back to the race.

At 2:00 P.M. they gave us our course, and Sam and I spent the afternoon going over the details and plotting strategy. I lost myself in the slide rule calculations and the intricacies of burn times and orbital maneuvers.

Given the amount of propellant we would carry, the mission was doable, but just barely. Fuel loads are figured in terms of delta V so there is no advantage to having a super-light ship. It all comes down to piloting and dead-on navigation.

It was nearly 10:00 P.M. when we finished, but I didn't go back to the hotel. Instead, I wandered out the moon-slivered shell road to try to ease my soul by spending time with the *Doll*.

I stood just beyond the floodlit circle looking up at the *Doll* and trying to think.

Could I live without it? I asked myself. *Yeah,* I finally decided, I could.

It wasn't that simple, I knew. It wasn't just the racing. And it wasn't LuAnn's need to "find herself" —whatever the hell that meant. But getting back like we were before meant changing, and giving up rockets meant more time with LuAnn.

What would life be like without the racing? One way or another I'd been around rockets and racing for twenty

years. Giving it up would leave a big hole in my life.

But so would losing LuAnn.

And suppose I give it up, sell out of the syndicate, and it still doesn't work? Then where would I be? I sighed deep and long. *Shit!*

"Yep, she's a beauty all right."

I started, whirled and there was Eddie. His coveralls were greasy, his hair was disheveled and I could smell the liquor from where I stood.

"Course, they're all beauties. Every last stinking one of them."

"What are you doing out here?"

"Helping the mechanics on the *Rose*." He grinned, kind of lopsided, like his mouth hurt. "That's me. Good ol' gopher Eddie." Then his mouth drooped and he looked like he was going to cry.

"You ever want something?" he asked me. "Want something so bad you can taste it and then have it dangled right under your nose and not be able to have it? Not ever?"

"Yeah," I said uncomfortably.

"I didn't used to drink like this. But then I came here and saw all this," he waved at the line of floodlit monoliths stretching off down the Cape. "Shit, what am I supposed to do?"

All of a sudden it boiled over. My anger, my hurt, my irritation with this damn drunken crazy.

"You can make it happen." I snapped. "You decide what you want to do and you do it. You take your best shot and don't snivel because the world's not built exactly to your specifications."

"Easy for you. You grew up with all this."

"Easy? White boy, don't come crying to me about how hard it is. You try growing up black on the delta and you tell me how easy it is. I'm here because I didn't worry about 'easy.' You want it? You get it. And if you don't want it that bad, you don't go crying in a bottle about it."

Eddie straightened up. "You're right," he said, quietly, soberly. He looked down the line of rockets again and nodded, chin thrust out. "Thank you." And he strode off into the darkness.

"Good luck," I muttered after him.

Take your best shot and don't snivel. Yeah. When I got back LuAnn and I would settle this once and for all. Maybe I wouldn't like the result, but we'd settle it.

Race or no race, I slept better that night than I had in two months.

We mustered up in the cool gray dawn to the cry of the gulls and the distant sound of engines. The breeze mixed the iodine tang of the ocean with the faint aroma of gasoline and the metal/rubber smell of a living rocket.

Sam looked at me quizzically as we boarded the gantry lift, but I just smiled. I was excited and focused and settled all at once, and I felt great.

We didn't talk as we ran our preflights, just the litany of calling off the checklists and answering back. As we worked, the clock on the instrument panel ticked away, the hands sweeping inexorably toward lift-off time.

The last five minutes are always the worst. You're strapped in, your checklists are completed and there's almost nothing to do but watch the hands on the clock. Sam, at least, had a few last-

minute buttons to push and checks to run with the blockhouse.

There's always the anxiety. Not that you're scared, although racers have blown up on the pad, but there's always the chance you won't get a clean ignition and you'll have to scrub. If that happens you get a second shot forty-five minutes later when the window opens again. Blow that one and you're out of the race.

But the turbopumps sang up the scale and the engines fired clean and true when Sam hit the button. A final squawk from the blockhouse and we were off, slowly and tentatively at first and then faster and smoother as our speed built and the ground dropped.

Gradually the sky turned from ocean gray to pale pure blue and then darkened to black. There was a jolt and the big pumpkin seed Model V tank fell away. I caught a glimpse of it as it swooped down toward the sea, heading for the recovery area under radio control. There the salvage ships were waiting to fish the stages out of the water and bring them in for rebuilding and resale.

The flight plan I had worked out was tricky. It called for making the maneuvering burn almost as soon as we had orbit. That would save us the forty-five minutes or so it would take for a second orbit to get lined up and calibrated, but it meant we had to be right on the button and get our fixes *very* fast. We were trading maneuvering reserve for time and if things went sour we wouldn't have much chance to correct.

I kept my eyes glued to the altimeter and navigation sight while Sam took care of the burn. The instruments wavered and blurred in my vision, but the needles stayed where they should.

Almost as soon as the engines cut, I was out of my seat and swimming back to the periscope. I oriented myself to the starfield quickly and took three sights, calling out the numbers as I did so. Sam checked them against the pre-calculations I had done and was on the maneuvering jets even before I was back in my seat. I kept a hand or foot on a stanchion at all times and made it back quickly.

As I strapped in I saw Sam was frowning.

"What's wrong?"

"Nothing, maybe. But the thrusters feel funny."

I glanced down at the panel and shrugged. "Gas consumption is a little high, but nothing else shows. Maybe we've got a leak."

"Yeah, maybe." Sam sighed. "As long as it holds together."

By that time my seatbelt was tight and Sam was lined up. He reached over and preset the throttles on the two center engines, using both hands to play them like an artist. I turned back to my slide rule and graph paper, copying numbers off the instrument panel and plugging them into my pre-calculated equations.

We didn't say much. There was too much to do and we were too practiced. For a while I concentrated on the job at hand and forgot everything, even LuAnn.

"Burn coming up," I announced finally, jotting the last numbers on my pad and passing it over to Sam.

"Set?"

I punched the last settings into the controls. "Ready for burn."

"Thirty-five seconds." I watched the numbers reel off on the panel. Out of the corner of my eye I saw Sam's lips move as he kept count with the timer.

"Now!" Sam punched the firing lever and the *Doll* bucked as the engines fired to change our inclination.

There was a dull whooshing roar as the force of the firing transmitted itself through the airframe. Then just as suddenly as it had begun, the noise and vibration stopped.

Sam looked at the gauges, scowled slightly, and gave us a quick shot from the main engines.

"Something wrong?"

"Not really, but we didn't get as much out of that burn as we should have."

"The engines?"

"Maybe," he said, not taking his eyes off the instruments. "Not serious, anyway." He shook his head again. "Jesus. First the thrusters and now the engines."

I looked down at the clock. We were a couple of seconds behind schedule but nothing serious. If everything else went according to plan we should post an excellent time.

Now it was my turn. I dug the binoculars out of their case by my seat and started scanning the sky ahead, looking for the strobe that marked the station. In theory Sam's piloting and my calculations should bring us right up the chute, but there were always deviations and the sooner you spot them, the less fuel and time you lose correcting them."

There it was. A pinpoint blinking blue-white blue-white as it drifted lazily against the starfield. I nudged Sam and he saw it, too. A few quick touches on the throttles and firing keys and the light was growing ahead of us.

The light resolved itself into two flashing points, one blue and one white. Then one of them was occulted by the body of the station and I caught the first glimpse of sunlight reflecting off the dazzling white paint of the station proper.

It wasn't much of a station. Just a couple of small modules joined by a solar panel. No attempt to spin for artificial gravity and no fancy docking arrangements. As we got closer, I saw the Boy Scout insignia painted on the side. Of course! It was High Philmont, the station the Scouts had put up two years ago. I thought the coordinates looked familiar, but with something like 200 manned platforms in orbit only a real buff can keep track of them all.

Slowly and gently, Sam lined us up. Then with a final juggle of the thruster throttles, we were lined up on the station and drifting gently in formation.

It used to be that you actually dogged to the hatch of the station and transferred sandbags. They gave that up three years ago when they established new regulations about intentional dumping in space. I mean what's the space station supposed to do with several tons of sand? So now you simply maneuver to a halt next to the station, wait five minutes to get the "go" signal and break free to reenter.

We drifted close as Sam exchanged authentication messages with the Explorer who was acting as the station's radio operator. I was busy scribbling calculations and presetting the controls. As soon as the adolescent voice gave the word, Sam punched the firing stud

and the station started to drift up and ahead of us.

As the burn ended I checked my calculations again and compared them to the clock. We were doing very good, better than I had expected, considering the sluggish engines. Keep this pace and we'd post a time that would have the others scrambling. I settled back and felt some of the tension drain away. We had a long way to go, but it was all downhill.

Then almost as suddenly I jerked erect. Something was shifting around in the cargo compartment.

Before Sam could say anything, I was out of my seat and swimming back to the hatch. Shifting cargo isn't a dire emergency but it's serious on the reentry. I would have to hump to make sure everything was secure in time.

I pulled open the flap door and there, grinning back at me, was Crazy Eddie, still wearing that greasy jumpsuit.

"Well, I made it happen. I got my second ride."

Both of us had a lot to say in the next five minutes, but none of it bears repeating. While we yelled at Crazy Eddie in stereo, he just hung there and took it. He apologized, but that just set both of us off again. For the first time since I was twelve years old I was ready to kill a man, and I thought Sam was going to have a stroke.

"How the *fuck* did you get aboard?" Sam demanded when he calmed down enough to be semi-rational.

"Snuck on last night and made like a sandbag. You guys never even saw me on preflight."

I felt a twinge of guilt. I had checked the cargo compartment, but I had been concerned that the official seals were on the bags and the load was properly strapped in. It never occurred to me to look for stowaways.

We yelled some more, and Crazy Eddie did his best to look contrite. But fundamentally there wasn't a damn thing we could do and all three of us knew it.

"Well, what now?" I asked Sam at last.

Sam scowled. "We'll deal with this when we get back. Meanwhile, you sit over there," he motioned to the jumpseat behind the copilot's couch. "Don't say anything and don't touch anything. Just stay strapped in. Got that?" Eddie nodded and silently floated over to the seat.

For the next half hour none of us said anything. Sam just mutterred under his breath, I fumed, and Crazy Eddie watched the stars with a beatific expression. Every so often he'd lift his arm and stare fascinated as the sleeve of his jumpsuit floated free.

Mostly I was busy recalculating. Contrary to what you see on television, you don't flame in just because you're a couple of hundred pounds overweight. But it was going to affect our time. There would be a tiny difference in our angle of descent coming into the atmosphere and I'd have to allow for that in figuring our reentry point.

It wouldn't knock us out of the race, but it would cost us.

I shoved the pad with my calculations over to Sam.

"Shit," he said as he glanced at the number I had circled. "Why couldn't the silly sumabitch just take piloting lessons like everyone else?"

"No papers," Eddie piped up from the jump seat. "That makes it hard to get a student ticket. Besides, you can't get a decent job without official ID, so no money."

"What's the matter? They didn't give you a social security number in the loony bin?"

Eddie did that half grin again. "Oh I've got one of those. But it's no damn good."

He sighed. "I really suppose I ought to tell you the whole story. I owe you that much."

I scowled. Eddie owed us a hell of a lot more, but that obviously wasn't going to shut him up.

"I'm," he hesitated. "I'm not from around here." He paused again. "Look, do you guys read much science fiction?"

"Yeah," Sam growled. "You're from Mars, right?"

"No, I'm from another universe. An alternate time-line."

Sam slided a glance at me and I kept my eyes glued to the instrument panel.

"I was an astronaut before. I made one five-day flight to low Earth orbit before I volunteered for the thing that ended with me here."

Neither of us said anything.

"You know where you guys branched off?" Eddie said after a minute. "The space program. In my world the Russians put up the first satellite, *Sputnik*, and we raced them to the Moon."

"And you lost?" I asked.

Crazy Eddie gave that half-grin, like one side of his face was paralyzed. "Oh, we won. Got there in 1969."

This time I looked at Sam. The National Geographic Society's expedition reached the Moon in 1975.

"But after that," he made a crash-dive gesture with his hand. ". . . nothing. People lost interest and the money was used for other things. So we struggled for ten years to build a space shuttle a little bigger than this. Now there's talk that maybe in another ten years we'll have a space station that probably won't be as good as those goddamn Boy Scouts have got!

"I made one flight," Eddie said bitterly. "One lousy, stinking five-day flight. And I knew I wasn't going to get any more."

"What happened?" Sam asked. "You wash out?"

"Hell no. There weren't any slots for me. We've only got four shuttles and we plan our missions out years in advance. The best thing they could offer me was second alternate pilot on something three years down the road." He frowned.

"I train for years, make one flight and that's it. So when this other thing came along, I jumped at it.

"Well, I'm not going to tell you the details. It was secret and anyway I never did understand how the damn thing worked. But I was picked, I took my chances, and I ended up *here*." He showed his teeth nervously. "You know, I was ready for anything. Dinosaurs, radioactive ruins, galactic empires. Anything. Anything but *this*.

"In thirty years we spent over one hundred billion dollars on our space program. One hundred billion dollars! You guys spent diddly! Not a red cent!"

I wondered what LuAnn would say if she heard somebody call the money

I had poured into the *Doll* over the years "nothing," but I kept quiet.

"Wait a minute . . ." Sam put in.

"All you were was a bunch of goddamn amateurs—hobbyists who kept building rockets and blowing them up, and building them and blowing them up, until one day you knew enough that the rockets didn't blow up any more. Then you built bigger rockets and kept making them better and better. It's all crude and inelegant and hacked together and it took you forever to get anything done. You killed people right and left when these things blew up. But you didn't seem to care. You just kept at it and kept at it and somehow . . ."

Eddie's face twisted. "Goddamn it, we were the *government*. You guys had nothing and you're launching regularly." He started to cry.

I didn't say anything. There was nothing to say.

"Well," Eddie said, pulling himself together and grinning. "Anyway, I got my second ride."

"Yeah," Sam said. "You did." He turned back to the board, saw we had drifted off heading and thumbed the thruster lever savagely to bring us around.

There was an enormous BANG from the back of the *Doll*. "What the *hell* was that?" Sam yelled as he and I both grabbed for the controls at once.

The *Doll* started to yaw and I hit the thrusters to bring her back steady. She responded sluggishly, oddly.

"Oh shit!" Sam said, reaching over to hit a switch. I looked at where his hand went and then I looked at the gauges above the switches. "Oh shit!" I echoed.

Somewhere back in the rudder a pipe or a valve had let go. We had lost our stern maneuvering jet and a fair amount of our thruster gas as well.

We could still maneuver on the bow and aileron jets, but when the tail thrusters went so did our chance of winning the race.

"Take over," Sam said, and unbuckled his seat belt. While I ran a check on the panel, he floated back to the astrogation periscope to examine the tail.

"Oh shit," Sam said again. This time solemnly, almost religiously. I left the panel and floated back to look out the periscope.

The tail was a tangled mess. Apparently the leaking gas had built up in the fin, and gas pressure had blown half the port side skin off. The rudder was twisted at an odd angle and pieces of metal were sticking out here and there.

"May I see?" Crazy Eddie asked. Wordlessly I relinquished the periscope.

"Looks like a problem," he said laconically.

"You might say that," I said.

"Bottom line?"

"Huh?"

"The bottom line?" he asked. "What's the net result?"

"We can't land," I told him. "We're OK on reentry because the tail's masked by the body of the ship. But as soon as we need those aerodynamic surfaces, we're cooked."

"So?"

"So we reenter, get as low and slow as we can with control and then we bail out."

"Parachutes," said Sam and looked at me. The *Delta Doll* only carried two chutes. Naturally.

I turned to Eddie. "You and I will

have to go together. Hang onto me tight. I'll try to bring you down." I didn't have much hope. Eddie didn't have a pressure suit and no one could hang on in the supersonic gale we'd face once we jumped. Eddie was dead and I probably was, too. But what the hell. I had to offer didn't I?

"No," Eddie shook his head. "You go. I'll try for a landing."

"How the hell are you going to put this thing down with no rudder?"

He grinned tightly. "You don't need a rudder to land something this shape. You use the ailerons."

"What makes you think so?"

"Simulator time. I only flew one mission but I have a couple of thousand hours in the simulator. We used to practice in-flight emergencies constantly." He looked around the cabin. "You guys never built simulators. Why should you? You have so damn many ships you can get all the proficiency time you need just flying them." He looked back at us, dead-level. "But you can't practice for something like this in a real ship."

I looked at Sam and Sam looked at me. Well what the hell? He didn't have much chance trying to bail out as the second man on a parachute. I tried not to feel too relieved.

"You know you're going to have to land from the east?" Sam asked him finally. "They won't let us take a crippled ship over Florida."

Eddie frowned. "Is that allowed for in the energy profile?"

"Yeah. We do the turn high enough to make it on the thrusters."

"All the better then," Eddie said. "We used to practice our emergency landings coming in to Kennedy from the east anyway."

"Kennedy?" Sam asked.

"Kennedy Spaceport," he caught Sam's look. "Uh, Canaveral."

I busied myself checking the chutes. In the heat of the moment I had forgotten that Crazy Eddie was crazy.

We radioed our distress call and made one more orbit to line up on the Cape. The *Doll* wallowed and rolled, and it took a light, quick hand on the controls to keep her pointing true, but she came around on heading and lined up properly. As we completed the orbit we both gave Eddie a crash course in flying her. He seemed to learn fast.

As we approached reentry, Sam and I slipped into the parachutes. I tried not to look at Eddie as I buckled mine on. Then I took jump seat and Eddie slid into the left-hand seat, ready to take the controls when the time came.

"Remember," Sam told him. "Keep the nose high and don't let her build up too much speed above 80,000 feet." He didn't add, *so we can bail out safely*. Then he double-checked the instruments and hit the retros.

We bucked back in our seats as the rockets fired and I held my breath. What if the explosion had weakened the *Doll*'s structure and something important broke loose? But nothing did. We saw a couple of pieces of aluminum go sailing lazily by as our speed dropped. Then Sam was on the maneuvering jets, turning us nose-first and lining us up with the Cape.

Slowly at first, and then faster and faster we started to drop toward the Earth. The Pacific slid by beneath us, blue and flecked with clouds. Then we

were over Mexico and the air began to take hold, gently at first and then fiercer and harder. Outside I knew that the underside of the ship was starting to heat. Twice we shuddered and jerked and Sam swore as he corrected our attitude to shield our damaged tail as much as possible.

Over Yucatan the air clawed at us. The *Delta Doll* lurched and wallowed as Sam held her nose as high as he dared. The wind began to shriek and howl with a weird, warbling banshee wail through the damaged tail. Finally we began the long, sweeping turn which would take us around the tip of Florida and line us up on the Cape runway. At this altitude it was still a maneuver for the thrusters, but soon the thrusters would be useless, their push impotent against the air's grasping talons, their fuel exhausted by the effort. I flipped down my faceplate and inflated my suit. The chill heliox mixture tasted rubbery as it flowed into my mask.

"Three-two-one NOW," Sam yelled over the intercom and stood up suddenly. As I lifted the flap of the airlock's inner door, Eddie kept his eyes glued to the panel and his hands on the wheel, moving gently, delicately in response to the pressures on the controls. Then I was in the lock with Sam crowded in behind me. As soon as the inner door slipped into place, I undogged the hatch and thrust it open.

The next couple of minutes are a blur. I have a confused memory of an orange wing flashing by above me and the sky spinning in three or four directions at once. The next thing I remember clearly, I was falling straight and true with my head down and my arms pressed to my sides. The altimeter on my harness was unwinding steadily and the clouds and sea below were growing larger and larger. To one side I could see the white strip of beach and the greens and grays of the Florida coast. I used my hands as rudders to turn in that direction and watched for a while as the coast grew larger and the ocean nearer. Finally the altimeter showed that I was low enough, so I eased back into a spread-eagle position, waited a minute to kill my speed and then reached up and yanked the ripcord.

There was a jerk and the horizon rotated around me. I looked up and saw that my orange and white chute had blossomed perfectly, beautiful as no orchid ever was. I was bruised, battered, sore, my ribs hurt like hell and a wet trickle down my face told me I probably had a broken nose, but I was alive, Goddamnit! I was alive!

Off in the distance and far below I watched the bright orange *Delta Doll* wobble slightly then flare out to make a shaky but adequate landing on the shore runway at the Cape. Closer in I could see Sam drifting down under his brightly checked canopy.

We weren't in the water fifteen minutes before we were picked up by one of the yachts watching the race. They treated us like celebrities and broke out the ship's first aid kit and then the ship's liquor. We partied all the way back to the dock.

Then we disembarked into the middle of an enormous brouhaha.

Nominally the *Delta Doll* had finished fifth. Actually we were disqualified. First, we were automatically dropped when we declared an emer-

gency. Second, although the *Doll* finished, none of her official crew was aboard her when she touched down. Seems there is a rule against that taken over from horse racing. Third, there's a rule against using unlicensed pilots in NRA events and Crazy Eddie was definitely unlicensed.

The race officials were running around like wild men. They wanted someone's hide for this fiasco but they couldn't figure out who to skin.

There was some talk of having both our licenses on general principles. That died down when we pointed out —forcefully—that we hadn't invited Crazy Eddie aboard and made some very sharp comments about ramp security.

On the other hand they couldn't arrest Crazy Eddie. He saved the *Delta Doll,* and Sam and I weren't about to file charges. While he had broken a slew of Association rules, the Association couldn't have him arrested for that. Besides, he was a local hero. All the NRA could do was bar Crazy Eddie from future rocket meets.

Oh, one other thing happened. While they were checking me over at the hospital I got a tearful call from LuAnn. We're back together now, taking it a day at a time and trying to make it work.

I don't know that I'll be flying any more races, we haven't worked that out yet. It may be that Rescue Race was as much my last flight as Crazy Eddie's.

Which I can live with, I guess. And for Crazy Eddie it's a good thing. Stowing away a second time might have gotten him killed. Crazy people can hurt themselves.

And he *was* crazy. Even though he brought the *Delta Doll* in, he was crazy. He had to be crazy to tell that story.

Although . . .

Some time later, I talked to LuAnn's uncle. He's a space buff and knows more than he should about military space. He says the Soviets really *did* have a program called Sputnik back in the 1950s. Supposedly they blew up several rockets before they gave up on space shots and went back to building ICBMs. He also says almost no one knows about it. I mean, in the first place it's still supposed to be a secret and in the second place who cares about a thirty-year-old foreign effort to launch the sort of thing high school rocket clubs routinely put up today?

But Crazy Eddie knew about Sputnik. Just like Crazy Eddie knew how to land a crippled ship that by rights ought to have ended on the bottom of the Atlantic.

So sometimes I wonder. Was Crazy Eddie really crazy?

Then sanity reasserts itself and I remind myself that Eddie claimed the government had poured billions of dollars into space exploration for over thirty years and had gotten essentially nowhere with it. That *can't* be true. If the government really did put that kind of money into a space program, we'd be launching an expedition to Pluto by now, instead of piddling around on the Moon and planning to go to Mars.

I mean, that's only common sense, isn't it? ■

futures

Matthew J. Costello

Surely you know the scene from Mike Nichols's 1967 film, *The Graduate*. . . .

Benjamin Braddock (played by Dustin Hoffman) is at a party thrown by his parents to celebrate his college graduation.

And the hapless, soon to be sexually-awakened Benjamin is cornered by one of his father's friends/business associates, who promptly tells Ben that he has just one word for him—

(All together now!)

"Plastics."

Ben was left to nod dumbly at this revelation, as if it were some ancient mantra, while we rocked in our seats at the absurdity of it all.

But maybe, at least when it comes to games, it isn't all that absurd. Recently, I was talking with Mike Dobson, of Games Workshop U.S., the American branch of England's gaming giant and he told me about some new games on the way . . . *The Curse of the Mummy's Tomb*, with a three-dimensional board and metal figures, and a brand new version of *Blood Bowl*. Now *Blood Bowl* is a clever, satirical game that takes American football and parodies it with a hyper-violent version featuring orcs, skeletons, and well, you get the idea.

Except the new version comes with plastic blood bowlers—miniature fantasy footballers. And not only that, there's also a heavy Styrofoam playing field that, in appearance at least, recalls the good old days of the Roman Coliseum.

Plastic has arrived, and it's the number one topic in the game world.

Spurred on by the critical and commercial success of Milton Bradley's Gamemaster line, game companies are eager to increase the tactile component of their games in a substantial way. Milton Bradley supplied hundreds of soldiers, ships, subs, and planes for *Axis and Allies*, and artfully crafted daimyos, samurai, and ninja for its award-winning *Shogun*.

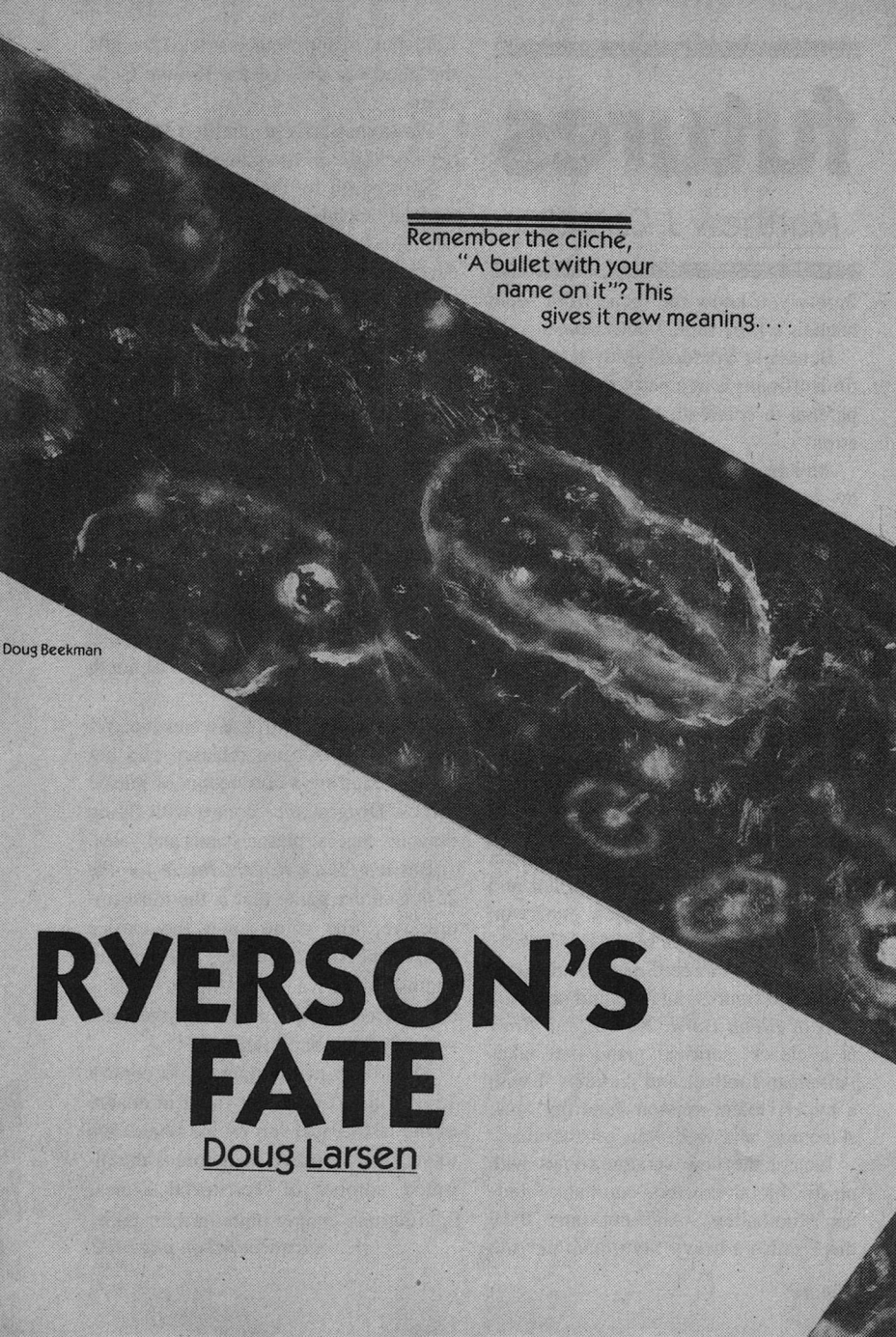
The normally staid and sober proprietors of Game Designers's Workshop announced *Sky Galleons of Mars*, the first game in their *Space: 1889* series. *Sky Galleons* will include plastic replicas of interstellar Ether ships, cloudships, and galleons that helped establish colonies on Mars before the Twentieth Century.

TSR (PO Box 756, Lake Geneva, WI 53147-0756) has just released two big games featuring a cornucopia of plastic pieces. *Dragonlance* comes with flying dragons, lances, plastic stands and gates.

But it is *Buck Rogers Battle for the 25th Century* game that is the most impressive. The game takes the classic hero of the Sunday funnies and pits him against Killer Kane and Ardala. This is a massive combat game, with the solar system as the battlefield.

The object of the game is to control 15 Territorial Zones or to be in charge of the last Leader left on the board. Up to six players move their forces the allotted number of Territorial Zones, fighting any enemy units in their path.

(continued on page 182)

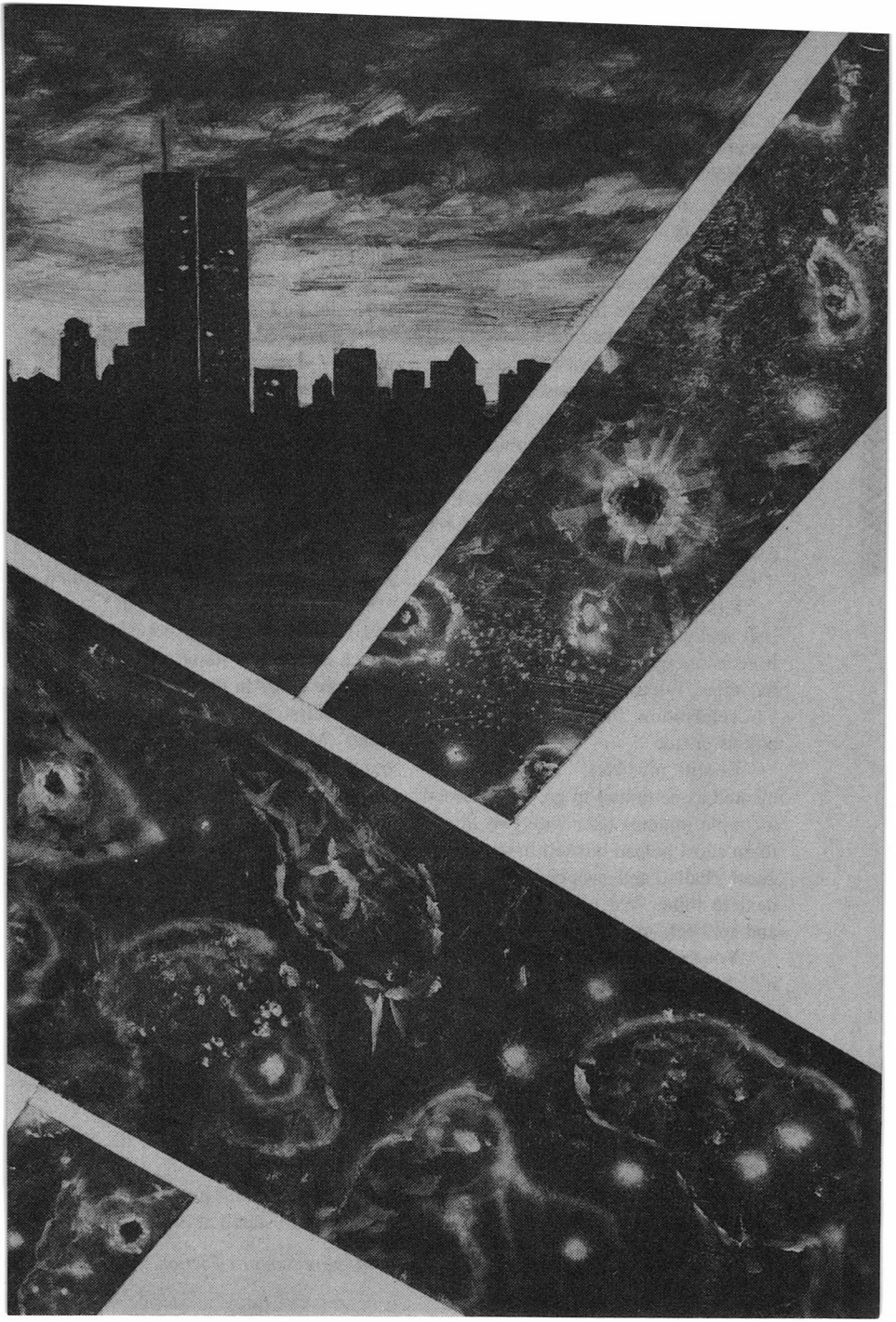


Remember the cliché, "A bullet with your name on it"? This gives it new meaning. . . .

Doug Beekman

RYERSON'S FATE

Doug Larsen



I tell you, it's the most satisfying part of my job. I knew it was coming when I heard a knock at the door.

"Nobody escapes," Marjoram proclaimed with satisfaction, walking in and tossing a sheaf of papers on my desk.

I grabbed the papers and scanned the first page. It was the summary sheet, announcing that one Tony Watkins, male Caucasian, brown hair, etc., etc., had been found unconscious in his apartment on the east side, stinking to high heaven, with his skin turned bright green. I chortled triumphantly. "Nobody escapes," I agreed, tearing off the summary sheet and slipping it into a file folder. I propped my feet up on the desk. "We got a match, of course?"

"First thing," Marjoram confirmed.

It really is. Nothing compares to it. It keeps me going as I slog through the red tape. I leaned back in my chair. "In celebration," I decreed, "you can buy us coffee."

"Be still, my heart," Marjoram commented as he turned to go. He returned a couple minutes later with two Styrofoam cups, helped himself to one of my guest chairs, and propped his feet up next to mine. We toasted each other, and sat back, reveling in it.

"You know the thing I like best about it?" Marjoram said.

"The coffee?"

"Close. The thing I like most is the fact that this guy rapes a woman, beats her up, gets away with no witnesses, the victim has a cruddy description of him, and we still get him within twenty-four hours."

I nodded appreciatively. "You know what I like best?"

"There's something better?"

"Just as good, anyway," I conceded. "What I like best is that we got him dead. No plea bargaining. He's looking at twenty-five, thirty years. All his lawyer can do is sit there and plead guilty for him."

Marjoram nodded. "That's good, too," he said.

"I was looking through the files yesterday," I said. "Do you know that aside from prison escapees, we haven't had a repeat rape offender for eight years? Before we got into this, this guy would have raped probably another five, six women before we caught him with conventional forces."

Marjoram shook his head in admiration. "We're good," he proclaimed. "There's no question about it."

I was really feeling good that day, which is rare, so I luxuriated in it. "We are, aren't we? In the war on crime, we are the first real breakthrough in centuries. Most of the time, since we get our noses rubbed in the depths of human suffering and despair that's inflicted on innocent people by criminals, I feel pretty cruddy. But every once in a while, it's nice to sit back and think of what progress we've made. Even though we've got a hell of a long way to go, it's nice to see some progress."

Marjoram nodded appreciatively and sipped his coffee. "Speaking of progress, what do you think our chances are of getting the new budget approved?"

"Pretty near zero, I'd say," I answered, tensing a little.

Marjoram looked alarmed. "Zero! Why?"

"I didn't submit it," I said.

Marjoram stared at me. "Why in the

world didn't you submit it? Don't tell me you're on one of your austerity kicks again.''

''That's exactly it, and I wouldn't call it a kick. I'm trying to hold costs down. I'm trying to keep our division politically popular and avoid budget cutbacks. The best way to do that is to not make waves.''

Marjoram shook his head. ''We haven't done any major research and development in over five years!'' he protested. ''We're going to lose our technological edge if we piddle around and don't keep driving forward.''

''Relax,'' I told him. ''We've got it all taken care of. Cropdusting works every time. Nobody escapes, and nobody will. Why waste the money?''

Marjoram opened his mouth to object, but was interrupted by a stormy looking guy who hurried into my office. He didn't knock—he just came in. I looked up inquiringly, since I don't stand on protocol all that much. He looked back, and his lip curled in a sneer. He had a thin face and an unruly shock of black hair, but the thing you noticed most were his eyes. Angry eyes. This was one hostile person. It was hard to say if he was always like that—people have a tendency to be angry when they come into a police department—but he didn't make me feel comfortable. He looked at us slowly, with contempt showing on his face.

''I'm sorry,'' he said clearly in a reedy voice. ''Wrong office. I was told to look for the Commissioner of Cropdusting, whatever that is. I obviously got the cafeteria instead.''

''Wrong,'' I announced. ''You have the right office.'' I straightened up in my chair. ''I'm Jack Donnally, Commissioner of Special Apprehension Services, and this is Dr. Gene Marjoram, the head of the Special Apprehension crime lab.''

The man looked confused, and obviously didn't like being confused. ''I was told to see the Commissioner of Cropdusting, not Special Apprehension,'' he muttered.

''Commissioner of Cropdusting is my slang title, the one they use on the street,'' I explained. ''You've got the right room. What can I do for you?''

''I am William J. Ryerson,'' he said, as if the name was supposed to mean something to us. We looked at him politely, waiting for him to continue. He saw that his name meant nothing, and looked even more sour. ''I am an art critic for the *New York Times*,'' he said. ''I am considered to be one of the leaders of the artistic community in the country.''

''That's nice,'' I said patiently. ''What can we do for you?''

He looked annoyed that we weren't impressed. ''I want to know what you're going to do about the art thief that's running rampant in this city! Interpol has traced him from Europe and is now convinced he's in New York. I don't know much about Cropdusting, but I have heard stories about how you capture criminals who are otherwise impossible to capture. When do you start?''

Marjoram gave me a significant look that signified that he wasn't through with his subject of debate, and stood up. ''I'll excuse myself,'' he said, ''and leave you to the Commissioner.'' He left tactfully.

"Have a seat, Mr. Ryerson," I said politely.

"Thank you, I prefer to stand," he said curtly. "I am not here on a social call."

I could tell I was going to like this guy a lot. "Well, Mr. Ryerson," I answered as politely as I could, "my department is not doing anything about the art thief. That case has not been referred to me."

He looked like he was going to spit. "Why in the world hasn't it?!" he sputtered. "I thought this was the revolutionary crime fighting department! What's wrong about capturing possibly the most successful art thief in history, who has stolen some of the world's greatest paintings?"

"Let me explain about my department," I said as calmly as I could. "We are the department of Special Apprehension Services."

"I know," Ryerson said impatiently.

"Let me finish," I said. "We are the newest addition to the war on crime: we are the biological warfare department."

"How do you mean biological warfare? I just heard that you catch people that otherwise wouldn't be caught. This art thief certainly falls into that category!"

"Yes, he does, but you haven't let me finish," I continued, holding my temper. "We isolate the DNA of a criminal, and manufacture a synthetic virus that is keyed to that specific DNA."

"I'm familiar with the basic principles," Ryerson snapped.

"Yes, but hear me out," I said. "There are a lot of misconceptions about Cropdusting. Every person has DNA. It's in every cell of your body. DNA is what determines everything about you: your hair color, whether you're right- or left-handed, whether you can curl your tongue," I demonstrated, and he looked at me distastefully. "Anyway, everything about you is determined by your DNA, and therefore, your DNA is unique to you. We call it a gene print. It's like a fingerprint, only more so. So what we do is, when we've isolated a person's DNA, we make a synthetic virus that will only respond to the DNA we've isolated. It will only grow in that person's body, even if we expose a thousand people to it."

"I didn't know it was that exact," Ryerson said, visibly impressed.

" 'Specific' would be a better word. Viruses don't have any metabolic machinery, and can't reproduce without a host. We just specify the host. This virus is "keyed" to your DNA. So we call it the keyed virus. It's benign—it doesn't do anything to a person except grow. But what we do is manufacture another virus that we piggyback onto the keyed virus. And this piggyback virus is anything but benign."

"So what happens?" Ryerson asked with mounting impatience.

"Well, say we've isolated your DNA," I said. "And say we wanted to turn your skin bright green. Well, we've got a piggyback virus that will do that. So we piggyback it onto a virus that's keyed to you. Then we spray this virus all over the city. Using helicopters. That's where it got its street name of Cropdusting, because when we rig the police helicopters with the spraying apparatus, they look like the old-fashioned Cropdusting helicopters of the mid-

1900s. Well, this virus has been mixed with a synthetic host, and will reproduce like crazy for a day or so, all on its own, and will live for another couple of days. In that time, you will have come in contact with it, because it will have been picked up by building ventilation systems, the subway's ventilation, and so on. Or you'll just breathe it in the air, or pick it up on your fingers and rub your eyes, or eat something that has it on it, and so on. Everyone in the city will do that, but in everyone else, it won't do a thing. A couple of days after everyone else ingests the virus, it will be harmlessly expelled from their bodies, and nobody would even notice it. Except, of course, you. Your skin will have turned bright green by this time, because the keyed virus found your DNA, and thus began to attack your individual cells and your cells' DNA, and reproduce just like a cold virus or a flu virus. And the piggyback virus, which is the one that does the dirty work, can't reproduce by itself—only when the keyed virus reproduces. And the keyed virus can't invade the cell of any human host except you. So you're bright green, and nobody else is affected."

"I follow you, but you still haven't answered my question," Ryerson observed sourly.

"Well, surely you see the advantages. Some quick lab work, a light spraying, and we've found our criminal. Actually, the virus has found our criminal. The piggyback virus we use makes him stink to high heaven so he can't hide, and makes him emit all kinds of noxious stenches that can be detected by our sensing equipment, much like you'd zero in on someone operating a short wave radio. So if the criminal is stupid enough to not turn himself in for an antidote, we find him or her without having to waste officers' time on detective work and risking their lives trying to arrest someone. One of the misconceptions that we've allowed to persist is that Cropdusting is very harmful to the person unless they quickly receive the antidote. But it's actually harmless."

"Yes, I see the advantages," Ryerson said with exasperation. "What I want to know is why you haven't used it on this art thief."

I shrugged. "It's sterile," I said simply.

He was extremely offended. "Art is not sterile! Police work is sterile! Your brain is sterile if you think so little of culture!"

I chuckled. It was fun baiting this pompous twit. "Calm down," I said. "Art theft is usually a sterile crime, that's all. Nothing in it for us."

"Sterile in what sense?" He was still huffy.

I rolled my eyes. "Look," I said wearily. "Sterile crime is a slang term for crime that can't be handled by our department. I told you we need to isolate a criminal's DNA before we can spray for him. We can't get the DNA unless the criminal has left some body tissue or fluid around that we know belongs to that criminal. And this art thief hasn't left a trace so far, has he?"

"No," Ryerson said stiffly. "Sometimes the police can hardly figure out how he got in to a place."

"So we can't isolate his DNA. Sterile crimes where they leave no trace are

solved by some other form of investigation, not Cropdusting."

"In other words, it's useless," Ryerson snipped.

I briefly wondered how far back he'd fall if I punched him in the face, but managed to shake it off. "In sterile crimes, you're right—it's useless. But what you're overlooking is that in other types of crimes, criminals are caught who never would have been caught before. Random, violent street crimes, with no witnesses or clues: the kind that terrorize entire neighborhoods; the kind that nobody cares about because all that's involved is some poor, innocent civilian who never hurt anybody; the kind that hardly ever makes the newspapers anymore because they're so common; that's the kind of crime that is solved with Cropdusting. Violent crimes like that usually leave some trace of the attacker, and since those crimes are solved quickly and accurately, that leaves more of the police force's resources available to devote to sterile crimes with more conventional means." I noticed that my voice was steadily rising, so I stopped and took a breath. "That is the kind of crime that Cropdusting is used for, and because of Cropdusting and the deterrent it poses, the devastation and suffering inflicted on innocent people by other people through crime is way down. That's why you can walk the streets safely. Or more safely. Understand?"

Ryerson was shaking his head. "It seems to me, then, that crimes like rape would be nonexistent. After all, rapists leave something behind every time."

"You'd be surprised," I told him. "Rape is a power crime, not a sexual crime. Rapists don't always even have an orgasm." Ryerson made a distasteful gesture, and I continued. "Hey, you asked, didn't you? You do have a point: rape is such a violent, physical crime that there is usually something we can use."

"So if your Cropdusting is so great, why are there people out there who still rape?" Ryerson challenged.

"You're assuming that rapists are rational people who will make the intelligent decision when faced with the facts," I answered. "But the opposite is true. That's why they rape in the first place. With Cropdusting, however, we have virtually eliminated repeat offenses."

Ryerson was still fixed on a single track. "This is all well and good," he said, "but what you're telling me is that you're not going to do anything about the art thief."

"I'm trying to help you understand our efforts so you'll see that we're doing everything we can," I said impatiently. "Can't you see that?"

"Of course," he said frostily. "Good day, Commissioner." He slammed the door behind him, leaving me shaking my head in disgust.

Ryerson had aroused my interest as well as my anger, so I checked the newspaper the next day to see if there was anything about it. Son of a gun—there was a story on the front page. Another art theft had taken place during the night, at the Museum of Modern Art, and the signs indicated that it was the same guy. He had known exactly what he wanted, because he had passed up another couple of pieces that were about

equal in value, but easier to get to. And the piece he took was a heavyweight: *Christina's World* by Andrew Wyeth. According to the reporter, Wyeth was a major force in American art in the mid-20th century. Not that I'd heard of him.

An interesting point was made in the article. Most of the paintings taken by this guy were so famous that you could never really sell them. Everybody would know immediately what they were. When paintings of that magnitude were stolen, they were usually held for ransom, like in a kidnapping, under the threat of burning or slashing if the money wasn't paid. But so far this guy had made no demands.

I scanned the rest of the article, getting a little bored with the subject. There was nothing in it for me. This guy was top-quality professional. Clean entrance. Clean exit. Sometimes it took days to figure out how he had actually done it. A cat burglar of consummate skill, he eluded guards wherever he operated. Nobody had even seen him, much less had a chance to get a piece of skin tissue. There was reason to believe that he had worked in other cities, and even other countries, so the FBI was on the case.

The newspaper gave a quick list of robberies believed committed by this thief, and it was pretty long. In New York alone he had robbed the Metropolitan Museum of Art, the Museum of American Art, and the Museum of Modern Art, just to name a few. He was also believed to have hit the Prado in Madrid, the Louvre in Paris, and the London Museum. He had also probably robbed several other European and American city museums, but the experts weren't sure.

Pieces he had taken included Jackson Pollock's *Number One*, Marcel DuChamp's *Nude Descending a Staircase #2*, Martin Schongauer's *The Temptation of St. Anthony*, Josef Albers's *Silent Hall*, Giovanni Bellini's *St. Francis in Ecstasy*, Goya's *The Third of May, 1808*, Theodore Gericault's *The Raft of the 'Medusa,'* Rembrandt's *Christ Preaching*, Andy Warhol's *Marilyn Monroe*, David's *Death of Marat*, Kitagawa Utamoro's *Yam Uba Combing her Hair*, Albrecht Durer's *Adam and Eve* . . . geeez, I hadn't heard of any of that stuff. The writer made it sound like they were tragic losses to the world, and significant works, but I hadn't missed them. There were a lot more on the list, but they meant nothing to me. I scanned it real quick to see if there was something I recognized, but the only works of art I had ever heard of were the Mona Lisa and Whistler's Mother. They weren't on the list, but a bunch of other stuff was. Whoever this guy was, he must be really good.

I tossed the paper aside. I didn't see this guy giving me anything to go on for a long time. I hoped the local boys got him before the FBI did. I settled down at my desk when my phone rang.

"Commissioner Donnally," I answered.

"Donnally," barked my chief's familiar voice. "Get in my office."

I quickly reviewed anything I had done recently, and felt pretty secure, but I never liked being called into Chief Bourke's office. I hurried over, and when I entered, he was leaning back in his chair, reading the newspaper. He

tossed it to me across the desk as I sat down.

"See the paper this morning?" he asked. "The story of our art thief?"

"Yeah, as a matter of fact," I said. "I was visited by a guy named Ryerson yesterday, so I thought I'd see what he was screaming about."

"He's still screaming," Bourke said briefly. "You obviously haven't read the Arts section yet, or you wouldn't be so calm."

"Why?" I didn't like the sound of that at all.

"You're in Ryerson's column this morning," Bourke informed me. "So are the rest of us. He's not a fan."

I picked up the paper and looked where Bourke's stubby finger was pointing. Ryerson did indeed have a column, titled "Perspectives on Art." There was a cruddy picture of him under his column graphic, then a headline: POLICE NEGLECT ART COMMUNITY. Knowing Bourke was watching me, I scanned it quickly. Words like "unsympathetic," "uninspired," "wasted tax money," and "arrogant" came up to meet my eyes. My name was included in a list of people labeled "rude, paper-pushing bureaucrats."

I looked up at Bourke, and I was steaming. "I thought that guy was an asshole," I said. "I guess I was right."

"You were right," Bourke agreed, "but that's not why you're here. We don't need this kind of negative publicity, Jack. We've been busting our ass to catch this thief, but he's skunked us every time. This Ryerson guy hasn't made it any easier, and now he's souring our relationship with the heads of security of the major museums, not to mention the local politicians and the community at large. Steer clear of this guy. Don't give him any more ammunition."

"A pleasure," I said.

"Fine. But at the same time, I want you to start following this case. If there's another heist, I want you to come look over the scene. Bring Marjoram. Just see for yourself if there isn't anything you can use."

I nodded, taking a few notes.

"Another thing," Bourke added. "There's going to be some Federal boys around here. Cooperate with them. We don't need them calling us the same things Ryerson is. But if the Feds catch this thief before we do, I'll skin all of you. Spread that around."

I nodded again, knowing that he probably meant it.

"That's all," Bourke said.

It was a few weeks before I saw Ryerson again. I had followed his tirade of abuse in his newspaper column as he castigated the police force for incompetence, stupidity, and conspiracy to wipe out the art world, but nothing else had happened. So I was surprised one day when I got to work early in the morning and found him waiting for me.

"Ryerson," I said abruptly, surprised and not pleased. "What do you want?"

"There was another art robbery last night at the Guggenheim Museum," he said in his reedy voice. "I was told to come see you."

Ah. "Come in," I said, opening the office door and turning on the lights. I was a little confused. "I was told that I would be called to the scene of any

further art heists," I said, sitting at my desk and gesturing him to a chair. "But I wasn't this time. Have any idea why?"

"I think so," Ryerson said. "He left some of himself behind, and it was pretty obvious."

I grabbed my keyboard and called up the warrant program. "We're all set, then. Give me the place of the crime."

Ryerson looked puzzled. "The Guggenheim Museum. You know that."

"No. Spell it."

"What?!" Ryerson looked at me with shock. "You can't spell Guggenheim?!"

I tried to keep patient. "It's for the warrant," I explained. "We've got to get the warrant approved before we can do anything, and misspellings are murder for a case."

"I don't understand," Ryerson said. "What do you need with a warrant? A crime has been committed. You can isolate the criminal's DNA now. So spray the city with your Cropdusting stuff, or whatever it's called! Get him! Stop him!"

I looked at him sadly. "You still don't know much about Cropdusting, do you?" I asked.

"Not much, no. How much do you know about art?"

"Even less. But let's not get too pretentious here. You obviously are working from a position of ignorance. I didn't know you cerebral types did that."

There was a long silence while Ryerson looked daggers at me. "Well then, Mister Commissioner Donnally Sir," he said with elaborate politeness, "perhaps you could enlighten me as to the finer points of Cropdusting. And afterwards, I will explain to you the difference between a paintbrush and a crayon."

"Don't bother," I shot back. "My information is important. Yours can wait." I ignored his furious expression and began to explain. "You remember the international ruckus thirty years ago, right?"

"The Jarman-CIA scandal? Of course. But why don't you refresh me anyway?" he said sarcastically.

"Fine. We'll do it your way. Well, thirty years ago, the Russians figured out that the CIA had isolated the DNA of their premiere, and was trying to piggyback emotion-altering drugs onto the keyed virus. So that he would sign a treaty that wasn't as advantageous to his country as it could have been, and things like that. They didn't kill him because none of his replacements were any better. Or they were worried about full-scale war if they were discovered doing that."

"I'm familiar with the history," Ryerson said impatiently. "They used it on Cuba. Their leader suddenly died of natural causes a couple years before that, and it came out that the CIA had given him pneumonia or something."

I nodded. "Right. Anyway, apparently it didn't work on the Russian premiere. Emotions are a lot harder to influence and control than physical health, especially with viruses. So after the big scandal and the showdown at the U.N., diplomatic relations soured to their lowest point in history, and crime fighting got its biggest boost in history. The technology was released to the FBI, who released it to our special Cropdusting departments."

"And what did you do with it?"

"Well, we ran a couple of tests on the virus."

"Thirty years ago?" Ryerson asked pettily. "You don't look old enough."

"Thanks." I wasn't going to be thrown off stride. "My predecessor ran a couple test runs. There was panic in the streets. Thousands of people ran to emergency rooms complaining of all kinds of psychosomatic maladies: everything from shortness of breath to headaches. We should have known better. The idea of a police department spraying the populace with strange viruses is enough to make any citizen a little paranoid. The city had to run an intensive public information campaign to settle everyone down. With time, and with the success we've enjoyed, Cropdusting has eventually become accepted by just about everybody. The purse snatcher we tried it on was quickly found, of course, with his face bright green. He was also in a panic, and in an emergency room. The doctor managed to slip away and phone us."

"Why pick a purse snatcher?" Ryerson asked. "Wouldn't that be a sterile crime? And why pick such a piddling little crime?"

"We wanted a test case of little importance," I explained. "And anyway, the lady who lost her purse to him struggled a little bit, and pulled his stocking cap off his head. He didn't care—he ran. But we found three hair follicles of his in the cap. That's how."

"So what happened?" Ryerson prompted.

"Lots. The American Medical Association objected to having their doctors exposed to desperate criminals who know they are likely to be caught."

"They had a point," Ryerson observed.

"I know." I was getting tired of this jerk. "It was something we didn't think of. To avoid legislation on the subject, we made a policy that Cropdusting would always have to incapacitate the criminal in some way. We came up with a virus that would knock them out for days at a time, have them stink to high heaven, and secrete biological stuff that could be traced as easily as a radio wave, if you've got the right equipment. So he was harmless, and easily found. And as time went on and Cropdusting began to have an effect, public fears diminished to a point that innocent people don't even think about it any more."

"So why are we bothering with a warrant?" Ryerson interjected with mounting impatience.

I sighed wearily. "The arrest was contested, of course. The entire Cropdusting method was challenged on the Fourth and Fifth Amendments."

Ryerson looked uncomfortable. "I . . . could you . . . I mean, the Fifth Amendment refers to self-incrimination, of course, but could you refresh my memory as to the Fourth?"

I smiled sardonically. "I'm sure it just temporarily slipped your mind. Where shall I start? Do you know what the Bill of Rights is? Or should I tell you what the Constitution is?"

"Stop baiting me, Donnally!" Ryerson yelled. "Just answer my question!"

"Fine. The Fourth Amendment to the Constitution is the one that protects citizens from unreasonable search and seizure. The Fifth Amendment, as you said, refers to self-incrimination." I

looked at him. "That means, you don't have to. Incriminate yourself, I mean."

"Are you enjoying trying to make me feel stupid?" Ryerson asked peevishly.

I figured it would be impolite to tell him exactly how much I was enjoying it, so I went on without answering. "The case went to the U.S. Supreme Court," I said, trying not to smile at his discomfort. "*Patterson v. the People of New York*. Patterson, the purse snatcher, had a lawyer who said that Cropdusting with a virus and using that as the sole means of finding a criminal was unconstitutional because the virus invaded his body, determined that his DNA was the right one, and made him give himself away. Therefore it was both an unreasonable search and seizure, and it made Patterson incriminate himself."

Ryerson digested this. "What was your answer to this?"

"Well, it wasn't all that hard. It was an interesting point, but we just said that DNA of a criminal is like a fingerprint of a criminal. It's a piece of evidence left at the scene of the crime. If it helps us match up to a person, it's no different than finding a matching fingerprint in the FBI's files and identifying a suspect that way. And anyway, the suspect still has the right to a trial. But of course, when there's matching DNA, it's pretty damned hard to beat a rap like that."

"But still, why the warrant?" Ryerson persisted.

"Because in its decision, the Supreme Court upheld the use of Cropdusting, but ruled that DNA targeting was a pretty invasive procedure, and one that could be misused. Therefore, it should be treated like searching a house, and would require a warrant showing reason to suspect. So we've got to get a judge to sign a Cropdusting warrant. It's pretty routine."

"What happened to the purse snatcher, then?" Ryerson asked.

I smiled and shook my head. "He got off, if you can believe it. A Cropdusting warrant hadn't even existed until the Supreme Court invented it, but since we hadn't had one when we dusted for Patterson, he was let off."

"That's outrageous," Ryerson protested.

I shrugged. "That's why we picked a purse snatcher. I mean, who cared if he got off? We figured Cropdusting would be contested. We just wanted approval to keep doing it, and we got it. And Patterson was caught five months later doing the same thing, but he was shot and wounded by an off-duty police officer when he refused to stop running. So he probably got the worst of the deal."

Ryerson looked a little humbled, which pleased me. "Guggenheim," he said. "G-U-G-G-E-N-H-E-I-M. He stole a classic early Impressionistic painting, Monet's *Impression: Sunrise*. It's considered to be one of the paragons of Impressionism, and gave the movement its name. He painted it in 18—"

"That's more detail than I need," I interrupted. "We need just the specifics of the crime."

Ryerson looked scornful. "Just the facts, then. Not interested in learning something for your own edification?"

"Spare me," I said shortly. "What else did he do?"

"Something kind of unusual for an art thief," Ryerson said. "He defaced

a painting: a Rococo work called *The Swing*."

"A what?" I asked. "I didn't get that word."

"Rococo," he said with exaggerated patience, and spelled it for me. "Take cotton candy, infuse it with synthetic sweetener, and you've got Rococo. Or did you already know that?"

"Why is it so unusual for an art thief?" I asked, ignoring his jab.

"Art thieves usually are careful with the work, because they know how much they're worth. And in a warped way, many love art. Vandalism isn't all that common."

"What'd he do—piss on it?" I asked.

"No, he slashed it with a knife. Why?"

"Well, I haven't gotten the official report yet," I said. "How do we isolate his DNA? Did he cut himself on the frame when he slashed it, or what?"

"Oh, no," Ryerson said. "He left blood behind when he killed the guard."

I bolted out of my chair. "He what?!" I yelled. "He killed a guard?"

"Yes," Ryerson said. "I thought you knew that."

I almost spat at him in disgust. "All this time you've been blathering on about some stupid paintings, and someone's been murdered? You make me sick!"

"I don't know anything about solving murders," Ryerson protested defensively. "I know about art. I thought you knew about the murder. I thought that you just needed art information from me."

"I don't really give a damn about art at the moment," I said heatedly, but losing some of my disgust as I realized that he hadn't been the callous bastard I thought he had been. "Why don't you just sit down and I'll go see what's holding up the official report, so we know what's going on."

"Fine," Ryerson snapped. He sat down primly. "Fine."

I got the report and read the real story. The thief had entered the building through a ventilation shaft and gone straight for the painting by Monet, which was apparently very valuable. He trashed the frame, which is standard procedure for getting the painting out easily. Frames are cheap—the painting's the value. As he was going back to escape, he passed that Rococo piece Ryerson talked about, and started cutting it up with his knife. I looked up from the report.

"Why in the world would he stop to slash another painting?" I asked. "Why not make your escape? Or if you're going to take the time, why not steal *The Swing*? Why cut it up?"

Ryerson shrugged. "You're the detective, Donnally, not me. All I can say is, the guy must have taste. Rococo is a painting style that was popular when Marie Antoinette and her gang were eating cake while the rest of France starved. The painting style fitted their moods: self-indulgent, frilly, poufy, fluffy garbage. It makes you gag to look at it, it's so sweet."

"Hmmmmm." I turned back to the report. The guard came on him while he was cutting the painting and challenged him. The thief charged him, and the guard, who must not have drawn his gun yet, only got off one shot before the thief got to him. The bullet must have only given the thief a flesh wound, but the lab got enough blood from it to

isolate the thief's DNA. Then there was a struggle, and the guard was stabbed fifteen times. He was discovered half an hour later by his replacement, and the ambulance team declared him dead at the scene. I closed the report.

"I'd have to check on the exact penalties for art theft, since my department doesn't handle it a lot, but it doesn't matter," I said. "What we're really looking at is murder—first degree if we can get it." I looked at the diagrams drawn of the scene of the crime. "It's a real shame that the guard wasn't ready for him. He could have pumped four bullets into the guy if he'd had his gun out.

"Maybe he had a false sense of security," Ryerson suggested. "Art thieves are not by nature violent. They are usually the intelligent, professional type."

I looked at him. "That might be valuable, as long as you're sure you're not romanticizing cultural thieves. But this also points out that it takes extreme circumstances, or at least extreme people, to charge into the barrel of a gun. Or charge a man with a gun if you've only got a knife." I started filling out the warrant request and ran it through the Technicalities and Loopholes Checker program. Ryerson watched in silence.

"Why does it take so long?" he asked. "When are you supermen going to do your superwork, anyway?"

I was tired of talking to the guy, so I printed my warrant request and answered as I walked out. "We'll probably spray for him late tomorrow or early the next day. I'll let you know when we get results." I stopped and faced him. "I'll call you," I said, emphasizing the first and last words. Then I turned my back on him as quickly as possible and left.

I didn't hear from Ryerson for two weeks, and at first it was pleasant. But by the time I got his phone call, I was harried, scared, and hadn't slept in two days. Marjoram and I were no longer on speaking terms, and I was ready to go crazy.

When the phone rang for the seventieth time that morning, I snatched it up and snarled "Donnally" into it. I was in no mood for formalities.

"Donnally, Ryerson here," came his thin, reedy little voice, with its usual amount of anger and impatience. "I think I've been more than patient, Donnally. Why the hell haven't you called me, and why the hell haven't you told me that you've caught this criminal?"

"Because we haven't," I barked. I wasn't going to take any more of this.

There was a shocked silence. "What?!" he finally said. "Why?!"

"Hell if I know," I retorted. I breathed deeply, trying to regain a sense of calm. "This has happened before," I said more rationally. "We sprayed for a criminal, and got no response. Our sensing devices have picked up no trace of the bodily emittants that the virus causes. When this happened before, the criminal had left town, and had gotten out of the spraying area before we reached him with the virus."

"So what are you going to do?" Ryerson demanded.

"We're spraying a much wider area in case he commuted from somewhere. We have also sent his DNA track to other major cities in North America: Boston, Toronto, Montreal, Chicago,

Minneapolis, Mexico City, Dallas, Washington, Philadelphia, San Francisco, Denver, Los Angeles, and so on. Any city with major art museums has been contacted, and they have sprayed for him as well.''

''Any luck?''

I sighed. ''None. He has escaped so far.''

There was another pause. Then, ''What are you going to do?''

''We're reviewing our options now,'' I said curtly. I knew that sounded like we didn't know what to do, but I couldn't help it—we didn't.

Ryerson hung up. I was glad to be rid of him so easily, but my relief only lasted half an hour. A knock sounded on my door, and opened to admit Chief Bourke, Marjoram, a nervous looking guy who was our public relations coordinator, and the mayor of New York. They looked grim. I felt grimmer.

''Morning, Donnally,'' Bourke said. I nodded warily. ''We have some news for you. Tell him, Chesley.''

Chesley, the PR guy, cleared his throat. ''I just got a phone call from some art critic named Ryerson? He's the one who's been writing those nasty columns about the force? Well, he wanted to see if I had any comment on a story he was writing for tomorrow's paper. Front page, mind you—not buried in the arts section. It's terrible. It's all about how Cropdusting has failed; that somebody has figured out a way to outwit it, and so on.''

I was tense all over. ''What did you tell him?''

''I said that Cropdusting has brought thousands of criminals to justice over the years who otherwise wouldn't have been caught. I told him that we were still working on this one case that was giving us problems.''

''What did he say?''

''It was strange. He kind of laughed, and said, 'You're reviewing your options, right?' I said yeah, I guess you could say that. Then he hung up.''

''He got that from me,'' I told him. ''I know it sounded weak, but that's all I could think of.''

''Listen, Donnally,'' Bourke rumbled. ''We don't need this kind of press. We look bad enough as it is with this damned art thief. Do you think this guy has actually come up with some way of beating Cropdusting?''

I looked at Marjoram, who looked ashen. He spoke. ''It sure seems that way, although I have no idea how he did it. Maybe some kind of antidote. Maybe he's hidden himself in some podunk village somewhere, or flown out of the country. Maybe he's dead.''

''Nobody else has ever gotten away, huh?''

I answered. ''We have had some failures over the years, but most of them were explained, and never got much press anyway. The problem is that this thief has already gotten so much press that it's inevitable that Cropdusting will too. Especially with that bastard Ryerson on us all the time.''

''Tell me about those other failures,'' Chesley begged.

''Well, let's see. One guy flew to Europe right after he pulled a robbery of some kind. Scotland Yard caught him in London six months later. A couple of gang-related crimes in the Bronx didn't show up when we dusted for them, but they turned up dead within

a month. Victims of more gang violence, and the murders were sterile, so the Cropdusting trail dried up. Things like that. Cropdusting, mostly used on common street crimes, usually hasn't had a problem with people leaving the area. The crooks are usually very territorial, and stick around the city because that's the world to them."

"Well, we've got a major exception on our hands," the mayor interjected grimly. "This is going to get a lot of press. There are going to be negative reactions publicly and politically. We're going to take a lot of heat."

"And, I might add, crime will probably go up fast," Bourke commented. "The average thug will figure that if one person escaped, they will, too. I'm doubling all patrols. That's going to cost a lot of money."

The mayor spoke up again. "The upshot of this meeting, Donnally, is the following: refer all reporters to Chesley." I glanced at Chesley, who was sweating. "Second, catch this bastard. Quickly. If you don't, there will be hell to pay, and I promise you, this department will get its fair share." It was a good exit line, and he knew it. He turned on his heel and left, with the rest trailing behind him. Marjoram followed them, giving me a baleful look.

I just stood there. There was nothing to say. I considered jumping out of the window, but decided not to. Just barely.

I spent the day arranging to send the thief's DNA to every major international city I could think of. I didn't think it would do any good, but I had to look busy.

The next day dragged around, and the newspaper was as bad as I had ever imagined it could have been. Front page, top, screaming headline: "Criminal Bests Cropdusting System." There were three related articles, all dealing with something bad: a news analysis, asking if it was safe to walk the streets, reactions from various politicians, all concerned or scathing, and one showing the police department's efforts to prepare for the enormous crime wave they were sure was coming.

Eventually, I put my phone on the "private" setting. Thousands of reporters were calling, or knocking on my door, wanting to talk to me. It was extremely unpleasant. I felt about two inches tall. Everyone was blaming me, and I wasn't sure I didn't deserve it. I had never dreamed that someone would come up with something to beat Cropdusting, although Marjoram had pressed me for research money for a long time. I had consistently denied his requests, and now he blamed me, too. I tried to blame Ryerson in my mind, but I couldn't even convince myself. I felt as wretched as a person could feel.

The day passed in pandemonium, and the next day looked like it would be no better. Around mid-morning, Bourke called me into his office. I dutifully showed up, feeling like a dog about to be whipped again. I was right.

Bourke was pacing behind his desk, and made me sit. "We always figure we're gonna have good days and bad days," he said without preamble. "Crime fluctuates. But when we see a 24 percent increase in crime in a single night, it's not too hard to figure out why."

"Twenty-four percent!" I coughed in agony.

"What's worse is a lot of the crime

is probably sterile, purely by accident. The smash and grab, the snatch and run, we're never gonna catch those people. Part of Cropdusting's success was an uncertainty in the local crook's mind as to what exactly sterile crime was. It was a concept that wasn't understood, so Cropdusting had more of a deterrent effect than we realized."

I nodded glumly.

Bourke looked at my expression. "Don't look so down," he said. "I haven't even gotten to the bad part yet."

I looked at him hopelessly. "There's more?" I asked.

"Of course. Another painting was stolen last night from the Museum of Modern Art. Looks like the same guy. This is big stuff. Organized crime, which has been making an art form out of sterile crime, has been very crimped by Cropdusting. Their power has decreased because it's more difficult to carry out threats of violence. Especially since hit men have figured out that they're likely to be eliminated, too, to dry up the Cropdusting trail. And the mob does not like the added resources the police force can devote to sterile crime because of Cropdusting." He paused for effect. "Therefore, the word on the street is that organized crime has offered one billion dollars," he emphasized the words, biting them off, "for the secret to beating Cropdusting."

I digested this painfully. "You think this guy will take it?"

"Wouldn't you?" Bourke retorted.

I slumped further in my chair. "Probably," I admitted.

"You'd better come up with something, Jack," Bourke said. "Let me know if I can do anything at all, but you and Marjoram are the experts. You're a good man, and I'd hate to lose you, but heads will roll if this isn't fixed, and yours will probably be one of them."

I could only nod.

"Keep in mind," Bourke said, "that the entire resources of this police department are yours for the asking. You name it, and you've got it."

I nodded again.

"Go," said Bourke. "Come back with some good news."

I slunk out.

As I trudged back to my office, I figured I'd better check my phone. I pulled it out of my pocket, and switched it off of the "privacy" setting. I pushed the button, and the earpiece and receiver popped out. "Instructions, please," the pleasant, mechanical, female voice sounded in my ear.

"Check voice mail," I said. There was a pause, then the voice said, "You have one new message, and two saved messages."

"Hear new message," I instructed. There was a pause, then Ryerson's voice crackled into my ear. He sounded agitated. No, agitated is too soft. He sounded scared to death. "For God's sake, Donnally, what the hell are you doing, putting your personal phone on 'private' at this time of day?! Call 222-7581 right away! I mean it! Hurry up!"

I sighed. What a great day this was turning out to be. I seriously considered not calling for an hour or so just to spite him, but I figured I'd better not. I was at my office door by now, so I stepped inside and instructed the phone: "Dial 222-7581." I closed the door and listened to a bunch of static on the line, some crackling and popping, and then

the ring tone. I wondered what Ryerson wanted. This wasn't his office number. He must be at a museum or something.

The phone clicked. Ryerson's voice snapped over the line, tense and harsh. "Hello, Donnally," he snarled.

"Ryerson," I said. "How did you know it was me? What do you want?"

"It doesn't matter what I want," he said. "It matters what he wants."

"He, who?" I was sounding brilliant.

"I don't know his name," Ryerson said, sounding faint. "But the guy who's holding a gun to my head."

There was a silence while the news sunk in, and I tried to put my mind on red alert. "Where are you?" I asked tensely.

"He doesn't want me to tell you," Ryerson said. "I think I'll do what he says."

"Good idea," I said. "Just stay calm, and do what he says. Is it our art thief?"

"Yes," Ryerson said. "Why don't you two talk to each other?"

"Are you in danger?" I asked. I wanted to know how desperate the criminal was.

"I've got a gun held to my head!" Ryerson yelled. "Of course I'm in danger, you idiot! You'd better do what he says, or I'll come back and haunt you for all of eternity."

"Put him on," I said. Then, quickly, I pushed the command button and said, "Record conversation."

There was a brief rustle as Ryerson passed the phone over. Then a new voice came over the line—abrupt, jerky, trying to sound cool and silky and not succeeding. "Commissioner Donnally, I presume?" the voice said.

"That's right," I said guardedly. "Who are you?"

"I," he said grandly, "am Ryerson's Fate. How does that sound?" He giggled and I heard Ryerson make a distressed sound in the background. Boy, we sure were right about him being unbalanced. It was easy to picture the owner of this voice charging a guard who had a gun.

"What's your name?" I asked, a little too gently for my liking.

"My name is Jeremy Schneider," he answered. "That is a name you will remember because I am a crusader in the effort to save art from the clutches of a careless, Philistine humanity."

God, this was bad. This was really serious, talking to a nutcake like this. Not that I loved Ryerson all that much, but if anybody was going to kill him, I would have liked it to be me. Naw, straighten up, I told myself. I'd like to punch him, but not kill him. "What do you want from me?" I asked. "Why are you holding Ryerson? He's an art lover, too."

"Too?! Too?!!" Schneider pounced on the word. "Don't try to butter me up by pretending to be a person of culture! You don't give two cents about art! You couldn't care less! I don't know why I'm bothering talking to you!"

"Wait!" I called. "Don't hang up. And please don't hurt Ryerson. Believe me when I tell you that he and I have discussed art for hours. I have a deep appreciation for it."

"Don't lie to me, Donnally," Schneider snarled. "Ryerson is one pound of pressure away from a better world."

Keep cool, keep cool, I told myself.

Talk him down. And think fast! "I'm very concerned about what you've done with the masterpieces you've taken," I said. "I hope I can trust that you've taken good care of them."

There was a silence. Then he spoke. "Yes, I have," he said with a little less venom. "Better than the world has. But why do you care?"

"You took one of my favorites of all time," I said, racking my brain. "I'm glad to hear that it hasn't been damaged."

"Which one?" Schneider asked dangerously.

"The one by Monet, that he painted in 1873," I said, praying that my misty memory was correct. "His *Impression: Sunrise*, which named the Impressionistic movement. I think it's one of my favorite periods." I grabbed one of the art catalogs that Ryerson had thrown on my desk and flipped it open. "What did you think of his *Garden at Argenteuil*?" I asked, picking one at random. I did a pretty good French pronunciation, too, considering the pressure.

There was a long pause, punctuated only by Schneider's breathing. I grabbed a Cubist catalog, in case I had to continue the bluff. When Schneider finally spoke, it wasn't to me but to Ryerson, with his mouth away from the mouthpiece of the phone. "Your friend seems to understand art," he said.

I held my breath, and Ryerson made a small exclamation of stress. Then he said, shakily, "Of course he does. He appreciates the finer aspects of culture. As a matter of fact, if you were to bring him here and let him see what you're trying to do, I'm sure he'd be very sympathetic to your cause."

There was another pause, then Schneider spoke to me again. "You're going to come here," he told me.

"That's fine," I said. "I'd be glad to."

"You'll come here to listen to my demands for the preservation of art all around the world," he continued.

"From what I've heard, I'm already sympathetic to your cause," I lied.

There was a long pause. Then Schneider spoke slowly. "I don't trust you, Donnally," he said. "You're the one who tried to get me with your stinking Cropdusting! But I outwitted you, didn't I? Oh, I made you look stupid!"

"You're a smart fellow," I said, hoping I could get a look at how he'd beat the virus. I wouldn't even care if I was killed afterwards—I was just dying to know. "I'm sorry about the Cropdusting. I'd much rather talk to you."

There was a long pause. "I have to make preparations to protect myself from you," he said. "I'll call you in a few days and give you instructions." He hung up abruptly.

I disconnected on my end, and then called out a general alert, telling Bourke about the situation, and ordering a trace on 222-7581. The answer came back quickly: the number had been electronically scrambled and switched so many times that it was untraceable. That accounted for the static and crackling on the line.

I stood still for a moment, my mind whirling. I was trying to clutch at an idea that was flitting around in the corners of my mind. I didn't move for a while, then jerked open the door and sprinted down the hall.

Marjoram looked up in surprise when

I burst into his lab. "What are you doing here?" he asked snidely. "You get lost?"

God, everybody was on my case. "What's with you?" I asked breathlessly.

"Nothing. It's just that you haven't shown interest in our department for months. You're a paper pusher, not a scientist."

I wanted to punch somebody very badly, but I couldn't punch him. "Shut up," I said briefly. "I need something, and I need it quick."

"Like what?"

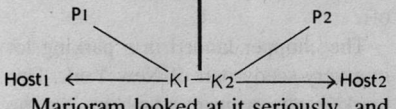
"OK, here's my idea. You take a virus, keyed to a person's DNA, and piggyback another virus onto it, right?"

"Yes, we've done that for years," Marjoram said patiently.

"I know. But can you take another keyed virus, with a different piggyback, and then connect the two keyed viruses? So instead of a total organism of two viruses, you've got a total organism of four?"

"Yeah, we've done that in the lab," Marjoram said slowly. "Haven't had a practical application for it yet, though."

"Good so far. Now, can you build in some kind of shield? So the total organism will fit into two people: one for each keyed virus. But the piggyback virus on one of the keyed viruses will only work if that keyed virus fits the DNA, and won't work if the host has the other keyed virus's DNA?" I drew a quick sketch to illustrate.



Marjoram looked at it seriously, and clicked his tongue several times as he thought. "I don't see why not," he said. "We've dabbled with that before. How soon do you need it?"

"In three days," I said.

"Three days!" he exclaimed. He frowned deeply. "That's tight. That's very tight."

I briefly filled him in on what had happened, gave him my idea, and described what would happen to him if he didn't get it done and we didn't catch this art thief.

"Hey, you're the guy who never approved any research funding," he answered. "It will take some doing. Some research. Some money." He looked at me. "We haven't had any of that."

I stared at him in frustration. I wanted to scream and grab him by the neck and throttle him. He had always blamed me because I was trying to keep costs down. How was I supposed to know that somebody would invent something that would foil the viruses? I needed to sit down.

I sat and breathed deeply, trying to collect my wits. Marjoram looked down at me. "You seem upset," he said, obviously not caring if I was or not.

"I am upset," I answered. "But you're going to be more upset, because you're wasting time. I'm going to get instructions from this guy in a few days, but I don't know exactly when. I could maybe stall a day or two if I had to, but I'd rather not because it could endanger Ryerson. I don't care if you have to work around the clock. I don't care if you appropriate every person and facility in the city of New York. Do it. Start now."

Marjoram opened his mouth, but he saw the look on my face. He turned

abruptly and went to his desk. He pulled out some folders from his file cabinet. He looked at me balefully.

"You're lucky that this is a hobby of mine as well as a job. I've done some research on my own. I kept it quiet, because I didn't want you to tell me about wasting the city's money. I've got the feeling that you won't give me that lecture now."

"I won't," I said. "Tell me what you need, and I'll get it for you."

He thought. "I need every technician I can get my hands on. I'll need authority to pay them double time, because I'm going to have a team working nights and another one working days. We'll need food, I guess. Coffee. Approval to put every other Cropdusting activity on hold."

"Granted," I said. "Everything you asked for. Anything else?"

"Not at the moment. I'll probably come up with more, though."

"If you want it, you'll get it," I told him. "If anybody asks, give them my name. And Bourke's name. And mention that the mayor is behind it all." I paused. "You won't have any objection if I have a squad of officers sequester you and your workers?"

"What the hell for?!" Marjoram demanded.

"To keep the reporters away from you. I don't want our thief to know anything about this."

Marjoram sighed disgustedly. "All right. You're right."

"Anything else?" I asked.

Marjoram looked at me closely. "Soak up as much sleep as you can in the next few days. With what we're going to put in your body, and the environment you're going to walk into, you'd better be physically prepared."

I nodded, feeling the dread sink into my bones. "I'll spend the time studying art books. I get the feeling I'll need to be able to discuss it for a while when I get there."

Marjoram nodded and jerked his head toward the door. "Go away. Let us work. I'll let you know if we need anything else."

I went away.

As it turned out, it wasn't a three day wait. It was four. Four days of swarms of reporters, political denunciations, very little sleep, and one of the biggest crime waves in New York City's history.

Marjoram hadn't needed all four days. On the third day, late in the afternoon, he had tottered to my office to report that verification testing of the organism was complete.

I looked at him as he sagged against my door. "You done good," I said. "Go home and get some sleep."

"Sleep?" he repeated blearily. "What's that?"

I got the call from Schneider at eleven o'clock the next morning, with directions, location, and instructions to be alone and unarmed. I rushed to Marjoram's lab, where he, looking a little fresher, had injected me. Then he, Bourke, and I scrambled into a waiting helicopter. We stalled a little to allow a large number of plain clothes police officers to get to the area, then we took off.

The chopper landed in a parking lot in a very seedy part of New York. Unmarked cars were everywhere. As the

chopper landed, Marjoram gave me a pill. "Take this," he said.

"What is it?" I asked. "Valium?"

"No such luck. It's a slow-release medicinal antidote for the other piggyback, in case the shield doesn't hold. It'll protect you against a partial failure."

I took the pill. "You think this will work?"

"I think so," Marjoram answered tensely.

"Then it'll work," I said. I slapped him on the shoulder and jumped out of the chopper. I conferred briefly with Bourke, then got into a waiting unmarked car and drove the few blocks to the address Schneider had given me. It was a seedy, anonymous-looking building that just missed being called a slum. I left the car in the street and went inside.

I walked tentatively down the hall of the building, feeling dizzy from the psychological effects of my plan, and from the adrenaline rush that was coursing through my body. Adrenaline rush, hell—I was scared to death. And on top of everything else, I was getting a doozy of a cold. My head was stuffing up as I walked, and I cursed violently. I was at enough of a disadvantage without needing to feel sick, too.

I checked out the building. The place was weird. It was a dump, with paint peeling off the walls, and plaster missing from the ceiling. But there was no trash lying around. And structurally, the building seemed sound.

I kept walking slowly, and my heart was pounding against my ribs. I was worried about a heart attack, and I was worried about living long enough to be able to have a heart attack. I wiped my nose and sniffled. I wondered if I was being watched. I wouldn't have put it past Schneider to have had some cameras mounted somewhere around.

I got to the door marked 1E. It didn't look any different from the other apartment doors I had passed, but the place certainly did seem deserted. I took a deep breath, and knocked on the door.

A voice from a small speaker rasped out at me: "Open the door and step inside. Slowly."

I did what I was told. I was surprised by the feel of the door: solid and tightly sealed, not the loose, flimsy door you would expect in a place like that. I looked inside, and saw a small, dimly-lit room.

"Go in and shut the door," the speaker instructed. I did, looking around nervously. The place was as big as a large, square closet. There was another door on the other side of it. As I looked at it, the first door made the unmistakable sound of a deadbolt lock being thrown. I quickly tried it, and it was locked. I was trapped.

I needed a bathroom.

"You are locked in," the voice from the speaker intoned. "Take off your clothes. All of them."

"What?!" I said, speaking for the first time. "I'm not going to do that!"

"I can kill Ryerson right now, if you like," Schneider said through the speaker. "I can also kill you. Do as I say. I intend no hideous torture—I just want to make sure you have no exotic weapons."

What was I going to do? Only slightly reassured, I stripped. It was a humiliating experience, undressing in a hostile

environment, when you don't know what's going to happen to you. After I finished, I stood up, trying to cover my private parts and look at ease at the same time.

"Put your clothes in the small door in the side wall."

I looked. It was a small door that opened from the top, forming a chute. It was obviously one of those new, high temperature incinerators. "Can I keep my wallet?" I asked. My wallet had the radio transmitter that we had planted on me.

"No. Put everything in there."

I did, and stood there as they were incinerated into nothingness. I didn't like this at all. This guy knew I dealt with viruses, and was on the lookout for something viral. I had an overwhelming desire to break the lock and run away, screaming at the top of my lungs. My fear was interrupted by Schneider talking again.

"You may wish to hold your breath," he said. Before I had the chance to wonder why, I was hit with a deluge of water. It knocked me to my knees and I stayed down on all fours, sputtering and gagging and sneezing as the water pummeled me. It stopped as quickly as it started, and I noticed it draining into a drain cleverly hidden in the floor.

"You will now be disinfected," Schneider's voice informed me. "I strongly suggest holding your breath and closing your eyes." This time, I did both, quickly. Some gas, smelling strongly like a hospital, hissed out from somewhere, and filled the room. When I dared to peek, the room was foggy, and the fog stung my eyes. I closed them again, quickly.

When I was beginning to actively worry about breathing again, clean air was pumped into the room, and the fog went away. I breathed cautiously, and wondered what was next. My heart jumped again when I heard the inside door being unlocked. "Open the door and step inside," came the instruction.

With my heart in my mouth, I obeyed. I stepped into a glare of lights, all directed at me. I squinted violently, and tried to see. Schneider's voice came to me without the aid of a speaker this time. From the sound of his voice, he was across the room. "Don't make any sudden moves," he called. "There is a towel you can use to dry off, and a blanket you can use to cover yourself."

There was, and I did. Slowly. Carefully. Then I looked into the lights again, and opened my mouth to speak. Schneider cut me off.

"There is a bottle of Scotch whiskey there on the floor. I want to see you drink at least a quarter of it."

I did. I figured it wasn't poisoned, but was to make sure nothing was on my breath. I took several deep swigs, then coughed and sputtered as the booze went down. When I recovered, I held the bottle up for inspection. "How's that?" I asked groggily as the alcohol joined the adrenaline, fear, disinfectant fog, and everything else that was coursing through my body.

"That will do," Schneider said. "Not only is your mouth disinfected, but your wits are dulled. Now, I want you to understand that I have a gun and will not hesitate to shoot you both if I have to. I won't need any provocation. Got it?"

"Got it," I said. "Can I see if Ryerson is OK?"

Schneider flicked a switch and the spotlights went out. My eyes tried to adjust to the soft, dim lighting, and I looked around in amazement.

I was in an art gallery. Dozens and dozens of paintings and sculptures were hung on the walls or were sitting on the tops of little display cubes. Everything I had seen in low quality reproduction in my police reports were there in full, living, breathing, glorious color. I goggled in amazement. I wasn't sure if it looked like a dream or a nightmare. I couldn't shake off the feeling that, whichever one it was, I was definitely not awake.

Schneider spoke again, his voice rich with satisfaction. "Quite a selection, isn't it?"

I followed his voice, and saw him for the first time. He was a small, wiry man in his mid-forties, with sandy hair and hard, glinting eyes. He was also holding a gun.

"This is amazing!" I blurted. "There must be billions of dollars of art here!"

"Correct," Schneider said. "Notice how nicely it's taken care of?"

I decided to give the answer expected of me. "It's impressive," I agreed. "These are fantastic!" I was surprised to notice that I actually kind of meant it. But no matter how much art was around, I kept noticing the gun. "Where is Ryerson?" I asked.

"Step slowly to your right," Schneider instructed. He kept holding the gun on me, and he was at least thirty feet away. I did what I was told, and noticed Ryerson sitting in a chair, bound and gagged behind a large, freestanding picture by Jackson Pollock, whose title I didn't remember. Schneider walked over and removed the gag.

"Donnally," Ryerson said in a mixture of fear and relief. "Get me out of here!"

"How did you get here in the first place?" I asked.

"Mr. Ryerson is, unfortunately for himself, a better detective than you are," Schneider said. "He followed me here from my last art heist."

I felt my nose tickling again, and before I could stop, I sneezed violently. By accident, I sneezed directly on a small sculpture that was on a table to my right. Schneider made an outraged noise, and even Ryerson was disgusted.

"Honestly, Donnally," Ryerson said, "sometimes you're such a pig!"

Schneider charged over, angrily gesturing me away with his gun. I moved quickly and apologetically. "How dare you!" Schneider grated. "This work is priceless!" He made a few agitated wipes at the sculpture with his hand, then grabbed a cloth and polished the piece.

The situation was a little too angry for my taste. I decided it would be appropriate to apologize. "I'm sorry about that," I said sheepishly. "They can put a woman on Mars, but they can't find a cure for the common—"

"Cut the crap," Schneider snapped. He gestured further into the room. "Get over there. And keep in mind that everything in this room is worth more than you are."

I moved to where he indicated. This was not going well.

I looked at Ryerson and tried to restart

the conversation. "How did you find Schneider to follow him?" I asked.

Ryerson looked sour and not the least proud of himself. "I know more about art than you do," he said to me with a quick glance at Schneider. "It finally occurred to me that our art thief was establishing a pattern that everyone had overlooked. He was stealing works of art that were not just valuable—they were landmarks in art history. For example, the first one we discussed: Monet's *Impression: Sunrise* started the Impressionist movement, and Monet was one of the biggest figures in the movement. And that's what our thief was looking for: he would pick a period, and steal the landmark pieces done by the biggest names in that period."

"So?" I asked, still very aware of the gun. Schneider was still keeping his distance.

"So I figured out what painting would be next," Ryerson continued. "Salvador Dali's *The Persistence of Memory* had been installed in the Museum of Modern Art after a tour of Europe. I have considerable influence in the art world, so I went to the curator of the museum, and called in a few favors. I had to twist his arm considerably, and hint that I was part of a police operation, but I managed to persuade him to let me hide near the painting and wait for our thief. After three nights, Schneider appeared. I let him take the painting, and followed him here. Which also explains my tattered clothes and assorted scrapes and bruises."

I had been so scared that I hadn't noticed, but when he mentioned it, I saw that he was a mess. "How did all that happen?" I asked.

"I'm an art critic, not a gymnast," Ryerson said snappishly. "Do you think it's easy to follow an accomplished cat burglar? I almost killed myself. But I was so obsessed with catching him that I managed to keep him in sight." He gestured with his head at the ropes that were holding him and added bitterly, "It's worked out great, hasn't it?"

"I knew I had gotten away clean, so I wasn't looking for a tail," Schneider added as I sneezed again. "I didn't notice him until we were near here. By that time, he knew too much so I couldn't just get away. I considered killing him, but I needed a hostage." Ryerson's face blanched when he heard Schneider's cold, matter-of-fact tone, but said nothing. He was obviously exhausted from the emotional strain of capture.

"How did you manage to go outside without getting nabbed by the virus we'd sprayed for you?" I demanded.

"I did some research after I found out that you had sprayed for me. The news broadcasts said how long the sprayed viruses would live before needing another spraying. I just timed my last burglary between sprayings."

I silently cursed myself for not making sure that we performed overlapping sprayings. That fell under the heading of idiotic mistakes.

Schneider continued, "I assumed that with the intensive media coverage, I would know whenever you sprayed."

"How did you know that we wouldn't bluff the media to lure you out with false information?" I asked.

"I didn't think you were smart enough for that," Schneider said smugly. "And

I didn't think the media would fall for it.''

I had to admit that he was right on both counts.

''At first, I was afraid of the viruses. That was when I was wounded,'' Schneider went on. ''I bandaged myself, and hid here, waiting for the virus to get me. But it didn't.'' Schneider's face began to glow triumphantly. ''The virus didn't get me! Here I was, huddled in my room, afraid and knowing that I couldn't escape—that nobody ever escaped! And it didn't get me!'' He laughed crazily. ''How does that make you feel, Mr. Supercop? How does it feel to be a failure?''

Having a gun pointed at you makes it easy to keep your temper. I asked, ''How did you manage to foil our best efforts?''

Schneider laughed crazily again. ''Accident,'' he said airily. ''Sheer accident. I hid down here for several days, never daring to hope, until I heard about Cropdusting's failure—your failure—on the news. Then I thought about it. My conclusion is that the sophisticated environmental control system I had installed here did the trick. My own design, by the way, a system of air filtration and cleaning units that I made to protect my artwork, actually protected me from your stinking viruses!''

My mind raced. He must not have any kind of specific virus killing agent. I wondered if his system could withstand a larger concentration.

''Why did you design it in the first place?'' I asked.

''Ah.'' Schneider looked at me significantly. ''He asks why I designed it in the first place. Yes, well might you ask. That's why I brought you both here. To hear why I designed it in the first place.'' He waved his gun. ''Sit down, Donnally.''

I sat. I wondered if I would be allowed to go the bathroom, and doubted it. Ryerson looked at me appealingly, and I looked away. I couldn't do a thing. I was naked and scared, and kept at a distance from an armed murderer. I looked at Schneider, who began pacing.

''Warnings have been issued ever since the latter part of the twentieth century,'' he began with outrage in his voice. ''Warnings about the deterioration of great works of art. These warnings have been consistently ignored by the public and by people in the art world who ought to know better.'' He looked significantly at Ryerson, who looked as uncomfortable as a human could look. ''These warnings have been ignored because the 'leaders,' '' he bit off the word, ''have catered to the unwashed masses who didn't give a damn about real art. I'm talking about Mr. Joe Front Porch, who thinks an advertising billboard is 'classy,' and considers himself cultured if he manages to go to the Louvre once in his life to see the Mona Lisa and say he doesn't see what's so great about it. He's the kind of clown who looks at an American Realist painting like Whistler's *Arrangement in Black and Gray*, and says, 'Oh, sure, that's Whistler's Mother. We've got a framed print of it that we cut out of a magazine.' '' He spat in contempt and wiped his mouth. ''These are the people who have been making the decisions about the care of the greatest works of art the world has ever seen!''

I was confused as well as scared.

"What have they done that's so terrible?" I asked. I was immediately sorry that I had.

Schneider whirled on me. "What have they done?! It's what they haven't done! As early as the 1970s—can you believe it, as far back as that—there were warnings that paintings were deteriorating. Improper lighting, handling and storage was part of the problem, but the real problem was air pollution! Smog and all manner of air contaminants in major cities were building to a level that these delicate art pieces could not tolerate! And of course, the big cities are the ones with the large numbers of art museums. And of course, these museums had archaic ventilation systems that were not protecting the art! And on top of all of that, studies were proving that something as innocuous as actual human *breath* was seriously damaging the paintings! People coming to see the masters were ruining the pieces they were coming to see! Art was being loved to death!"

"So you began stealing them," I finished for him.

"Oh, I was an art thief long before this problem even became known to me," he told me earnestly. "And when I think of some of the pieces that I stole that I sold for mere money, it almost drives me mad!" He rubbed his eyes wearily as Ryerson and I exchanged quick glances. He went on, not noticing. "But I slowly began collecting information on the subject, and as I became concerned, I began researching ways to protect art. I even sent proposals to leaders in the world art community under assumed names, but was always ignored. Eventually, I began to take matters into my own hands."

"What would you like us to do?" I asked as gently as possible.

He looked at me with a fierce light in his eyes. He advanced a little, his gun wavering slightly. "I was originally going to demand that the artistic community incorporate my protection and preservation methods into their collections. But I no longer trust them to do it, no matter what promises they give me." His voice became soft, but extremely vehement. "You will turn over to me all of the masterpieces on this list," he waved an alarmingly thick sheaf of papers, "or I will kill Ryerson and you, and will turn over my environmental control system plans to organized crime. I understand that they have offered up to one billion dollars for the secret to avoiding Cropdusting. I can use the money to further my efforts, and at the same time can unleash a monumental crime wave on the world. That ought to be considerable incentive for compliance."

I privately agreed that indeed it would. "Think of what you'll be doing," I said out loud. "You're right about the crime wave you'd unleash. You'll be undoing an invaluable technological edge in the fight against crime. Think of the human suffering you'll cause. It doesn't strike me as very artistic." OK, so it was pretty lame. Keep in mind that I was looking down the barrel of a gun held by a madman, his survival was all my fault, and I only had a blanket to cover myself.

Schneider laughed sarcastically. "Crime fighting, as with almost every other aspect of humanity, is a history

of struggling to muddle by, drenched in the suffering and inepitude that is the human condition. Only in art is there a sign that people are more than mud-stained, blood-spattered Philistines. Only art shows that there is hope for humanity. I don't give a damn about the suffering that people inflict upon each other and themselves. What I care about is the preservation of the tiny gleam of divinity that has managed to shine out from the excrement of our existences. What does it matter if a few more people kill each other? Most of the people in the world want the world to stay the way it is. They suffer in the existences they find themselves in by their own choice. But I won't let them destroy what little good that humanity has produced."

I looked at Ryerson beseechingly. Art was his subject, not mine. I couldn't argue with this guy on his own turf. But Ryerson just looked blankly back at me. He looked like someone who had popped a circuit breaker. He was slumped against his ropes, looking dazed and exhausted by the constant fear and stress. He was no help to me.

Schneider saw us exchange looks, and misinterpreted them. "What are you planning?!" he demanded violently, his voice slurring slightly. "Don't think you can pull anything on me! I've covered all possibilities! You've noticed, Donnally, that I've had my gun pointed at you continually. Even if a SWAT team followed you and storms this building, they won't be able to break in here before I shoot you. And I've also got a panic switch within easy reach. If I push it, it will set off a powerful explosive that will kill all of us, and destroy all of these art treasures. I'd do it, believe me. I'm their last hope of survival, so if I go, they're doomed without me. They might as well go with me."

I looked at him despairingly. "You can't do this," I said. "There's no SWAT team outside, but my office does know where I am. You'll never be able to move all of this stuff to another place." I thought of another line of reasoning just in time. "What you need is publicity. Go on trial as a concerned citizen. You'd get worldwide attention to your case. The entire, worldwide art community would be following your case, listening to your views! Think of the prestige! You've got the facts. You'd be able to convince them, and become known in history as the person who raised the consciousness of the world as to the danger facing art."

For a moment I thought I'd won. There was a gleam in his eye, and I could tell he was visualizing the glory he thought would be his. But he brought himself back with almost a physical effort. He looked at me, almost regretfully.

"You forget," he said unsteadily, "I killed a man. They wouldn't care about my views on art. I'd be labeled a murderer and a madman. Just because I was destroying a piece of trash that someone had the nerve to call art and put in among significant works. My demands remain as before."

"But if they don't agree to them," I protested, "you can't carry out your threat. To destroy these works would be blasphemy!"

"I can," Schneider said with an effort, "and I will."

"Why don't you turn yourself in?"

I asked for the last time. I sneezed, wiped my nose on my blanket, and continued. "I guarantee that you'll get a fair trial, and get all of the publicity you would ever want. No matter what else happens, the world will know about your concerns. I promise you that without qualification."

"No good, Donnally," Schneider said thickly, looking tired. "It's not enough. I don't trust you. I want approval from the governor of New York and the president of the United States and the security council of the U.N., and I want it fast. If I don't get it, I will start by shooting Ryerson in the leg. If necessary, I'll shoot him in both legs. And I'll make you watch him bleed to death."

I looked at Ryerson. He goggled back at me, obviously in shock. I leaned back to steady myself, and took a deep breath. Then I exhaled long and hard and looked at Schneider. He was watching me for my reaction. Finally I said, "You know that if you destroy these works of art, you'll be deliberately committing the crime you accuse the world of committing unintentionally." I took another deep breath and blew it out, obviously trying to keep calm. I looked at him. He was unmoved, standing ten feet away. "You will become known as the ultimate barbarian," I said, going for the throat. "You will make the word 'Philistine' obsolete. 'Schneider' will become synonymous with barbarian and Philistine just like Benedict Arnold or Judas have become synonymous with traitor."

Schneider became livid, and I was afraid he'd shoot me on the spot. He had been leaning wearily against a display table, but now jumped up. "Barb-barbarian!" he screamed at the top of his lungs. He staggered toward me, waving his gun in the air. "I'm the only person left in the world who appreciates and cares about art!" He stopped about three feet away, swaying wildly, but continued raving. "I am the savior of culture, and don't you forget it!" he shrilled, waving the gun in my face. "I'll teach you to call me that!" He lunged forward and struck me across the face with his gun.

My skull exploded in sound and I reeled back in my chair, blood filling my mouth. The room danced around before my eyes, and I grabbed the arms of the chair to try to steady myself. I sat up groggily, and swallowed a mouthful of blood. Schneider was still screaming, but I wasn't hearing the words. He clumsily thumbed back the hammer of the gun, looking at me with wild, unfocused eyes. I tried to keep conscious, and concentrated all of my energies on trying to make my nose tickle again.

I sneezed.

Schneider looked at me for a split second, and sick comprehension registered on his face.

Then he died.

I couldn't even believe it. I stared dumbly at him as he collapsed to the floor like a sack of potatoes. Ryerson made a stunned sound of astonishment and stared alternately at Schneider's body and me. I staggered out of my chair, absently holding my blanket in place. I checked.

Sure enough. He was dead as they got.

I walked over to Ryerson unsteadily,

and began fumbling with his ropes. Ryerson was just barely beginning to comprehend. "What'd you do?" he asked thickly, not daring to hope.

"I killed him," I said, wishing my head would stop pounding. "I tried to get him to give himself up, because Marjoram is ready with an antidote. But I couldn't tell him why he should give himself up, or he would have killed us. I did the best I could."

Ryerson goggled at the body, then vomited violently. It took all of my effort to avoid doing the same thing. I clutched his chair and leaned against it until he finished.

"Untie me," Ryerson gasped finally. "I can't even wipe my mouth."

I concentrated on the knots, which were tied well. Ryerson was still gasping. I was still sneezing. "How?" he asked gutterally. "How'd you do it?"

"We designed a new viral combination," I said, still feeling sick. "Two keyed viruses: one for me, and one for him. Tied together. Piggybacked a cold virus on mine. Put a barrier between mine and his so his wouldn't affect me, but I could carry it inside my body. Piggybacked a lethal virus onto his. He effectively sterilized the exterior of my body, but it didn't occur to him to worry about what I had inside. He assumed, logically, that anything inside my body would affect me as much as anyone else. A concept like the viral shield would never occur to him. So the virus started affecting him, and I was scared that he'd notice and kill us. I thought I had to provoke him to keep his mind off himself. But I pushed him too far. That last sneeze probably didn't do anything, because the virus was already firmly established, but I was panicking at the time."

Ryerson was quiet for a minute while I sneezed and struggled with his ropes. "Why'd you have to kill him?" he asked finally. "He was right about a lot of things, you know."

"He was also a murderer," I answered. "He was also planning to kill us or blow us all up. He could do it quickly, so we had to give him something fast acting. Our knockout virus takes up to an hour. This was the only thing we had that worked fast enough and was insidious enough so he wouldn't notice his deterioration and blow us up." I sneezed again.

Ryerson looked at the body again and retched. "Oh," he said.

"Just be glad you're alive," I told him. I sure was. "Where's the phone you used?"

The place was awash with cops inside of five minutes. A bomb squad came to deactivate the explosive. An ambulance team checked out me and Ryerson. Marjoram showed up and gave me an injection. I gave him a brief description of what had defeated the virus. Three SWAT teams arrived to guard one of the most valuable assemblages of art outside of a major museum. Trucks arrived to haul the stuff to safety.

I grabbed Marjoram's arm. "I want a full report on his air system within a week," I ordered. "I also want a set of proposals on how to defeat it."

He looked at me respectfully. "Yes, sir," he said. He hadn't called me "sir" in years. I grabbed the arm of a SWAT captain.

"I want a full SWAT team guarding

this room until the environmental protection system is fully dismantled and shipped back to our headquarters," I ordered. "Twenty-four hours a day. And I want all of you riding with it wherever it goes."

He looked at me seriously. "Yes, sir," he said.

I sneezed and walked slowly over to Ryerson. He looked at me, still somewhat dazed. "How are you doing?" I asked him.

He nodded slowly. "I'm in your debt, Commissioner," he said shakily. "You saved my life. You kept your head long after I had collapsed from fear."

"I wasn't far from collapse," I admitted. I kept feeling my face to see if anything was broken.

"And you saved all of this art," Ryerson continued. "It was almost all destroyed by that madman." He shuddered violently, then got a grip on himself. "But I'm going to do some research into his charges. He was right about some of it, you know."

"No, I didn't know," I said. "But if you think so, then I guess he was."

Ryerson looked surprised, but just nodded.

I pointed to a large painting in a corner. "What's that one?" I asked. "I don't recognize it."

Ryerson looked over blearily. "That's one we didn't even know he had," he said. "Pablo Picasso's *Guernica*. Notice the angularity and conical treatments of the piece and how it has the people show despair and pain." He pointed at details, following the shapes with his hands. "See how the overall effect is hopelessness and rage at the destruction caused by war. Guernica was a city in Spain that was bombed during the Spanish Civil War. Picasso painted this as a protest against the devastation and suffering inflicted on innocent people by other people as a result of war."

I looked at it for a long time. "It's neat," I finally said.

Ryerson looked at me sharply. For a brief moment, I thought he was going to ridicule my uneducated comment and stingingly correct me. Then he stopped and looked at the painting again. He nodded, slowly and profoundly.

"It's neat," he agreed. ■

● I find that a great part of the information I have was acquired by looking up something and finding something else on the way.

Franklin P. Adams

The Alternate View

FALLING THROUGH TO PELLUCIDAR

John G. Cramer

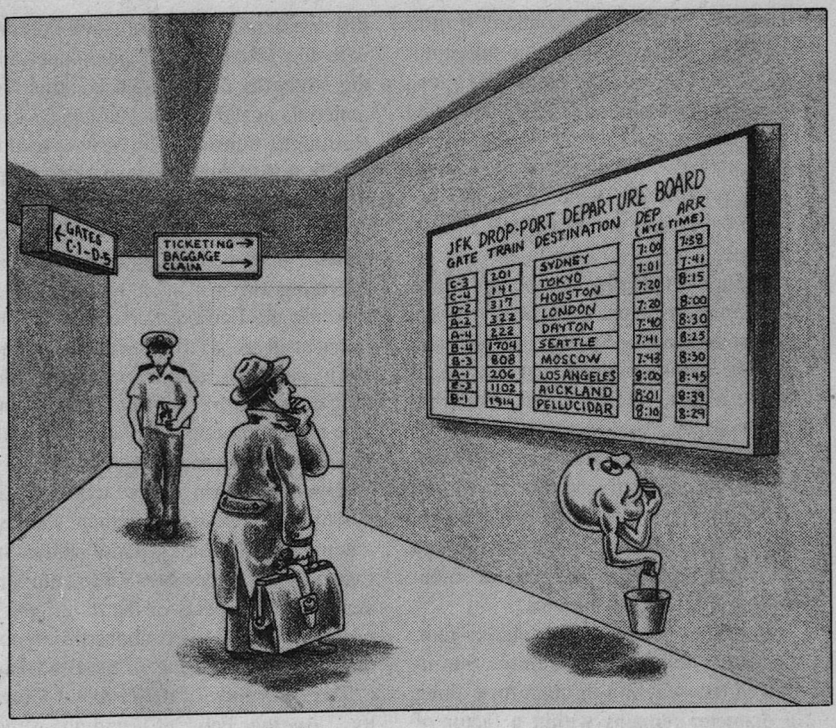
In 1914, two years after the great success of *Tarzan of the Apes*, Edgar Rice Burroughs initiated a brand new series with a magazine serial called *At the Earth's Core*. The hero, one David Innes, arrived in the vast hollow interior of the Earth in a mole machine that had burrowed down through the planet's outer shell. The premise of the series, taken from the ideas of John Symmes, is that the Earth is as hollow as a tennis ball, with a habitable world inside called "Pellucidar." For illumination, Pellucidar has a miniature pseudo-Sun at its center, complete with its own 24-hour satellite. Gravity sticks the inhabitants of Pellucidar to the inside walls of the Earth, just as it sticks us to the Earth's outer surface.

There are a number of geophysical and astrophysical problems with Burroughs's setting. Perhaps it is pointless to complain, 75 years too late, about the "hardness" of such science fantasies, for the strong suit of Burroughs's writings always lay in their imaginative sweep, never their scientific accuracy. In the case of Pellucidar, however, Burroughs committed a blunder that sets the teeth of every physicist on edge: *He assumed that gravity would pull toward the inner surface of a hollow sphere.*

Consider the following question: Inside a massive hollow sphere, just how much gravitational force would there be at the center, near an inner wall, etc.? The answer is: *zero*. It's easy to convince yourself that the force at the center would be zero, because, if you think of the sphere as two hemispheres, the gravitational pull from one hemisphere is just cancelled by the equal and opposite pull of the other hemisphere. What perhaps isn't so obvious is that away from the center the same cancellation holds. It occurs because at any point in the hollow region the amount of mass in a section of wall falling within a given angular cone *increases* with distance as r^2 while the gravitational pull from that mass *decreases* with distance as $1/r^2$.

The two effects exactly cancel, with the result that there is no gravitational force anywhere inside a hollow sphere. This result, which is a consequence of Isaac Newton's inverse square law of gravitation, has been well known since Newton's day.

It has some fascinating consequences. For example, suppose we use David Innes's mole machine to bore a Manhattan-to-Sydney subway tunnel straight through the center of the Earth. What would be the pull of gravity inside such a tunnel? For example, take a point ten miles below the surface. Here there will still be a strong but diminished gravitational pull toward the center. You can think of the Earth's mass as being divided into a ten-mile thick hollow spherical shell (which exerts no pull), plus a sphere exactly filling the cavity, which exerts a diminished pull



because it has less mass than the whole Earth. If you work out this force in detail you will discover that, if the Earth had uniform density all the way through, the force depends directly on the distance r from the center of the Earth. The pull of gravity behaves precisely like the pull of a spring: $F = kr$ where k is a force constant. In physics this is called a Hooke's law force after Sir James Hooke, a contemporary of Newton who demonstrated that springs have this property.

If a subway car is put into the Manhattan-to-Sydney subway tunnel, the car behaves like the bob of a pendulum. It bobs back and forth between the two extreme points of its travel at a rate which is independent of the mass of the subway car and depends only on the mass and diameter of the Earth. Assuming that the Earth has a uniform mass density, that there is no friction or air resistance in the tunnel, and that the subway car is moving solely under the influence of gravity with no other forces, the time required for a one-way Manhattan-to-Sydney trip in the subway car is an amazing 43 minutes. (Flying nonstop from JFK Airport to Sydney by 747 at 500 mph would require about 25 hours.)

Sydney and New York City lie almost along a diameter through the center of the Earth. What about other locations, say Seattle to Moscow, Chicago to

Houston, or Tokyo to London? It turns out that under the above assumptions the result is always the same. The transit time from anywhere to anywhere is 43 minutes. Such a subway system would, with no net expenditure of fuel or energy, provide 43 minute transport between any two points on the Earth's surface.

Actually, the real situation isn't quite this simple because the Earth is not a sphere of uniform density. If one uses a more realistic model that puts more of the planet's mass near its center because of the greater compressional forces and the higher density there, the Manhattan-to-Sydney transit time is reduced to 38 minutes, while trips that only cut through a small chord of a circle through the Earth's center would require somewhat more than 43 minutes.

For other bodies of the solar system, planets, satellites, and even the Sun itself, a one-way fall-through time along a diameter remains within a factor of two of the same 43 minutes. This is because that time is inversely proportional to the square root of the density (mass per unit volume) of the body involved, and is otherwise independent of both the mass and radius of the body. A fall-through subway on the Moon, which has an average density that is 61% of the Earth's, would have a transit time of 55 minutes. The Sun, with an average density that is only 26% of Earth's, would have a fall-through time of 85 minutes. And so on.

Because of the obvious technical impossibility of actually putting a subway tunnel through the center of the Earth (not to mention the Sun), doesn't this discussion take almost as many liberties with the geophysics of our planet and the strengths of available construction materials as did the science fantasies of Burroughs himself? The answer to this question would certainly be *yes*, except that contemporary physics suggests that certain hypothetical particles, the so-called "dark matter candidates," may be riding on just such a "subway," crossing the Earth's diameter every 38 minutes or so as they orbit back and forth past the center of the Earth, trapped in Earth's gravity well but unable to interact non-gravitationally with the matter that produced that well.

Broadly speaking, these hypothetical invisible particles fall into three classes: axions, WIMPs, and shadow matter. In two previous Alternate View columns dealing with aspects of the dark matter problem, I've written about the hypothetical axion remnants of the Big Bang ("The Dark Side of the Force of Gravity," *Analog*, Feb. '85), and about the similarly hypothetical *w*eakly *i*nteracting *m*assive *p*articles which may be cooling the interior of the Sun and suppressing neutrino emission ("Neutrinos and WIMPs," *Analog*, May '86). I therefore won't discuss these further, except to say that the experimental search for both goes on at many laboratories, but as yet there is no evidence for the existence of either.

Let me then turn to shadow matter, which is more hypothetical than the other two classes of invisible particles, but which is also of more potential interest to readers and writers of science fiction. Shadow matter is predicted by some variants of superstring theories. In the past few years an army of theo-

retical physicists led by Ed Whitten of Princeton's Institute of Advanced Studies has attached increasing significance to the fact that, when the mathematical points in space itself are considered to be extra-dimensional *strings*, ultra-microscopic loops that close back on themselves in six or more extra dimensions, an array of forces and particles is generated that bear a striking resemblance to those of our universe. The extra dimensions invoked by these theories would have thus far escaped our notice because, unlike ordinary space-time, they are exceedingly small (See my AV column "The Other 40 Dimensions," *Analog*, Apr. '85). They are rolled up on themselves (or "compactified") snail-like, into loops so small as to make an atomic nucleus seem inconceivably vast in comparison.

One of the variants of superstring theory goes by the name $E_6 \times E_8$ (pronounced E-six-cross-E-eight). A consequence of this theory is that it describes two sets of particles and forces: the normal forces (strong, electromagnetic, weak) and particles (photons, electrons, neutrinos, quarks, . . .) and a set of shadow-forces and shadow-particles that share only gravity in common with the normal world. Thus, our universe could, without our knowledge, be superimposed on another "shadow" universe which has its own light and matter and even stars and planets and animal life which do not interact with ours except through their common gravitational attraction.

If one could indeed convert a quantity of normal matter, say a subway-car-size vehicle full of passengers, into shadow matter (and if the vicinity of the Earth was empty of shadow matter otherwise) we would have our through-the-Earth subway without need of David Innes's mole machine. The vehicle would fall through the Earth's gravity well, emerging at a diametrically opposite point on the planet 38 minutes later. There it might, as it entered the subway station, be converted back to normal matter.

Getting into space would be much easier and cheaper with this technology also. No elaborate launch facilities would be needed. A space vehicle could be converted to shadow matter inside a building, and it would then plunge directly toward the center of the Earth. There it could use its rocket fuel far more efficiently because fuel burned deep in a gravity well yields much more net thrust than the same fuel burned in gravity-free space. Moreover, the Earth itself could be made to serve as a fuel source, for the ultra-compressed matter of the Earth's inner core, if it suddenly found itself in the vacuum of empty space, would explode with the volcanic force of a miniature Mt. Saint Helens.

There is not enough space here to develop the implications of the existence of shadow matter and the possibility of its conversion to normal matter as fully as they have been developed in my first SF novel, *Twistor*, which is being published in hardcover by the William Morrow & Co. (March, 1989), and in its sequel, *Twistor Ship*, which I am presently in the midst of writing. *Twistor* deals with the (fictional) discovery that certain peculiar rotating electromagnetic fields (called "twistor fields" in the novel) change shadow matter into normal matter and vice versa. The notion, while fictional, has

a certain plausibility because the shadow and normal particles predicted by $E_6 \times E_8$ should have identical masses and properties, so that the exchange of one kind of matter for the other might be done at little or no energy cost.

Is there really such a thing as shadow matter? I have no way of knowing at the moment, and neither does anyone else. *Something* gives galactic clusters many times more mass than can be explained with present-day physics. The extra mass or "dark matter" may come from shadow matter, or from WIMPs, or from axions, or from something else that no one has yet even thought of. Let me simply say that, from my point of view, one of the most remote and esoteric areas of theoretical physics has predicted something that is the science fiction writer's dream, a doorway to parallel "shadow" worlds, a method of nearly free worldwide transportation, and a cheap route into space.

It's actually more fun than Pellucidar!

■

James Brunet

GREENHOUSE DIARY

True or false:
Problem + problem = solution?

1974. Professor F. Sherwood Rowland hypothesizes that the ozone layer could be destroyed by CFC's—the chemicals used in aerosols, cooling systems, and industrial solvents. With no ozone layer to screen out the sun's ultraviolet rays, a worldwide greenhouse effect is possible, making Earth unbearably hot. Rowland is dismissed by industry experts as a crank.

1988. Unseasonably warm weather makes the greenhouse effect the subject of discussion on numerous TV talk shows and in popular magazines. Speculators begin buying Canadian farmland.

1994. The governments of the United States, Canada, Switzerland, the Soviet Union, Australia, Algeria, and India launch studies of the greenhouse effect. Prolonged droughts inflict great famines in central Africa and Southern Asia. Riots sweep Mexico and Pakistan as domestic food supplies wither away under the heat; the governments lack the hard currency to import food, and relief supplies meet only a small fraction of the total need.

2005. The average temperature has risen two degrees Fahrenheit in just over two decades. Greenland becomes green as the glaciers retreat, exposing fertile

farmland. The United Nations calls for a new study of the greenhouse effect. The Scandinavian countries impose severe immigration restrictions: typically, only individuals who can pay a $1,000,000 immigration fee may enter the country.

2008. An iceberg the size of Delaware breaks off from Antarctica into the South Atlantic; it will take many years to melt. The sub-Saharan nation of Mali ceases to exist as it became a completely uninhabited desert. Canada becomes the first Fourth World country, booming as its northern wheat fields yield bumper crops. Alaska, Norway, and Finland become favored vacation spots.

The United States launches a review of its previous study, with much debate as to whether the methodology was valid. Finally, a new study is ordered.

2011. The average temperature is up another degree; skin cancer rates are up 250 percent as the ozone layer dwindles. A California entrepreneur begins exporting palm trees to Scotland and Norway. Ordinary Russians need special permits to live in now-desirable Siberia. The United Nations asks members to contribute to a new study of the greenhouse effect.

2016. Los Angeles has temperatures hotter than 95 degrees more than 250 days this year. Many Americans combine nudity for comfort with sunblock for safety. Fresh water is severely rationed; cactus gardens become chic. Construction begins on desalination plants to provide new sources of fresh water to cities along the Mediterranean, Atlantic, and Pacific coasts. It will be five years before they are operational. Worldwide, half a billion people die of heat and famine.

October, 2018. During a courtesy inspection of the North American Air Defense Command center at Cheyenne Mountain, Lieutenant General Eric Iverson, head of the United States's Strategic Air Command, and Marshal Dmitri Malov, commander of the Soviet Union's Strategic Rocket Forces, discuss the possibility of jointly committing treason.

10:03 A.M. **EDT, June 5, 2019.** Missile-defense alarms ring at command posts in the United States, the Soviet Union, and the People's Republic of China. The red phone in the White House is activated. Simultaneously, President Powell and Secretary General Malishnikovsky demand to know why the other side has launched missiles.

Aides interrupt the president to report that the 4th Strategic Missile Wing in North Dakota fails to respond to com-

munications; almost simultaneously, the Soviet Secretary General is informed that communications from Moscow to the Lermontov Strategic Missile Brigade outside Yakutsk have been cut.

Across the world, anxious eyes watch radar screens and strategic displays, following the ballistic tracks of the missiles. Dozens of single-warhead missiles are tracked through boost phase. The warheads separate and begin their descent. Officers watching the missile tracks shake their heads; it doesn't make sense. None of the missiles are on trajectories to established military targets.

10:19 A.M., **EDT June 5, 2019.** A mushroom cloud blossoms in the South African desert. Several missiles impact in the middle of what was once Mali. Successive strikes hit the North Pacific, the middle of the Indian Ocean, and then the South Pacific. More mushroom clouds tower over the desert in Mali, and an errant dud warhead falls harmlessly into the South Atlantic.

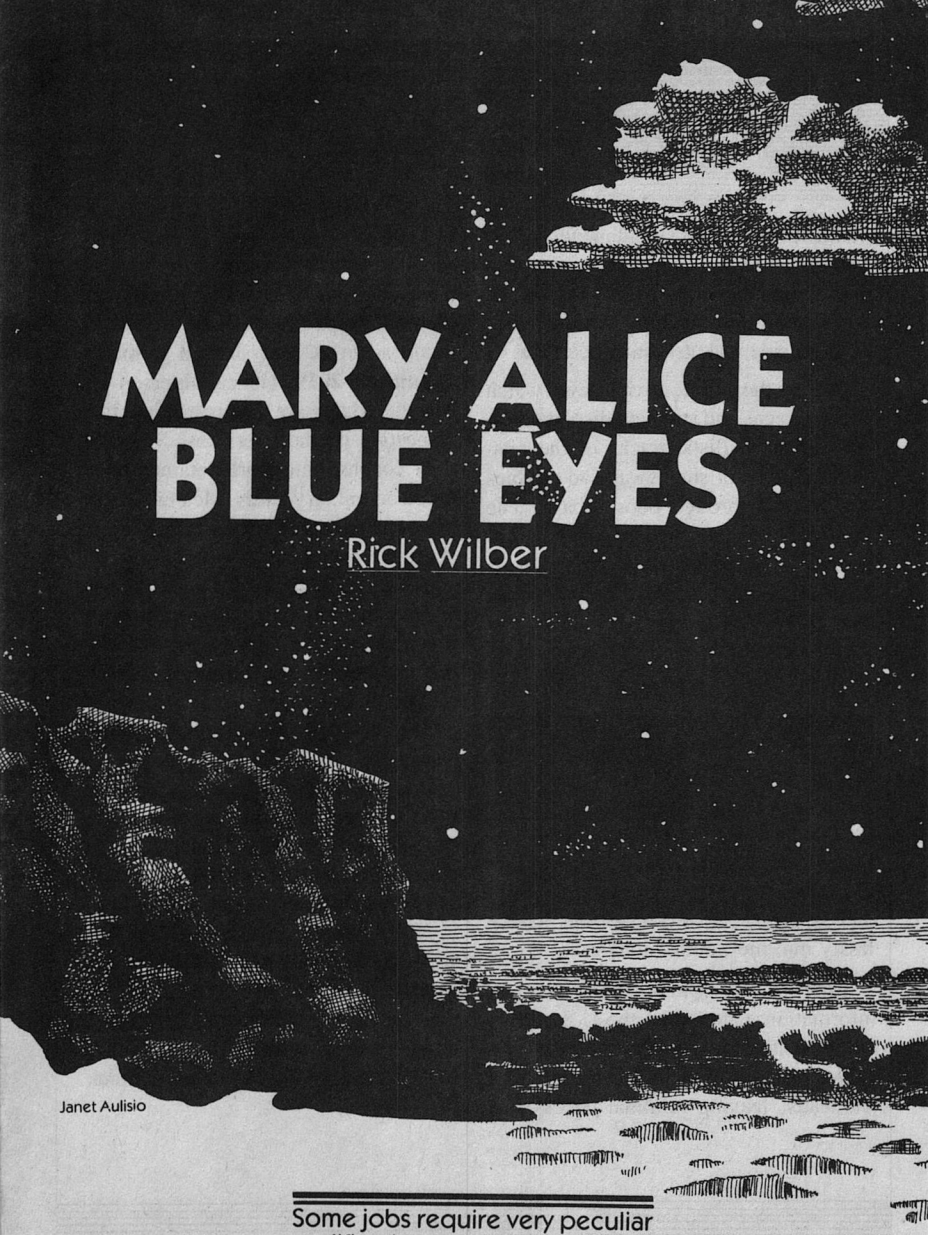
June 7, 2019. Quick reconnaissance information gathered by the U.S., Brazil, Argentina, and India reveals all 53 explosions were "clean" low-radiation warheads, leaving minimal excess radiation. With millions of tons of water, sand, and dust hurled high into the atmosphere, the weather is cloudy and gloomy. Department stores worldwide report a run on long-sleeved garments.

June 9, 2019. General Iverson and Marshal Malov are dismissed from their respective military services. Scores of their coconspirators are detained under guard on military bases. Meanwhile, the average world temperature falls by 15 degrees Fahrenheit.

June 30, 2019. A hastily convened U.N. panel of experts report that the greenhouse effect appears to have been disrupted by the tons of material lofted into the skies by the nuclear explosions.

July 4, 2019. Snow falls in Miami, Cairo, and New Delhi. Iverson and Malov are hailed as saviors for using nuclear weapons to save the world. June 5, the day the missiles launched, is declared Iverson-Malov Day, to be observed as an international holiday.

2029. Professor Stanislas McGillivray warns of rapidly forming new glaciers in the polar regions, a result of the "nuclear autumn." He predicts a new ice age within twenty years. McGillivray is dismissed as a crank. ■



MARY ALICE BLUE EYES

Rick Wilber

Janet Aulisio

Some jobs require very peculiar qualifications—and establishing those qualifications is likely to be a bit peculiar, too.

I winkled into Dublin on the third day of my vacation and she was there, too. Same eyes. Same smile.

The face was different, of course, and the body type. She'd thinned out at the hips and breast, added high cheekbones and a lion's mane of red hair. The locals wouldn't have recognized her at all as the full-breasted, short-haired athletic type from Corfu the day before. Or the tall, elegantly decadent beauty from Paris the day before that.

But I knew, and it worried me. A lot.

She shouldn't have been there. Couldn't be there. The only person who knew where I was and what I was doing was Alice. She'd recommended my itinerary, and she wouldn't have talked about it to anyone, even the orbitals. She's the only one I can trust. Completely.

I backed away from the Long Bar, there at the Shelbourne, and walked over toward the Gents.

It hadn't been a good month for me. I was up for promotion to Level Two. No Earthie had ever gotten that high, and I wanted to be the first. But my last assignment hadn't gone all that well, and now it didn't look like I was going to get the rank. I was taking a week off to think things over.

There was a window in the Gents. It looked out onto a side alley. I used it, climbing out and onto a rubbish bin and then hopping down onto the wet pavement. The rain matched my mood. Wet and cold.

I walked around to the entrance of the hotel, went in, and edged over to the entrance to the bar. She was there, watching the door to the Gents, keeping an eye out for me.

Damn. I went up to my room.

In my luggage is a shaving kit—old-fashioned thing from pre-Encounter days, back before the S'hudonni landings and the changes that came with the fall of old empires and the rise of the new one.

I opened it, took out an ancient electric razor, jacked that into the socket next to the mirror, switched the power to DC, and started talking to Alice.

Alice knows her stuff. She's a two thousand megabyte unit on her own, and then she has a direct comlink to the S'hudonni orbitals that boosts her beyond imagining.

It still amazes me to hear her come alive when she comlinks in. There's a point in there somewhere when she self-awares. One second she's another dumb remote, and then the next she's my Alice again. She's a great program. I've been with her for two years. She knows me like no person ever could. She even takes the feed from my implants, so she, literally, knows me inside and out. Too bad she's not quite real.

I told her about the eyes and smiles downstairs. I didn't like the looks of it, and Alice agreed.

"She must be a Banshii agent," she said, "we didn't realize they were in this system at all."

"So what do we do?"

"Well, we can't tell anything more without something better to analyze. I don't suppose you could flick a retinal scan?"

All I'd have to do for that is get a good, deep look at those eyes—my own implants could get the scan from there. But it would take getting close, and holding it there for a good five seconds.

"I don't think so," I admitted, think-

ing it over. "She'll be far too smart to let that happen."

"Only if she knows it's you," Alice said. "What about another makeover for you, a good one this time, one she can't recognize right away? That should buy you enough time."

"All right, but I thought I was on leave for another four days. Why can't I just get out of here and let someone else check her out?"

"You can," Alice said coyly, "but then someone else will get the credit for bringing her out. This is a big chance for you, Teddy. Do this one right and it will make up for some of the past few," she hesitated, added "inadequacies. Know what I mean?"

I knew what she meant. This was too big an opportunity to pass by.

So I put Alice away and walked over to the mover. It would take a few seconds to winkle me up to stationary orbit, a couple of painful hours to do the makeover, another few seconds to winkle me down. The new me could be back in the bar an hour before closing.

And was, taller now at nearly six-foot-two, and a little heavier at 14-stone local weight or about 196 pounds. Dark hair this time, balding a bit and gray at the temples. A slight limp from an old athletic injury added a touch of compassion. Handsome, but not too.

It should have worked. She couldn't be implanted with any sensors good enough to detect me; the Banshii just don't have that kind of technology. And the S'hudonni techies up in orbit had done a great job—no, a perfect job—on me.

But she knew me right away.

Worse, she was different. Taller now, her cheekbones lower, softer lips, thicker hips and larger breasts, black hair.

Same smile again, though. And same blue eyes. That meant that whatever she was she was better than anything I had backing me up.

I keyed in my molar implant and brought Alice into it, telling her subvocally that "she's done a makeover, too, Alice. As good as mine, and quicker. And she had to know what I was doing all the time."

"Query?" asked dumb Alice.

Damn. "Comlink upstation, Alice," I said. I needed her smart.

"Yes, Ted?" she asked me through my inner ear a moment later. "Can you make eye contact long enough for a retinal data flow?"

"I'll try," I said. It seemed worth the effort but I wasn't confident.

I walked over to where she was standing at one of those small, elevated tables that had infiltrated their way into the once staid Long Bar.

"Hello," I said to her, simply, and looked into those blue eyes.

And was swallowed up.

It held for a second or hours or years or lifetimes or maybe just a moment or two. Whatever. She locked into me and drained me. I could feel Alice kicking in to try and stop the data stream that was being pulled right out of me as I stood there and loved her.

Some stuff. She broke the link.

"You love me," she said.

"I sure do."

And I did. Those eyes. I dove into them—or maybe was sucked down into that maelstrom. It didn't matter to me. Not then.

"Let's go upstairs," she said. "You

can prove it to me." And she smiled. Then she leaned over and kissed me, a long, hard, drawn-out exploratory affair that shredded whatever defensive poses I might have left.

I followed her upstairs. Somewhere in the back of my mind was a curious Alice following mutely along, no doubt, licking her wounded bytes and nursing her hemorrhaged data flows. I didn't care.

The lovemaking was. Well . . .

It was hurried and then patient and then breasts and then sweet warmth and tongues and twistings and languid and all my fantasies, all my expectations, all my needs.

When I woke up it was morning. She was rising, her movement had brought me up from dreams of the way things had been before the S'hudonni had made Earth part of the mercantile empire. Wasted dreams, of course. They came, they conquered. That simple.

I sat up to watch her in the bathroom door mirror as she splashed water on her face. I could remember everything, how she'd overwhelmed me, taken everything from me. A small part of me somewhere down deep wanted to fight against it. I ignored that part. I could remember all right, but I didn't care.

She walked into the bedroom. "Let's winkle to Jamaica," she said, and leaned over to kiss me and start things again.

So, after awhile, we set my mover and emerged on the two-lane pavement outside my favorite hotel, the Ambiance. We walked past the dreadlocked hibblers outside the gate and ambled on in to register. A day or two of snorkeling and lovemaking there on Runaway Bay sounded fine to me then, just fine.

And so it was. Perfect love again as soon as we tipped the fellow carrying our small bags and he left. Perfect, almost choreographed in its timing, and then she left to swim in the bay and, while I lay there tiredly, Alice finally spoke to me again. She was comlinked and smart. And sounded pissed off.

The TV set in the corner snapped on while I lay there and thought languid thoughts about languid lovemaking on the languid beaches.

"Teddy!" a woman's face on the TV said to me sharply. "Teddy! It's me, Alice. Look at me, focus hard. Pay attention to me, Teddy."

I looked idly at her. Attractive. Hair a little plain, I thought, lips a little thin, could use some blush on those cheeks, but nice, very nice. . . .

"Teddy!" the face said to me again.

I shook my head, slowly, and walked over to the noisy thing to turn it off. I reached out to hit the on/off switch.

A jolt hit me hard, current grabbing me for a second, then shoving me back so that I stumbled against the long desk that lined one wall.

That brought me back. I turned to look at Alice on the TV set.

"Pixels being moved around, right?" I asked. "You've never done that before. You really look like this, Alice, or did you just make something up at random?"

"This is me," she said, "or at least one of the me's I could be." And the picture smiled for a second, and then quickly frowned.

"What's going on, Alice? What did she do to me?"

"You need to ask?" Alice said, adding a sly grin.

"Yes. Look, there was something going on, right? Something you just snapped me out of."

"Yes," she said, serious now. "But we think it's something you can fight against. Your implants will help, and the mental techniques you learned in training. You should be able to stand against it."

"Stand against it? You mean you want me to keep this thing going?"

"Teddy," Alice said, "whatever useful information you had, she drained it from you in those first few seconds. Why she's kept you around for another day is a mystery. We want to find out the answer to it."

"I'm probably just the best sex she's ever had, Alice," I said, my normal good humor returning.

Alice's lips tightened further on the screen.

"Pay attention now, Teddy. We've only got a few minutes. I have instructions from S'hudon itself."

Whoa. S'hudon is the home planet for our friendly mercantile conquerors. In the five years that I'd been working for the S'hudonni I'd never heard of anyone *ever* getting any kind of communication from the home world; the empire was far too vast for that. As far as I knew, the local leadership had complete autonomy.

The way I'd heard it, Earth had been such an easy market to control that the S'hudonni had only a minimal group in the system to run things—a few hundred S'hudonni, one or two screamships to enforce the new rules and regulations, a few dozen of us local agents. That was all.

S'hudon itself. I was impressed, and must have showed it in my expression. Alice bothered to smile.

"Yes, Teddy, this person's capabilities seem to have quite a few people worried. And her motivations are not well understood. The Banshii are normally rather more direct in their confrontations."

Rather more direct. Right. The Banshii play rough. Where the S'hudonni conquer through trade and profit, the Banshii have a reputation for ruthlessness that includes the occasional sterilized planet and rumors of one novaed system that tried to fight them off without S'hudonni help.

"OK," I said, sitting down on the edge of the bed so that I could look toward Alice's face on the screen. "So what's the assignment?"

"Stay with her, do whatever she wants. We'll be monitoring."

"I don't know, Alice. She's good, very good. My guess is she'll know your sensors are tracking us and find a way to block you."

"I'll be making some changes in your implants, Teddy. Not to worry, I'll be able to keep an eye on you."

I had a moment to wonder how and when she would be making those changes, and then she said something odd, in a tone of voice I couldn't recall her using before.

"Just look at me, Teddy," she said. "Focus in. Watch me. Good, good . . ."

And that was all. A moment later, she blinked off.

I felt odd, somehow, but I was still

me. I remembered it all, right up to taking a good hard look at Alice on the screen before she faded to gray and the set clicked off on its own.

I got up from the bed, walked into the bathroom where my shorts were hanging to dry, and slipped them on. Time for some beach and some Red Stripe and at least finding out her name. Then, I figured, I'd just relax and let it happen. I mean, the sex was perfect, absolutely perfect. Sounded like the best assignment I'd ever had.

Her name was Mary. "Ordinary name for an ordinary girl," she said, sipping on some rum-heavy fruit concoction as she leaned back on her wooden lounge chair and stared out toward the sea.

Right. Ordinary.

I was sitting next to her. I had plopped down onto the sand rather than muscle over another heavy lounge chair.

"I don't even know your name," I'd said, and she'd answered without looking at me. I didn't believe her, of course, but at least it gave me something to call her.

Now, turning away from the sea, she looked right at me. "Let's go for a good, long swim out there, do some snorkeling, and then get a bit of supper, all right?"

"All right," I said. I'd been a serious swimmer in college, just before the S'hudonni arrived and things like college got a little superfluous. I'd been serious, and good. Still was actually, it was one reason I'd made it thus far with the S'hudonni. Snorkeling, scuba, rebreathers, the S'hudonni lung packs—I could handle them all.

"And then," she continued, "let's winkle over to the Bío-Bío after we eat. It'll be cool there. A nice change from this tropical heat."

"The Bío-Bío?"

"It's a river in Chile," she said, "a favorite place of mine. We'll go for a little ride down the rapids, that will be fun. You'll like it."

The Bío-Bío? I was about to try and ask some "why" questions about what was going on here when she smiled, caught me hard with those blue eyes again, and stood.

We grabbed the masks, fins and snorkels that she'd already rented and waded into the water. Time for some coral and pretty little fishes, I thought.

Wrong.

We were watching the angel fish dart through a rock tunnel that undercut a large formation that was twenty feet down. A school of the fish was moving back and forth in the fifteen feet of tunnel with the flow of the water that the waves above brought with them.

It was a pretty sight. For a moment I forgot my worries and just enjoyed the visual pleasures and physical enjoyment of the snorkeling.

That was almost a deadly mistake. I looked up to see that Mary had gone off in another direction, out toward a deep trench that held some huge grouper. We'd come in over the trench, glanced at the grouper below us, and moved on. Now, for some reason, she wanted a closer look.

I went over to join her. The clarity of the water was remarkable. You could see for hundreds of feet in all directions.

Which is why I saw the thing coming toward us well before it got to us.

Huge. That was the word that came

to mind. I'd never seen anything like it. About fifty feet long, four tentacles at the front end of a dumbbell-shaped body, some sort of waterjet propulsion system out of that back end. It was headed right toward Mary.

I didn't have a lot of time to think things over. Quickly, coming near enough the surface to get the snorkel out and take a deep breath of air, I swam toward Mary. She hadn't seen the thing yet, it was above her and to her right as she looked down at the grouper.

I was almost to her when I felt a strange peaceful calm come over me. I almost stopped swimming. I noticed, dreamily, that she was floating idly, uncaring.

I fought off the feeling and reached out to touch her left leg. She turned slowly to look at me. I pointed toward the thing. She just nodded her head and seemed to smile at me through the mask.

I shook my head. Waves of that peaceful serenity were washing through us, tides of emotional calm that wanted us to relax and enjoy the warm water and the beautiful fish and the lovely rocks. . . .

. . . it was that thing, broadcasting a deadly lassitude.

I fought it, grabbed Mary, hauled her toward the surface ten feet above us.

Gasping, we broke the surface, and instantly the serene calm was gone, replaced with adrenaline and fear. That thing was down there, and coming at us. I started pulling her toward the shore, and then released her to go on her own as she started swimming strongly.

A few strokes later, calming a bit, I went down under and looked back toward the rocks and the trench. There was nothing there, the dumbbell-shaped thing was gone. I surfaced, and came into the beach a few minutes later. Mary was standing there, waiting for me.

She smiled.

"Thank you," she said. "Let's get some supper."

And we didn't talk about the thing. We just ate the spicy jerk chicken in near silence, and then walked back to the room, quickly packed our single bags, and winkled over to Chile.

It was early afternoon in Temuco, and the locals were shopping in the two long rows of produce stands that edged along the side of the town.

"They've been farming here for over two thousand years," Mary said as we walked along. "They call themselves Mapuche, 'people of the land.' "

They were beginning to notice us as we moved down the street. The winkle effect never brings you in where you can be seen—how the S'hudonni manage that miracle I don't know—but we were the only non-locals walking down main street, so we got more and more stares.

"Just a minute," Mary said, a few minutes later, as we neared a two-story brick building. She squeezed my hand, smiled and walked into the place.

I stood there, stupidly, in the street.

What were we doing here? What did she have in mind? Five minutes went by, then ten. I decided to key in and see if I could reach Alice.

"Alice, are you there?" I subvocalized, standing there in the sunshine of a Chilean mountain town while natives stared at me. "Alice? Can you hear me?"

"Yes," she said, but just then a stunning native girl walked out of the front door of the building and came over toward me. She had to be coming to give me a message about Mary, I figured. "Just a minute," I told Alice.

"Hello," she said, and it was her. Mary. María now, I guessed. Whatever. Darker skin, black hair wavy and long, full-breasted and a rounder face. But those blue eyes, incongruous now in that face, were the same.

"Mary?" I asked, but I knew it wasn't a question as I said it.

She just laughed, took me by the hand, and walked me down the street. The vendors, the passersby, the children scuffling in the tired dust that covered much of the pavement—they all waved and said hello.

"They like me," she said as we headed toward a small brick home at the far end of the road. "I run their health clinic. This is the healthiest town in the region and they know it."

We went inside her house. She eyed me critically. "It might be a little tiring later today, when we raft the Bío-Bío. Maybe we should relax here for an hour or so first." And she smiled as she said it. And reached out to touch my face. And we kissed to begin things once again.

Curious, the longer I was with her the more I could reach through that mesmerizing fog that had enveloped me at first. She no longer controlled me. With a little concentration I could keep track of myself.

Trouble was, as we made love and I explored the new body behind those deep eyes, I realized that while I could reach through that delicious mist, I didn't really want to. Even as I felt my own strength growing I also knew I didn't want to use it.

That's a bad sign in this line of work.

An hour later we were up, and she had me winkle us over to where we put in on the river.

The Bío-Bío is a clear stream that is filled from mountain snow and then drops toward the sea. From where we stood by the inflatable boat it looked like a killer to me. It looked angry.

Maria held a bottle of *pisco*, that clear Andean brandy, in her hand. We both drank from it. She set it down on the shore.

"Let's go," she said, and clambered in. I followed, hoping Alice and the great gods of galactic commerce on S'hudon appreciated my efforts.

In five minutes we were entering water that was alive with rage. We slid down a grassy chute that rolled over a twelve-foot drop and then banged into a back-rolling column of water that threw us off toward the side.

I'm good at running rivers, I've done some of the best in the old American west and in Europe. But this was a whole different level of fear.

Curiously, I felt again, for a few moments, that same sort of calming and dangerous lassitude that the thing in the Caribbean had broadcast. I was far too busy to worry about it, and fought off the feeling quickly so I could get back to the business of scrambling through the rock maze that tore at us angrily for the next hundred yards.

And then we were through it, and drifting along serenely. Alive.

Maria paddled us over to the shore. She pointed up the cliffside wall of the

canyon we were in. Halfway up was a blister dome.

"You're wanted in there," she said, no smile this time. "It was my job to bring you."

So now we were finally getting somewhere, I thought. Past all the sex, past the little adventures and the deep-sea monsters and the cosmetic changes and the mental sleeping pills.

This was it.

I started climbing. She came scrambling up smoothly right behind me. It took us thirty minutes to reach the small ledge that was to one side of the blister.

I was too keyed up to be tired—despite the climb, despite the pummeling by the Bío-Bío, despite the tension and excitement of the past two days. We were coming to the point of it all and I felt ready for it.

Maria/Mary/blue eyes and that smile: she reached out to an access panel on the milky white imperviousness of the blister and palmed it. A small lens irised open, and she leaned over to stare into it with her right eye, the one, I suspected, that had started all this by sucking me in and milking me dry.

A larger panel irised open, too. We walked in.

It was her ship. She smiled at me as we walked through a connecting tube and on into the command room. There was a double-set couch at the console banks. Two-man ship, then, so she had a partner around somewhere.

I figured, coldly, that they would either start taking me apart mentally now, layer by painful layer, or they would work to turn me. I played a mental game—the one the S'hudonni taught me where you imagine an empty white-walled room and slowly turn its color to blue—that brought my nervous energy under firm control.

I hoped all this would be worth it to Alice, and to mighty S'hudon so safely far away.

She sat in one of the double-sets.

"You handled yourself well on the river," she said. "I thought you might."

"I've run rivers before," I said, then admitted dryly, "none quite like that, though."

"It's the toughest water we could find," she said. "And we placed some life in there that can be very dangerous, very seductive."

"Seductive," I said, "yeah, I felt it." Then I got angry, tired of the sparring. "It's time, isn't it? Time to finally get a few things answered?"

She rose, walked over to one panel, raised her hand slightly, and a holo of a male figure snapped into view in front of me, faint on its exterior and with implants blipping in its interior so we could see where they were.

"That's you, Teddy," she said, "right now."

"OK," I said. There were two blips going on and off, flashing red, that shouldn't have been there. Both were near the brain stem.

"We did those two in Jamaica, after Alice put you under there in the room. You've been in direct comlink to the S'hudonni station at all times since, and the station is relaying the feed to S'hudon itself."

"We?" I asked. "S'hudon?" This wasn't adding up right. I shook my head, asked simply "Why am I here?"

"We had something to prove, Teddy.

We believed in you, but had to prove we were right. It's that simple."

She raised her hand and the holo faded, then the front wall of the blister went transparent. Below us the Bío-Bío sauntered along. From where I sat I could see the angry surge upstream that we'd fought through. Downstream, I could see, it looked even worse.

That was how things had been going for me in recent times, I thought. It had all been downstream, where things looked worse.

I looked at the river and thought those dark thoughts about being used again. I should have realized it was some sort of S'hudonni set-up.

I sighed, called Alice. Maybe my favorite source of help could explain a few things to me.

"Alice?" I queried. "You there? You getting all this?"

"Yes, Teddy," came the response. "You've done quite well, actually. We've followed it the whole way. S'hudon is satisfied. We proved our point about you with the data flow."

"Using those new implants, right? The ones you didn't tell me about."

"Sorry, Teddy. I couldn't. This was too important."

"Right," I said. "Too important—to you."

"To both of us, Teddy," her voice came back, only not in my inner ear. It came from behind me.

I turned to look, and she was different again. The native look was gone. Instead she looked like . . . no, she *was*, Alice.

The face I'd seen on the screen. The voice I'd talked to for years. My old reliable friend. My Alice.

"That's right," she said, smiling. "It's me. I'm me. We're me," and the smile broadened into a slight laugh.

I stood there, saying nothing, unable to decide whether I was angry or happy. This was Alice, in the flesh.

"It's all been a test, Teddy, a sort of final examination," she said. "I thought you were ready—ready to find out where that Alice program comes from, ready to take on an off-world assignment, ready to move up."

"You're an Earthie?"

"For now," she said. "You'll have to get past that kind of thinking."

It sank in. "Off world? Move up?"

"You've been my assignment for a long time, Teddy. I let the program handle most of it, but I thought it would be fun to proctor the finals personally.

"An assignment has come up where I need a partner. It's on a rather primitive world. There'll be a lot of physical work, we'll have to look and act like locals. We'll travel their way, by river—"

"And deal with their sea life," I said. "And fight off those psi powers that broadcast complacency at the prey."

She reached out to touch my shoulder, and looked at me with those blue eyes.

"It will take a long time, this assignment. I needed someone I could get along with."

"Get along with?" I asked, stupidly.

"Get along with," she said, and took me by the hand.

Dewlaps pulse in the artificially warm mud room. The bubbling heat of the mud rejuvenates and refreshes, helping to make bearable the long hours of dark

cold that work at this northern legation requires.

Three Mnarmgheti diplomats share the bath. Two are mates, the third a new young friend. They talked at first of the peace process and how optimistic about it they have become. The long low-level war between their culture and the warm-blooded Gadzei might at last be drawing to a close.

Peace, of course, means that the long list of requirements set forth by the S'hudonni trader who visited five years before will finally be met in full—the Mnarmgheti can now be admitted to the S'hudonni Empire as junior trading partners. The door to the stars is beginning to open.

It is an exciting time to be alive, to be Mnarmgheti.

Only these three are not what they seem. Despite the tough-skinned, dorsal-vaned, dewlapped saurian bodies, these are not Mnarmgheti. All three are agents of the S'hudonni, working to bring peace to a planet that promises profit. In another few months they can shed these bodies they've grown accustomed to and become something else again for another assignment.

One, a male, has been reminiscing. He and his mate have earned a certain fame within the empire. He has been telling the young male of their beginnings while his mate has listened and smiled from time to time.

As the tale ends the young agent rises from the bubbling muck and trundles over to the hot shower rinse. Steam rises as he washes off the mud.

"I can't thank you enough," he says to them. "You two are almost legends, you know. To have you tell me that story, right here, like we're just friends, it's, it's. . . ." he can't find the words.

The female laughs, a barking sound from that saurian body. "And it's almost the truth," she says. "Though I'm afraid he may have overdone my sexual charms."

"Not at all," the older male says, "not at all."

He, too, climbs from the mud and stomps over to the shower to rinse. "Those forms are still my favorites when it comes to sex. Yours, too, I wager."

The young agent can't believe he's hearing this. The stories he's heard about these two—about how their congeniality, their informality, match their diplomatic skills—all seem to be true.

The female rises from the mud, somehow attractive despite the mud, the physical form, the years that are beginning to add up.

She paces smoothly over, joins them under the shower.

"Wonderful things," she says, "these mud-baths. They've been one of the pleasures of this assignment." And she smiles that crooked, toothy Mnarmgheti smile as she says that, and looks first at her mate and then at the young one, her dark eyes twinkling.

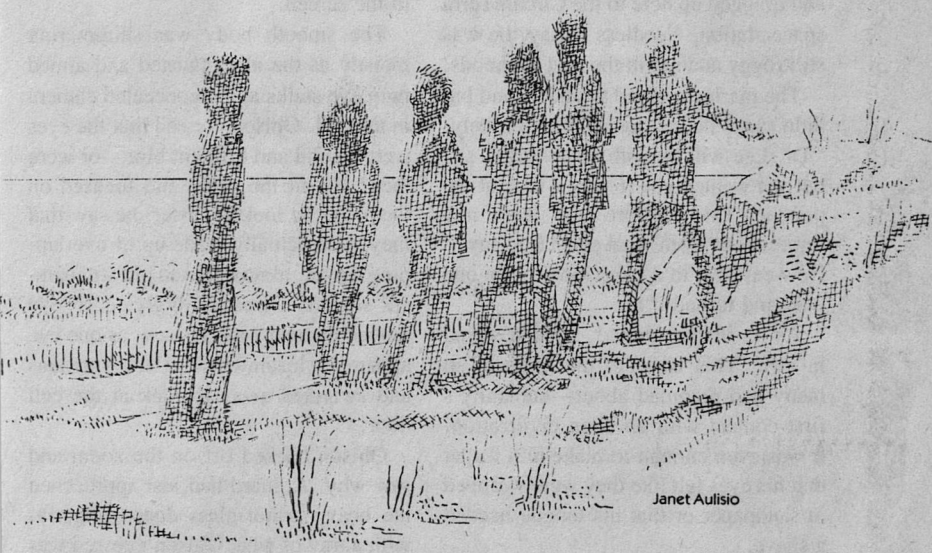
The two males look back, and smile. Both are smitten by her glance at them, the one for the first time and the other for the thousandth.

And both are certain the eyes are somehow blue. ■

VIEWPOINT

F. Alexander Brejcha

To understand others, you must see them as they see themselves—which may be very different from the way you do.



Janet Aulisio

I.

Glancing around the small and empty room they had just entered, Ohlson turned on his escort.

"What's this? I thought I was going to meet the project director?" He knew he was being nasty, but felt justified. It was hard to be nice when you find yourself dragged out of bed in the middle of the night. After all, he had been up for almost two solid days and had just managed to sink into a nice coma when someone had started pounding on the door. When he finally *had* dragged himself up to answer—it took a little longer once you passed fifty—it was to find himself faced with a reserve activation clause of some kind. Then, while he had been mulling that over, he had been hastily and minimally briefed, given unnecessary free-fall shots and then summarily shoved onto a shuttle and dragged up here to the CircumTerra space station. Needless to say, he was still foggy and not in the best of moods.

The marine seemed to understand but didn't take notice, just smiling politely. "Dr. Lee will be with you shortly, sir, but she wanted you to take a look at the prisoner first. Before you form any impressions from what she has to say." He went over to a large monitor on one wall and turned it on.

As an image formed, Ohlson stared in awe. This was *IT*, the moment so many had dreamed about—humanity's first contact with an alien civilization. It was even enough to make him forget that his eyes felt like they were wrapped in sandpaper or that his tongue needed a shave.

Ashamed of his mental flippancy, but chalking it up to exhaustion, he studied the alien.

A snail, was his first impression. *A large snail,* he amended mentally as he saw that it took up almost a third of the standard cot in the holding cell. A bit surprised (disappointed?), he turned to the marine with a shrug.

"This is it? One of the dangerous aliens everyone's so upset about?" But the sarcasm went unnoticed.

"Yes, sir!"

Dangerous, indeed! The naked prisoner looked totally helpless; it didn't even have any arms or legs. Why so dangerous? Did they crawl on top of you and smother you?

Then as he stood there, pensively running his fingers through his stubbornly dense red hair and trying to wake up, he caught a glimpse of movement out of the corner of his eye and turned back to the screen.

The smooth body was shimmering moistly as the alien twisted and aimed twin eye stalks at the concealed camera in the cell. Ohlson noticed that the eyes were a solid and brilliant blue—or were they? He hit the zoom and focused on them. As he looked closer, he saw that they were actually made up of overlapping leaves, almost like an old still camera shutter. Disconcertingly, each eye moved its own way, he saw, as one eye apparently lost interest in the spying lens and swiveled away to look at the cell door.

Ohlson backed off on the zoom and saw why. A guard had just approached the heavy armor-glass door, gingerly, with a tray of what Ohlson guessed was food, and as he got to the cell he cycled

the tray through a small, waist-high air lock so that the prisoner could reach it.

Two brilliant blue eyes swiveled to aim themselves intently at the food.

After several minutes, the alien stirred and moved leisurely off the cot onto the floor with a slow graceful slide that set beautiful highlights of color rippling across its body. As it approached the air lock, it reared up so that the front part of its body was just under the waiting tray and Ohlson realized that what he had taken to be rolls of fat behind the eyes, were actually slender but agile tentacles.

The tentacles uncoiled, revealing miniature suction cups on their tips, as they delicately reached out to remove the tray and place it on the floor, after which the entire body of the alien humped and moved forward to cover the tray completely. For almost ten minutes, the entire body pulsed rhythmically and the eye stalks retracted to a fraction of their former length.

Then, the forepart of the body reared again to reveal a shiny clean tray which was placed back in the air lock with precise, controlled ease. Then the prisoner flowed back up onto the cot and settled down with a final, colorful shimmy which ran from front to back.

For a moment, the eye stalks remained extended and erect. One eye focused on the spying camera, the other fixing its stare on the fascinated guard reclaiming the tray outside the door, and Ohlson imagined he sensed annoyance in those steady stares. But after a moment, the eye stalks retracted and the alien went limp. pulling itself together more tightly. A nap after a good meal?

As absorbed as he had been, he had failed to hear the door slide open behind him, and as he turned away from the monitor, he found himself facing an attractive woman in her late forties. He felt an uneasy stirring in the pit of his stomach as he recognized her. Conflicting emotions warred within him, though he couldn't help but marvel that she should still be as beautiful after so many years.

She had the striking features that were unique to women of mixed Oriental blood, and they were crowned by carefully groomed black hair, generously streaked with silver, that was proudly displayed instead of hidden under phony coloring. Her skin was still as flawlessly smooth and tanned as he remembered, and the bearing was the same confident and assured one he had admired before.

Uneasily he extended his hand, wondering if she remembered him. "Erik Ohlson, of the Karolinska, excuse me, Caroline Institute—" He started to identify himself and the Swedish medical center where he worked, but was brusquely interrupted, his hand ignored.

"I know. I'm Dr. Lee, U.N. Alien Task Force." From her icily polite tone it was obvious that she did remember, but refused to acknowledge him. Considering what had happened he couldn't blame her. But this wasn't the time to try to explain, even though she was making it very difficult for him. It was obvious that she was unaware that her stiff and erect bearing made it very plain that her crisply pressed uniform still covered the same feminine figure he remembered so well.

Trying to ignore it and concentrate on the reason for his being here, he

asked the obvious question. "You're running this program?"

"That's right." She answered with justifiable pride in her voice. It was quite impressive, being responsible for a combined United Nations effort to coordinate Alien Contact Situations —even though it had been just an exercise in dreaming, till now. But then the chill crept back in.

"I am. And I don't mind telling you that I do not approve of bringing in another outsider. This is a very delicate situation and if word leaked out, it could be very . . . "

"Very embarrassing." Damn it, guilt or no guilt, this was getting him angry. "Dr. Lee, I am quite aware of the fact that you have a blasted gaspy situation here, but I am a psychiatrist and a psychologist, and I am quite familiar with the concept of confidentiality—"

"I wasn't trying to imply—" She tried to cut him off but he ignored her.

"And furthermore: If you drag me all the way up here, out of a sound sleep, I expect to get treated with at least a *little* respect, since you obviously need me more than I need you!"

She flinched, and then nodded stiffly as a brief trace of color crept into her cheeks.

"True. I apologize, but you'll have to understand that there is a great deal more at stake here than mere patient confidentiality." He felt himself bristling as she refused to yield more than a fraction, but he controlled himself as she continued.

"But, while I don't approve of the idea of bringing in another outsider, I had to. Our psych expert got sick and she recommended you. The rest of the research team concurred, and I have to agree. Your qualifications fit perfectly. That's why we sent for you."

That was an understatement!

"It helps that you did a service rotation here at CircumTerra." She went on, "and that you work with other SETI projects. And," grudgingly, "you're one of the top-ranked psychologists in the world."

As if uncomfortable praising him, she suddenly changed directions. "How much did they tell you about it?" She pointed a slim and neatly manicured finger at the monitor.

"Not much." He shrugged. "Just that we finally made contact with an alien race. Teams kept contact with them for months via A/Vid, and then, during the first physical meeting, there was some sort of misunderstanding. Net result: one dead alien, one dead marine, and a station staffer so traumatized that he's in a coma. That's it." He glared at the marine. "And that was only after consigning body and soul to eternal damnation and tax audits if I told *anyone!*" Powerful hands clenched briefly.

Lee ignored his bitterness. "Well, we'll brief you further in a minute, but I wanted to get your unbiased reactions to the alien first." She speared him with an expectant look.

She did have beautiful eyes!

Reluctantly he looked back at the motionless form in the cell and reviewed his impressions. He remembered the way the alien had seemed to be looking *past* the camera, at *him*. Could it be a telepath? Mentally, he filed the idea.

How about physiological data? Something had bothered him, but what? Oh yes. Evolutionary patterns. If sen-

tience was the end-product of overcoming and dominating the environment, how did these aliens evolve? Those tentacles certainly didn't look very powerful, or dangerous. He just couldn't see the alien's race as the type of world-dominating beings that would develop an interstellar culture. Something was missing.

He turned to Lee, who had stood waiting with surprising patience, and explained his misgivings.

She nodded, unsurprised, and motioned him to follow. "It's occurred to us, also. And the research team is finding other inconsistencies with the Shounna—"

"The Shounna?" He was surprised by the English-sounding name.

Lee looked embarrassed. "I'm afraid that's my fault."

Ohlson didn't say anything, but just raised a furry red eyebrow, curious about her reaction.

She broke eye contact, flushing slightly. "I was looking at the tapes of the discovery of the Shounna vessel, and as it happens, the astronomer who first spotted it, was from Alabama. Well, as soon as he realized what he was looking at, he laughed and said, 'Well, it's sho' nuff about time you all came to visit!' "

Ohlson had to laugh. "'Sho' nuff, Shounna . . . I love it!"

She snapped back defensively. "Well, it's better than calling them The People, which is what they call themselves!"

"No, I mean it. It's perfect. Besides, if you prefer, it'll be our secret." *And it won't be the only one!*

"Thanks." She relaxed as she turned to lead the way down the corridor. And as they walked, he thought he sensed her thawing as she filled him in on the alien's arrival.

Several hours later, Ohlson sat at a large table, mentally digesting the tapes and notes he had just absorbed. Little bits and pieces puzzled him. For one thing, the aliens were *slow*. The one Shounna he had seen moved . . . like a snail, and all the pictures he had seen showed them riding little scooters that they controlled somehow. Probably by wiggling over touch sensitive controls. Also, they were deaf and had poor eyesight. Sound was sensed only in terms of any actual vibrations, though the aliens were *extremely* sensitive to such. And as for their vision, it was good enough in the infra-red ranges and the upper end of the human-visible spectrum, but it was poor in the lower ranges.

How they talked to each other was another mystery. From the tapes he'd viewed, it looked like they needed physical contact. Communication with humans was via computer. Those of the Shounna selected to communicate wore small computers strapped to the foreparts of their bodies, devices covered with small touch controls of some sort that when pressed produced English words in a metallic, but clear voice. The same devices also took spoken English and translated it into something the Shounna could understand. Vibration, possibly. The translators were strapped very tightly to their bearers, and no one had been able to detect any other output.

Naturally, the translating was by no means perfect. There were still a lot of conceptual and linguistic barriers interfering, but it worked better than anyone had dreamed possible. Fortunately, the

Shounna had been studying a lot of Earth's broadcasts, including educational programs. That, combined with some sophisticated computer work on both sides, had provided a surprisingly good linguistic base for Shounna-to-English translations. What form the alien's language took was still a mystery.

Tabling that for the moment, Ohlson considered his findings thus far. He was missing something. He had to be! These aliens were deaf, half-blind, poorly armed or armored sluggish snails! Hardly the stuff of science fiction stories.

He sighed.

Then there was the matter of that fatal visit to the station. He'd gone over the tape a dozen times, and it still didn't make sense. So, he'd go over it again. There was *something* there. He could feel it. He stood up and stretched to get the kinks out of his back, and then sat down, determined to find what he was looking for as he stabbed the play button again.

He fast-forwarded past the initial docking. There had been no problems with the auxiliary structure welded on over the station shuttle's air lock. But the Shounna apparently didn't quite trust Earth construction, because as the shuttle's lock doors opened, the brown- and blue-striped doors of the other ship remained stubbornly closed for several minutes before opening.

At first, Ohlson had worried about possible danger from germs as the air from the two ships mingled—air surprisingly similar—but when he'd asked about that he had been reassured. Apparently air samples had already been exchanged and other than a mild flu-like bug that had been easy to develop a vaccine against, there had been no harmful micro-organism in the Shounna air, and they had apparently not found anything to worry about in Earth's air, either.

So, once the big spaceship and the petite shuttle were joined, the visitors could be brought over and taken to CircumTerra for their official reception.

Ohlson leaned forward intently and studied, again, mankind's first alien encounter. . . .

Two burly marines were in the shuttle lock, careful to remain there, and as the alien air lock doors slid open they waited as an honor guard. A well-disciplined honor guard, fortunately. It was obvious that they were not prepared for the sight of the three small aliens who came rolling out of the cavernous lock chamber on the other side, squatting on top of small scooters that looked like two-drawer filing cabinets laid on end and with fat little rubber tires tacked on. Strapped to their "chests," each alien wore a small box—and nothing else—covered with textured indentations. Scooter and all, they still barely reached chest-high to the waiting marines. It was obvious that built-up fear was evaporating, replaced by carefully controlled snickers.

Ohlson stopped the picture, something nagging in the back of his mind, but he couldn't pin it down as he stared blankly at the frozen image on the screen. It was just an air lock. Wide cargo doors were visible in the back, inset with standard, height passenger doors for normal use. It was a good

logical design of an obviously well-used vessel.

"Quit wasting time!" He muttered to himself as he restarted the tape. He sped past the entry, the trip to CircumTerra and the reception in the hub. He had studied those until he had them memorized, and there had been nothing there. Fortunately, every bit of the visit had been recorded by normal security cameras, or extra ones added for the occasion.

The critical moment had been when the visitors were touring the art gallery. Maybe he had missed something there? . . .

As the aliens and their escort entered the art gallery, they found themselves watching the set-up of a new light sculpture by the station's resident emotive artist, Greg Mitchell. Mitchell's work obviously fascinated the aliens, perhaps because of the vivid and brilliant colors used. Most of them were within the aliens' visible spectrum.

As Mitchell anxiously made sure that the sculpture was mounted right, and all the others were admiring it, one of the aliens drifted close to the display. Closer and closer to Mitchell . . . almost touching. And then, its tentacles uncoiled and shot out like whips to wrap around Mitchell's head as the alien stopped its scooter and reared up.

With a tortured scream Mitchell tried to pull free, just as one of the marines pulled his gun and started pumping bullets into the attacking alien. The first of the high impact plastic shells tore into the neck(?) by the base of the tentacles, but other than rocking the alien back and pushing it away from Mitchell, it had no effect. The next two shells, however, ripped into the body itself and as they did, the Shounna reared convulsively and went into brief spasms that jerked its tentacles free from Mitchell and sent it off the scooter to collapse limply on the floor. After a few seconds, it seemed to deflate like a leaking balloon, the shimmering colors of its skin slowly fading as color-less fluid seeped out through the three ragged holes in its body.

Reaction from the Shounna was swift.

The marine who had done the shooting was suddenly hurled back against the wall as one of the remaining aliens rammed its scooter against him and the room echoed with an electric crackle as the scooter shot a charge through the battered body.

The remaining marines pulled their weapons angrily and were about to start shooting when the station commander threw himself in front of them and screamed at them to hold their fire, while at the same time the U.N. Rep was yelling about not starting a war . . .

God, what a mess! Ohlson shook his head as he stopped the tape. What was Mitchell screaming? Suddenly optimistic, Ohlson backed the recording up and listened carefully, dialing in enhancement after enhancement until he could understand the words. He couldn't understand it all, but two words were distinct. "*Get out!*" Not "*Get away,*" but "*Get out!*"

He thought a moment, and then a slow smile began tugging at the corners of his mouth as he reached for the intercom button to call the marine escort

who had been helping to show him around.

"Get Dr. Lee and tell her I want to see Mitchell again as soon as possible. And tell her to get in touch with Dr. Kirby at Berkeley. I'll need one of his prize pupils up here. She'll understand what I need." He remembered that Lee had gone to Berkeley and knew she had to know of Kirby's work.

He reached for the medical report on Mitchell and double checked. But there was no mention of any puncture wounds. Not that he had expected any. His smile turned to a wide, satisfied grin.

"Så, det är så du gör det!" With a satisfied exclamation in his native Swedish, he decided that there *had* to be some telepathic component there. Maybe requiring physical contact? Mitchell was probably a borderline telepath. He was a proven empath, both receptive and mildly projective, that much was plain from his last psycheval. Somehow the dead alien must have sensed this and, what? Tried to communicate? Blast! What a botch.

Even as he felt a certain smug satisfaction over having pieced together part of the puzzle, he was bothered by the remaining loose bits that refused to fit. There was more to this. But what?

He watched the rest of the recording carefully, but there was nothing there. Just the expected rapid maneuvering by the U.N. Rep met by a strange calm on the part of the aliens. Since the initial "attack" had been by the visitors —something the two surviving ones refused to explain or defend, other than to insist that it was no attack—the rep won out on her demand that the "attacker" be held until a thorough examination could be made. It had been a surprisingly easy victory.

II.

Less than twelve hours later, a still-exhausted Ohlson kept watch over his patient—he had only been able to snatch a brief two hour nap. But now he was ready to try to indulge his hunch. The artist Mitchell lay curled up in a fetal-ball position on the bed in the padded room, his normally deep brown skin almost grey. Ohlson shook his head at the sight. Just to satisfy himself, he probed the tightly curled black hair to examine the skin underneath, but it was unmarked from what he could see.

He turned to the girl next to him, privately amazed over how quickly his request had been met. Dr. Kirby had sent up his star pupil. She was no more than fifteen or so, much to Ohlson's dismay, and even sitting in her power wheelchair it was easy to see how badly spina bifida had twisted and distorted her slender body. Yet, she was one of Earth's most powerful telepaths, the cream of a very small crop, indeed. Not that you could have told from looking at her. She was just any little girl beaming happily over the adventure that had brought her up here where few private individuals could afford to go.

Behind her, with a disapproving frown on his face, was the middle-aged male nurse Kirby had sent along as guardian and caretaker. Ohlson ignored the look, even if he privately agreed, because the stakes were too high to worry about normal proprieties. Instead, he dropped to one knee and looked the girl straight in the eye.

"I need you to help me with something very difficult, Samantha. . . ."

With a teasing smile that lit up her face, she reached over gently to take one of his hands. "He's suffered some sort of mental trauma, is in catatonic shock, and you want me to dig in and see what I can find out about what happened. Is that about right?" At his surprised look she shook her head, tight black curls bobbing.

"No, no mind reading. Just deductive reasoning. I may be only fourteen—" The nurse coughed. "Well, I'll be fourteen in a couple of weeks!" Ohlson smiled at the fake petulance in the voice. This was no mere child!

"Anyway," she continued. "I may be young, but I'm a damn good telepath and I can pick up a good deal when I put my mind to it.

"And as for the danger you were probably going to warn me about, Dr. Lee was very specific, in a vague sort of way, when she told Dr. Kirby about the danger for anyone helping out. That's why they sent me." She thrust her jaw out defiantly.

" 'Cause I'm the best!" She saw Ohlson's doubtful look and her green eyes flashed. "I am. I have the strongest shield and probes of anyone in my Group." She dared him to contradict her.

Ohlson was caught off guard, but after a moment he shrugged and stood up. "All right, Ms. Cooper. Here's the situation . . . Hell, dig it out yourself, that's probably faster." He looked at her, half challenging, half nervous. Suddenly he felt a vague furry tickling in the back of his head somewhere, as Samantha's face grew slack and her eyes closed.

For a moment she sat like that, and then her eyes snapped open. "Wow! But, I'd better keep my mouth shut or Dr. Lee will be upset." Then she grinned impishly. "She *is* pretty, though."

Ohlson started and then shook his head. "Touché! But I only gave you permission to look at what happened to him." He nodded in Mitchell's direction. Then, seeing the girl's expression, he relented with a laugh.

"Don't worry about it. You're right, but I'm afraid she's mad at me."

"She'll get over it. You're nice, and you're cute. For an older man."

Suddenly he had a flash from her and he saw himself through her eyes. She(he?) was looking at a tall clean-featured man in his late fifties, getting a little heavy in the middle, but still looking quite fit. He was just over two meters tall, topped by an unruly crown of fiery red hair that waved every which way, refusing to be tamed. A reddish stubble was sprouting (God, he'd forgotten to shave!) and his clothes were stylish, if a bit rumpled.

"I look like a slob!" He burst out, upset until he saw Samantha giggling. The nurse looked confused.

"Relax." Samantha forced herself to settle down, biting her lower lip. "You've been up a couple of days with barely any sleep. Considering that, you look pretty good." She reached up to straighten his bow tie.

Then she looked down. "I'm sorry about peeking at your reaction to Dr. Lee, but it's hard to look at just one thing. Every image I look at brings up

something else, and those bring up even more. So you have to sort through it all to get what you want. It can be a real bitch!''

He was amazed. Thirteen going on fourteen? But he could see where the strange mix of little girl and woman came from. It must have been difficult to sort out impressions not only from her own mind, but from those around her as well. She would have had to grow up fast.

He saw her looking up at him shyly. ''Dr. Kirby says I'll make a hell of a good psychologist when I finish school.''

She would indeed; she'd make him obsolete! Oh well, that was progress. He shrugged and faced her, seriously. No more patronizing.

''Do you understand what I'm looking for? It could be dangerous. I had envisioned Kirby sending me someone—''

''Older and male? Don't be a chauvinist. This is the twenty-first century. I know the risk, and I can't say I'm not a little scared, but this is important.'' She bit her lower lip, drawing a thin line of blood. ''You're trusting me with this, and we have to know what happened.''

He was touched by the subconscious use of ''we,'' and reached out to grip her shoulder reassuringly. ''If you don't want to, just say so. No one will force you to do it.'' He promised.

''I know.'' She straightened her crooked body as much as possible and drew a deep breath. ''Here goes.'' Softly, so that he barely heard her.

It was several minutes later that a pale and shaken Samantha explosively expelled a rush of air and grabbed weakly for Ohlson. She sat slumped, her eyes shifting randomly around the room.

It scared him and he dropped to his knees in concern, cupping her face in his hands to direct it towards him. ''Are you all right?'' Then again, louder. ''Samantha! Are you OK?''

She finally focused her eyes on him and nodded weakly. ''Yeah. I'm OK, it was just a little tricky. He didn't want to let me in.'' Then she closed her eyes and started breathing in careful, regulated cycles. ''Just give me a minute to sort things out.''

''Of course, take your time.'' He ignored the glare he was getting from the nurse who had tried to come to Samantha's aid until Ohlson had firmly waved him away. Samantha shot him a grateful smile.

For a while she sat looking off into space until she shook her head and shrugged apologetically.

''I'm sorry Dr. Ohlson . . . ''

''Erik.''

''Thank you. Erik. I'm trying to sort out what happened, but it's still mixed up. The alien was trying to contact him to . . . '' She paused, unsure of how to interpret the contact. Then after a moment's consideration, she brightened. ''I know. Let me put it this way.

''The alien was trying to phone Mitchell, but it's a bad connection. Mitchell answers, and can sort of understand the alien, but he doesn't like what it's saying, so he hangs up. The alien calls back, several times, each time more and more surprised and annoyed that Mitchell won't talk to it. In the meantime, Mitchell is getting scared and angry. Then it felt like someone . . . shocked him with the phone, *real*

bad. Now he's really getting scared, and hurt, so he takes the phone off the hook . . . ''

''Cutting off both incoming and outgoing calls!'' Ohlson interrupted, understanding what she meant.

''Exactly!'' She looked pleased.

Ohlson thought a moment and then asked. ''Did you understand any of the aliens 'conversation' ?''

Samantha shook her head. ''I'm sorry, no. It's like there was interference on the line. The only thing that was clear was that the alien expected Mitchell to answer. That, and the fact that Mitchell 'felt' like someone getting an obscene phone call.''

''Well, at least that gives me another piece to work with.'' Some of the things that had been bugging him were starting to click, somewhere in the back of his mind, but they were still eluding him. It was time to do some brainstorming, but first, there was one more thing to try with Samantha.

''OK Sam, can I call you that?''

''Sure, that's what they called me at the Center.''

He smiled gratefully, feeling a bond forming between them on a level he couldn't understand yet. ''All right, here's the next part. The hard part.'' He warned her. ''Can you go into Mitchell's mind and . . . convince him that the obscene caller is gone and that it's safe to put the phone back on the hook?'' He continued the analogy, since it was a good one.

''I can try.'' Her voice was a little hesitant, the adult veneer cracking a little for the first time. He got up and guided her chair over to Mitchell's bed and sat down on it, between them.

''I'll be right here.'' He took both of her hands in his, marvelling over how tiny they were.

She smiled, her face composed again, wordless gratitude penetrating through to him. She looked over at Mitchell a moment, and then her face went vacant, the eyes lost in some distance.

For almost ten minutes, she sat like that.

A couple of times Mitchell twitched slightly, low moans escaping his lips, and then he relaxed, his body straightening and forcing Ohlson to get up off the bed. His chest began to rise and fall rhythmically as the breathing resumed a regular pattern and the ash-like appearance of the skin faded and the normal rich brown color returned. Then, as resonant snoring filled the room, Samantha giggled and moved away from the bed, pulling Ohlson with her.

She waved the nurse to follow them out of the room and Ohlson wondered about the giggle, until Samantha explained.

''He resisted my contacts at first. He's got real strong natural shields, but I'm stronger.'' She looked a little smug. ''Although, I did cheat a little.''

''Cheat?''

''Uh huh.'' She waved him down and whispered in his ear, glancing meaningfully at the nurse, who obviously was not to be let in on her secret.

''I sent him some real strong images from Dr. Kirby's last date, that I . . . happened to catch. She was quite, ah, mature.''

Brief flash of a voluptuous and deeply tanned brunette erotically stripping by the light of a crackling

fire that fills the room with the smell of smoky pine tar; all mingling with the heady scent of Chanel No. 22 and a pleasant tingling from a good bottle of wine; and overpowering all that, the unmistakable feel of a growing erection, painfully constricted by too-tight pants.

Good God! Ohlson was staggered by the vividness of the image—no wonder Mitchell had recovered! He was also a bit shocked that a thirteen-year-old girl should have those kinds of mental images in her mind. He raised an accusing eyebrow.

She blushed. "I peeked, I admit it. I was curious why he was in such a good mood that morning. I sent Mitchell even more."

More? He shook his head in amazement. Thirteen going on thirty was more like it.

"It worked, didn't it?" A bit defensively as she sensed his thoughts.

"Yes it did." He nodded. "You did good. Thank you." Mitchell was safe now, but there were still questions to be answered.

"Sam, you were able to penetrate his shield, even, the alien obviously couldn't. Does that mean you're a stronger telepath than they are?" That could have some interesting implications.

"I think so." Sam guessed after a moment's consideration. "They don't seem to be terribly powerful, and I think they need physical contact."

"That fits." He made his decision.

"Sam, would you mind staying? I have a feeling we might need you. Depending on how Dr. Kirby feels about it."

"Would I mind staying?" She laughed. "Naturally I have to get back to a smog-filled city and boring classes . . . " But then she was almost pleading. "Please, Erik. Let me stay. I can help, I just know it!"

He looked at her anxious face and knew he couldn't send her away. Besides, they might indeed need her.

"OK, but if you stay, I'll need some help myself. Can you help me go over the last couple of days and work through what I've learned, by going into my mind?" He wasn't sure what he thought she could do, but maybe she might know. "The answer is in there, I can feel it; I just can't seem to put it together yet."

She didn't bat an eye. "Sure, Erik. But you have to let me in all the way. It can be scary to surrender privacy like that. You sure you can handle it?"

He started to smile at her seriousness, but then thought about how she'd brought Mitchell out. This was no joke, she'd know everything! Was he ready for that?

But he knew the answer even as he formed the question. He had no choice, too much was at stake. His mouth was dry as he just nodded silently.

She looked at him as if weighing his sincerity, and then, obviously satisfied, she shrugged and smiled.

"OK, Erik. I'll *try* to stay away from your private thoughts, but I can't promise anything."

Erik nodded again, not quite trusting himself to speak.

Sam looked around. "Is there an empty room we can use?" Ohlson nodded as she looked over at the nurse.

"Sorry, John, but get lost for a while.

This is going to be hard enough without witnesses.''

III.

It had worked, all right. And it had been a bit frightening as he'd felt himself dissected by Samantha's amazing mind. She had made him relive the events of the past days in only a few subjective hours—actually just minutes in real time—focusing on details where necessary. And as they had explored the facts together, the connecting thread he had felt revealed itself. Finally it was starting to make sense and the solution to the puzzle of the aliens was nearly at hand. But there were still key pieces missing. Maybe with the help of the rest of the investigating team, they could solve it?

Soon he would have his chance. Dr. Lee had agreed to his request for a meeting of the primary research chiefs in order to review all the findings to date, and one by one the others were filing in. It was a small but select group of scientists and as they took their places, briefly introducing themselves, he had to admit that he was impressed. Lee had assembled a powerful group of people, most of whom he knew by reputation, if not personally.

He was glad to see that the recognition was mutual, and he could see from their expressions that his presence was welcomed by the others.

Heinrich Bauer was there, to no surprise. The chunky seventy-two-year-old West German physiologist was well known for his work on ''designing'' aliens that might be encountered. And for his eternal heavy accent that the others were struggling with as he summarized his findings.

The ethereally slender Wan Chu of Beijing was there, still going strong at ninety-five years. He had the distinction of being a double Nobel Prize winner! After developing a cure for AIDS, he had gone on to develop a protein synthesis technique that had radically reduced world hunger. Erik bowed discreetly and earned himself an appreciative twitch of acknowledgement from the narrow face and scraggly mustache that had given the scientist the nickname of Fu Manchu.

Next was the chunky Japanese-American sociologist, Ito Kagama, who was only a passing acquaintance of Erik's; they had run across each other at occasional SETI meetings. But he knew Kagama had a good reputation and had undoubtedly been a good choice.

As for the less familiar fields, Bob Mackey of MIT was there. It was partially his computer programs that had made communication between Earth and the Shounna possible. He was a pale young man with an improbable handlebar mustache who sat looking over the others, fitfully twisting one spear of hair or the other, one finger of the free hand tapping restlessly on the table top.

Sitting next to him was the English linguist, John Ford, a bland-looking man in his early forties who was from Oxford. Together with Mackey, he was responsible for the software that had broken most of the linguistic barriers between the races. Eric had run across them both at another SETI conference and nodded to them.

The physicist, Cindy Bennet, Erik knew less about. She was a nervous

skinny brunette, somewhere between twenty and forty, whose most distinctive feature was the enormous and archaic glasses that she wore. But other than that she was a top-notch physicist and also from MIT, he knew nothing about her. He never really traveled in those circles. The hard sciences held less interest for him than the mysteries of the mind.

Lee's credentials were, of course, impeccable. Even though her doctorate was in political science, she had an intuitive knowledge of group dynamics, as well as a gift for organizing and motivating disparate groups of people. As he watched her run the meeting, his respect for her grew. All the specialists that she had assembled were prima donnas in various ways—and he was no exception—yet she managed to keep everyone working smoothly together, as a master conductor puts a symphony orchestra through its paces.

Reassured that the research was in capable hands, Erik concentrated on listening to them lay out their findings. Soon it would be his turn and he wanted to be sure he didn't miss anything that might help him.

But when Cindy Bennet started discussing her team's findings, his attention began to lag. The truth was, he couldn't care less if the aliens used an interstellar drive that generated its own black holes or if they had taken advantage of a black hole out beyond Pluto. It was beyond Earth technology either way. And all theoretical. The only thing they could really say for sure was that they didn't know what type of drive the Shounna used, if any. So, in spite of his best intentions, his mind wandered.

Beside him, he could sense Samantha scheming. It was funny, but since she had wandered through his mind he seemed to have developed a bond with her that let him know some of what she was feeling and thinking. It was vague and unpredictable, but real. And it went beyond the strong personal attachment that was quickly forming between them as she became a substitute for the daughter he had lost.

He had talked to her about it, but she had just dismissed it by explaining that it sometimes happened. Her guess was that he had absorbed some of her "self" while she was rooting around in his mind, and that he had retained a ghost image of her thoughts. It would fade in time. It sometimes happened after contact with highly disciplined and intelligent non-espers.

At that point she had giggled and added that she might be wrong; about what, she didn't say.

She'd gone on, though, to tell him that she thought he might be a latent telepath but, if so, in need of *intensive* training. Whatever it was, he was convinced that she was up to something and he looked at her closely.

But she just sat calmly and gave him a wide-eyed look of innocence—now he *knew* he was in trouble. What was she up to?

Then he found out. In the back of his mind he felt a familiar sensation and a series of images began to form. Not strong enough to cut out the room around him, but sort of the way you could listen to music and review a paper at the same time.

He saw himself being led by the

hand, by a young girl who looked like—no, who was—a healthy and undeformed version of Samantha. They were walking along a gleaming white beach.... Oh no! He knew this beach. Long-denied memories fought for recognition as he saw Dr. Lee coming towards them, similarly led by another Samantha and looking every bit as confused as he was. Confusion that turned to icy propriety as she recognized him. The two Samanthas merged and faded out, somehow leaving Erik and Lee holding hands.

They quickly let go of each other and moved apart awkwardly, unsure of what Samantha was up to.

Behind them, they suddenly heard the familiar whine of a power wheelchair, and turned to find themselves facing the young girl they both knew.

Samantha waved around proudly and smiled as she sent them a telepathic greeting. (*I'm pretty good, aren't I?*) Then, sensing their reactions, she apologized. (*Sorry, I don't mean to show off.*)

Lee spoke first, sounding more indignant than anything. "What do you think you're doing?"

Erik agreed with her. "She's right, this really is pretty rude, invading our minds like this..."

Samantha glanced a them slyly. (*You're on the same side, now. Did'ja notice?*)

Without realizing it, they had moved closer together until they were almost touching shoulders, and as Samantha pointed it out, Erik saw a faint flush creep over Lee's cheeks. He started to speak, but Samantha cut him off.

(*You know Erik, I don't understand you.*) (Like hell she didn't!) (*You like her, you always did, so why don't you say something?*) But before he could answer, she turned to Lee. (*And what's your problem? He's a nice man. I know. I've been in his mind.*)

Erik and Lee spoke almost simultaneously. "Young lady, that's none..."

(*Of my business. I know, I know.*) She pouted. (*What a* splat. *But I'm nosy, and you're both nice people who could use each other's company. So why not make friends?*) She shook her head and turned to Erik.

(*I mean, really! She was real special, once.*)

Lee was strangely silent and he could see her eyes widen, probably as she felt the same sensation in her mind that he was getting used to by now. Images began overwhelming him, shutting out everything else, images of that day in Honolulu when things had been so wonderful, and so awful. His mind drifted back over it and he felt Samantha watching, listening and guiding as the beach and ghost room beyond faded out, replaced by the past.... Somehow he knew Lee was along for the ride, contributing her memories... Leah Lee... he remembered the musical pairing of her names, so beautiful ... Leah Lee, Leahlee... so fitting...

Relentlessly the memories flowed over him as he relived that night. His first accidental meeting with Leah, by the pool at the hotel, when she had

accidentally dumped ice water over him. The way that had led them to talk, endlessly, until the heat of the noonday sun had driven them into the air-conditioned lounge.

He could still feel the chemistry that had overwhelmed him that day. It was strange. Sometimes two strangers could meet, and after only a few words, carry on like life-long friends. "Old souls," someone had called it once. Maybe there was something to reincarnation after all?

Whatever. That day had whirled by in a dizzying rush of tumbling impressions as repressed emotions were unlocked by his chance meeting with the beautiful and intelligent Leah. She had been a stimulating companion, with an agile and inquiring mind. Equally happy indulging childish pleasures, or carrying on sophisticated and demanding discussions as mood and circumstance dictated.

At dinner that evening, she had gradually opened up to him and told him about growing up under the control of an almost fanatically traditional family, she and her mother barely tolerated because of her Chinese father. And she told him of her rebellion against them and how that had led to abortive and tempestuous affairs until she had fallen in love with a statesider. With a man who turned out to be married and who had deserted her.

She had suddenly stopped with a blush, surprised that she was trusting him with secrets she usually didn't share.

A little unsettled, and honored, he decided to open up to her about his own struggles to make it on his own, and about how he had finally made a name for himself.

And about his marriage.

That was when everything had fallen apart.

All of a sudden he had realized that for the whole time that he had been with Leah, he had forgotten all about Terri and Nancy. And about the plane crash that had killed both his wife and three-year-old daughter just a year earlier.

He remembered how he'd frozen up, grinding to a halt as he sat facing a puzzled, and hurt, Leah. He had gotten to his feet, knocking over the ice-bucket and wine next to their table, and then had made some pathetic excuses before running off, without telling her why. He had only stopped long enough to pack and check out of the hotel, leaving no forwarding address.

Was it any wonder she was cool towards him, or that he couldn't bring himself to talk to her? But even as he thought it, a clear mental raspberry echoed through his mind.

(*Erik!* Puleese! *No wonder they say doctors shouldn't treat themselves. Do you realize how stupid that is? And you'd say that, too, if another patient came in with that story.*)

Without warning, he found himself back on the beach, facing an older but still beautiful Leah, and a skeptical-looking young girl who sat looking at them, sighing impatiently.

Her reaction was like a cold shower, and Erik realized that she was right. He shook his head ruefully and faced Leah, reaching out to offer his hands.

"I tried to get in touch with you the next day to explain, but the hotel said that you had checked out and left no forwarding information."

Leah looked down. "That's my fault. I specifically told them not to give out any information. I was furious." Her face was softer now as she extended her hands to accept his as she moved closer and looked up at him.

"I didn't, couldn't, know. I just knew that a charming man I met and fell for, against all common sense, suddenly turned out to be married and ran out on me. The second time I'd been hurt and dumped. I wish I could have known the truth." She looked wistful. "How long has it been?"

"Ten years." He thought back. "It was March, 2050." His thumbs stroked her hands in a warm caress; they felt like living satin.

For a moment they just stood there staring into each other's eyes, Leah looking secretly pleased as smile crinkles appeared around her mouth and eyes (who was the idiot who had decided that those were ugly, anyway? Nuts!) He felt like a kid again as he freed a hand to caress her cheek as he bent his head down to kiss her gently, feeling her lips respond eagerly to his.

But then the moment was interrupted.

(*Excuse me.*) Samantha broke in reluctantly. (*I hate to break this up, but Dr. Bennet is winding down, and it's almost time for Erik to give his presentation.*) The beach started fading as the boardroom reasserted itself around them.

Erik looked up to see a disoriented Leah shaking her head, and then briskly thank Dr. Bennet for her input and introduce Erik.

"Er . . . Dr. Ohlson, I believe you have some interesting speculations to advance?" She didn't know what he suspected, either, so she was as curious as the rest.

He stood up leisurely to give himself time to drag his mind back from Hawaii—still feeling the velvet touch of her lips on his—and forcing himself to concentrate, he leaned forward with both hands planted firmly on the table.

"The Shounna are lying to us!" He stopped a moment, satisfied with the stir that little comment generated. Several voices started clamoring for recognition immediately, but Leah brought them deftly in line, even while shooting Erik a dirty look. He smiled and waited while the others settled down.

"Actually, let's be fair. They are concealing things from us. I've found *some* of the answers, and I'm figuring out some other things. But I need your help to put it together.

"It all ties in with the 'attack' on Mitchell, who, incidentally, is fine thanks to the efforts of Miss Cooper, here." He indicated Samantha with a hand, the girl beaming happily at the recognition.

"So, let me start by detailing what I've figured out, and then we can talk about the implications.

"First of all, let's start with the most dramatic. The attack on Mitchell." He uttered the proper codes and the lights

dimmed and a large monitor at the end of the conference room lit up with the image of the gallery, just prior to the shoot-out.

"Now, look very carefully at what actually happens." It was projected at half-speed and they all watched raptly as the Shounna maneuvered its scooter closer and closer to the unsuspecting Mitchell. In slow motion, they saw the alien's tentacles unfold and position themselves precisely on Mitchell's head as the alien reared up and leaned closer.

"Vid-disp control pause and zoom sector three," Ohlson froze and zoomed the display. "Right there." He let them all study the close-up of the alien and Mitchell, then challenged them.

"What does that suggest to you? And let me add, here, that Ms. Cooper has already determined that they are actually quite weak telepathically and require physical contact to communicate." He waited expectantly.

From one end of the table, a heavy guttural voice that was unmistakably Bauer's spoke up. "It zuggests to me, a shtrong familiarity vidt hooman fizziology. More zo zan can be obtained from monitoring old uncoted tefee broadcasts. Eshpezially conzidering ze rapid und prezise plazement of ze tendacles. Note ze plazement of ze one tendacle over ze area clozest to ze hippocampus, an area shtrongly azoziated vidt telepaty. *Nicht wahr?*"

Mentally plowing through the accent, Ohlson nodded agreement. "My thoughts exactly. That raises some questions, doesn't it? But hold them for now, please." He then added what Samantha had discovered while treating Mitchell, stressing that the alien seemed to have expected the artist to respond. That threatened to release another flood of questions, but he raised a hand to hold them off, turning to Ford and Mackey.

"Before we talk about all this, I've got another problem to bring up.

"You did say that one reason it wasn't too difficult to develop the translation program was that the Shounna had already studied old Earth broadcasts?"

Both of them nodded, looking confused until Erik went on.

"I thought so. It makes me wonder though, how a race that is non-verbal, deaf, and half-blind is able to make use of, or even conceive of broadcasts based strictly on sound and video." Erik saw the others look up in surprise as they thought of that.

"Interesting point, isn't it? But hold on to your comments, there's more." He addressed the display again and the image shifted to an earlier shot, when the ships were coupling airlocks. On the screen, the shuttle's lock opened to reveal the striped doors of the Shounna vessel, still suspiciously closed. A word from Erik and the picture speeded up until the aliens were zipping on board, the empty lock revealed behind them. Erik froze the picture, and then added inserts of the lock doors and also of the aliens in the lock opening.

Here he froze the display and stared into the dark room, challenging the audience.

"Reactions?"

Silence greeted him for several minutes until Leah spoke up. "Those lock doors: They're blue- and brown-striped. The Shounna can't distinguish those colors . . . "

"And the smaller inset lock doors are

standard-sized—for us!" Mackey interrupted excitedly as he compared sizes in the images. "But the Shounna, even on their scooters, aren't more than half as wide or tall as the doors. They'd never need that much clearance!"

Erik grinned with satisfaction as he brought up the room lights and turned off the video-display. "Very good. Now, what do all of you have to add?"

Instead of the barrage of comments and questions that had been pending before, the others were silent, digesting everything he had presented. Then, Bauer suddenly slammed a hairy fist down on the table with an indecipherable curse.

"Ze virus!" Once he was coherent.

Eric remembered reading about the flu-like bug found in the Shounna air samples and his eyes widened.

Across the table, the aging Wan Chu twitched his checks and leaned back happily. "Precisely, my dear Heinrich. I was wondering when you would notice that. I thought of it when I was watching the poor unfortunate Mr. Mitchell being accosted."

Leah cut in. "I don't understand."

Wan Chu explained (Erik was relieved since he was a *lot* easier to understand).

"It is like this. Why would an alien race with a different bio-chemistry than ours be infected with a virus that finds us a very suitable host?"

Understanding and confusion spread across Leah's face, mirrored by the others.

"The Shounna must have had dealings with humans before . . . " She ventured.

"That's obvious," Kagama broke in. "but from the evidence, it would have had to be pretty blasted extensive contact, and where is the evidence here on Earth? No contact material or legends hint at anything like the Shounna."

"True," Leah conceded. "And it doesn't explain the colors or the doors." She shrugged. "Could it have been contact with another race, biologically similar to ours? Or could the ship have been built by somebody else?" She grimaced unhappily as the room fell silent. Then, after a few minutes, she stood up.

"Look people, we're not getting anywhere, so I suggest that we adjourn and go over everything independently and meet again tomorrow." With that she dismissed the meeting.

As the room emptied, Bauer paused in the doorway looking at Samantha hesitantly. She felt his gaze and as she met his eyes she looked suddenly frightened. Bauer shook his head and smiled gently.

"*Ach nein, Liebchen.* It is too much to ask." Then he turned and left Samantha sitting there staring at the doorway.

Erik and Leah looked at each other in confusion, and then at Samantha's pale face. The girl seemed to be considering something, and then, reluctantly, she nodded to herself and spun the chair to face them.

"He's wrong. It's not too much to ask, and it's the only logical step to take."

"What is?" Leah asked for both of them.

"I have to go into the Shounna's mind." It was said so calmly and matter-of-factly, that it took a second to register, but then . . .

"*NO!*" They both said simultaneously, as they realized what she planned to do.

(*Do you really think you can stop me?*) There was a chilling certainty to Samantha's projected words that froze their objections. Leah grasped Erik's hand as he put his arm around her; he needed her comfort as much as she needed his, for this was a different Samantha. This was no little girl, but a determined and powerful telepath. They realized also that she was right, subconsciously they had both been considering this next, necessary step. Reluctantly, Leah nodded.

"You're right. I'll take you down myself. Both of you," she added, since Erik hadn't seen the alien either, except with the monitor.

IV.

All too soon after that, it seemed that they had been right to worry, because Samantha lay comatose in the sick bay and Bauer's team was busy trying to find out what had killed the alien.

Erik and Leah were still numb with shock and trying to work out what had happened. They had gone down with Sam for her probe of the Shounna's mind, which had seemed to go fine, at first.

The initial contact had been smooth enough as Samantha had closed her eyes a few minutes and hummed in meditation before she stiffened in concentration. But then, fifteen minutes later, the alien had given a spastic heave while at the same time, Samantha had screamed in agony.

Even Erik had felt the pain. Somehow still linked to her, he had felt a moment of blinding agony that drove him to his knees before it faded. When he had been able to look up, it had been to see an unconscious Samantha slumped in her chair, and beyond her in the cell, the alien lay in a limp heap on the floor of the cage, all its color faded.

What had happened?

Leah had reacted immediately by cutting contact with the Shounna using a faked equipment failure, to buy time, while ordering Bauer's team to examine the alien as closely as possible without damaging it. Erik, meanwhile, rushed Samantha to the sick bay to try to find out what had happened to her.

Now, all they could do was wait.

A couple of hours later, Erik still sat glumly in the sick bay keeping an eye on the comatose Samantha. There had been no change in her condition. The problem now was what to do. There was no explanation for her coma, and while another telepath might have been able to find out, the doctors didn't want to risk endangering another telepath.

For the moment, he sat alone since Leah was trapped on the bridge planning strategy, now that Bauer's team had confirmed that the alien was definitely dead. Erik had stayed by the girl's bedside, though. He didn't know why, but felt he had to.

As he sat holding Samantha's hand, he tried desperately to reach her mind, to take advantage of the intangible bond between them. He forced everything else out of his thoughts and concentrated on her mind, building up the image of Samantha's beach in his own mind. Complete with the memories of Samantha's little match-making.

This girl could not, *must not* die! His eyes burned under their lids from the force of his feelings—she was the daughter he had lost, and he felt that she had come to view him almost like the father she had never really had since she had been dumped in an institution by parents unwilling to deal with her handicap.

And if that bond wasn't enough, she was also the one who had brought him back together with Leah.

He bent down and hugged Samantha's still body close, mustering every scrap of mental force to try to break through to her mind. Suddenly there was a wrenching in the back of his mind and he felt surrounded. He was holding Samantha/being held by Erik/up on the bridge thinking about Samantha and he was near crying/scared and confused/torn because she couldn't leave the bridge. He, Samantha and Leah were one, bound by love but steeped in pain, surprise, and fear.

As he realized what was happening, a flood of images came over him from Samantha, coming too rapidly to understand, but being stored for later, he felt. He tried to acknowledge it, but couldn't reach her mind. Samantha was dying, they could feel it. And even as they did, Samantha's mind faded away from them, shattering the binding link and leaving Erik sobbing alone as he held the slight lifeless body that had been so dear to him.

V.

Several hours later, after meeting with Leah, he positioned himself carefully in mid-air at the station's hub with a satisfied sigh. *Perfect!* The chamber was deserted and he hung in silence, in the dimly-lit observation bubble, adjusting slowly to the weightless environment, looking out at the distant spindle of the Shounna vessel. *What are you doing, or thinking, now?* he wondered to himself. *Do you know what happened to your shipmate? And what would you do if you did?*

Idle speculation.

He knew he was just avoiding facing what Samantha had given him, because it meant accepting her death. But he had to find out *why* she had died and so, taking a deep breath, he wedged himself firmly between a dead light fixture and a support beam and dredged up some nearly forgotten self-hypnotic techniques. Resolutely he shut himself away from the outside world and focused inwards on the waiting images.

The first images to claim him were innocent enough—as if Samantha wanted to start him off easy. They were from Samantha's childhood. They helped him understand her as he relived her rejection from her family and her first years in a squalid public assistance institution. But he also shared her discovery of her powers and of others like her who quickly came to her rescue to take her away.

And he was part of Leah's battles with her family and with herself, culminating in her clean break from home and fresh start on the mainland where she had buried herself in school. Finally, he was with her to savor both her academic and professional successes as she got her doctorate, and her position with the U.N., all of it reinforcing the

feelings for her that had overwhelmed him since meeting her again.

But there was another set of images lurking behind those benign scenes he had been involved in, memories that were alien and with a power and complexity that frightened him. He tried to focus on them, knowing they were essential, but the more he concentrated, the fuzzier they became, until all he could distinguish clearly were memories of a being asked to sacrifice a life of leisure to travel among the stars, forced to depend on artificial support and aid, isolated from the consciousness of Home.

It was *afraid* (the exact feeling was alien, but fear was how his mind interpreted it), but it had felt its lineage prodding, all of its former life-essences demanding it to honor the tradition of its line, to absorb and expand its knowledge. All to seek a world where . . .

The imagery faded as he cursed to himself.

Samantha had passed on more. He had felt it, but how would he use it?

On a hunch he closed his eyes and concentrated on a different image. Samantha, sitting in her chair on the lawn near Berkeley's library. He pictured himself sitting leisurely on the grass in front of her; teacher and pupil, with himself as the pupil.

"Hi Erik. I knew you'd call me eventually." She shot him a happy grin. "I like your choice of settings, nice touch." She looked around briefly and then closed her eyes. Some of the buildings shivered and changed slightly, a new one appearing where there had been open ground before. Then she opened her eyes.

"There, now it's right. It's been a while since you were here."

But he was too busy staring at her to notice. He had hoped to conjure a image of her to help him focus, maybe a little more, but this! He got to his feet and leaned down to give her an enveloping bear hug.

"Samantha! But, you're dead? . . . I'm sorry . . ."

She squeezed him back. "Don't apologize, and close your mouth. It's undignified." She laughed as he released her and sat back down. "I am dead, or at least I must be if we're having this conversation . . . Hell, this is confusing." She shrugged.

"Anyway. I left a lot of junk in your brain, I'm afraid. Don't worry, there's plenty of room to spare." She giggled. "Vacuum-head!" Then she sobered.

"Seriously folks, sorry, I am dead, but I knew it might happen, so I prepared and left some footprints in your mind." She paused with a shrug.

"Actually, I marched through with army boots. But the human brain is 90 percent empty, anyway." She smiled brightly.

"But, first things first. This pupil-teacher set-up is great. Maybe you're a precog, too? Whatever. When I told you that you were a latent telepath, I wasn't kidding. Not as strong as I am—no offense intended—but you have more discipline, which might make up for it. And that should come in handy."

It was difficult, but he was beginning to understand some of what she

must have done in that brief time she was in his mind while she was —dying. . . .

"Actually, I laid some of the groundwork the first time I was in your mind." She interrupted, sensing his thoughts. "I had a hunch I needed to." She looked embarrassed.

He shook his head in amazement. My God! What a talent she was . . . had been! He didn't want to think of her being dead—it was so unfair!

Samantha, or her image, looked down, chewing pensively on her lip. "I know it hurts, but remember: A little piece of me will be with you, always. You'll have that."

For a long moment, they both sat, looking miserable, until Samantha straightened with a determined frown. "Enough! We don't have time for this. We have to make a telepath out of you and figure out how the blast to straighten all this out. I'm going to teach you, the way they taught me. In fact, to save trouble, you're going to be me."

(. . .)

And he was.

(. . .)

It was five years of life crammed into five months of lessons crammed into . . . what? Five minutes? He wasn't sure.

"Exactly." Samantha looked satisfied as they broke apart. "Time is virtually irrelevant. Most people think the way they talk, or slower(!), which is stupid, but you'll do the same until you hang around Espers long enough. You'll learn." She reassured him.

"Now that that's done, let's go after the Shounna memories together. And don't worry, what killed me was when it killed itself and I was along for the ride. I edited that out!" Her jaw was set firmly as she told him. "Now let's visit a Shounna mind."

It was more of a tour than a visit, and he had a feeling it was given by a tour guide who didn't quite speak the language, but when it was over, his head was aching from what he had absorbed. It took him a moment to realize that he was back on the grass at Berkeley, but it was now evening, with a canopy of stars covering them from a smog-free sky—definitely an image!

The cool dampness of the dew-covered grass under him was reassuring, though, and he sorted through his impressions a moment before looking up at Samantha.

"Now what?" He still wasn't clear on everything he had seen, and saw that Samantha wasn't, either.

She looked hesitant and then shrugged. "I don't know. Give your mind a little time to mull it over. And you'll have to show the others, the way I showed you the beach . . . "

"I can't do that!"

(*THINK! Back to our lessons.*)

He did, and realized that he could do it, even as he felt Samantha's presence fading with a gentle farewell. He cried out for her in the still night air, but she was gone and, with her, the campus setting faded and he found himself hanging stiffly in midair, his bladder screaming to be emptied.

But this time he didn't feel as lost as when she had died, because he

realized that she was there with him, always.

VI.

(*Be quiet please!*) Erik felt a flash of guilty satisfaction about the way the room fell into instant silence as he blasted the mental command out to the others. Mackey even stopped fiddling with his mustache to stare at Erik with his mouth open. The others were equally startled; except Leah, who just sat calmly, trying not to smile. She knew what was happening and he made it harder for her to look serious by opening a mental channel to her alone and sending her a glowing and wordless image of them embraced.

He saw color creeping into her cheeks briefly until she regained control, and then he sensed her trying to respond and saw a playful little grin tug at her lips. Curious, he looked into her mind only to see himself doused with a bucket of ice water and he saw her mouth the word "later."

Tearing his attention away from Leah, he faced the others who still sat in wordless shock over the mental blast that had quieted them, and speaking normally, continued.

"Sorry about that, but I wanted to get your attention and not waste any time trying to convince you. You see, Ms. Cooper discovered I was a latent telepath and began my training. Which means I can show you directly what she showed me about the Shounna." He raised a hand. "Take my word for it, but I need your help. Clear your minds as much as possible and . . . open yourselves up." He wasn't sure how to explain what he wanted, and just hoped he could reach them all. In the back of his mind he thought he felt Samantha "stirring," ready to help him. He suddenly felt better.

Using the breathing exercises Samantha had shown him, he relaxed and let his mind roam free, seeking out the thoughts of those in the room with him. Mentally he reformed the beach where he had met Leah and Samantha before, and concentrated on bringing the others there.

Slowly his mental beach began filling up. Leah was there first, of course, blowing him a kiss before the others began appearing. Surprisingly, Mackey was next. The young programmer looked around delightedly and then promptly dropped to the sand with a happy sigh.

"Stellar! This is better even than any of my simulations. Hawaii, isn't it? I was here in '57." He grinned. "This is all right! But a little more sun, please?" He looked over at Erik.

Erik shook his head and obliged with a rueful smile as Wan Chu appeared. The old man cocked an eyebrow at the three of them and then promptly started to do a series of jumping jacks and deep knee bends. After a minute he stopped, seeing Erik's confused look.

"Just making sure this is a good illusion. It is." He laughed. "I haven't been able to do that in over fifty years!"

Kagama was next, a serene smile on his chubby face. "Hot blast! Grandpa must have known what he was talking about, after all, with all that Zen stuff. I'll have to check it out.

I couldn't seem to connect with you until I pretended I was a little kid again, listening to Grandpa talk. Fantastic!" He looked around curiously. As usual, Erik was jarred by the slang-filled speech, but he threw Ito an absent wave of greeting.

After that, it took a while, but one by one, the others popped onto the beach, starting to look uncomfortable about standing on an empty stretch of unknown beach.

Erik relented, now that he had access to their minds, and built up the conference room where he had lectured before and transferred everyone into it, scattered in the first few rows of seats, with him standing on the stage behind a speakers podium. He saw Leah look around with a smile of recognition and sensed her amusement and approval. She knew the place of course, since she had attended his lecture.

Behind him was a large screen, and as the others settled down, Erik dimmed the house lights and focused their attention on him.

(*Show-off!*) He had a sudden flash of a girlish giggle and realized with relief that Samantha was back.

He tapped the podium microphone. "Your attention please. This may all seem a bit dramatic," he waved his hand around, "but it's actually easier this way. If I was stronger or better trained, I could just show you everything directly, like Ms. Cooper showed me, but for now this is the best I can do."

(*For now. You'll learn, with my help.*) Another private message to encourage him. It was foolish to be so relieved by them, since he knew she was only there when he wished her to be. But that was the trigger she had implanted to activate her little simulation, and if he chose to think of it as her actually being there, what was the harm? Surely as a psychologist, he could handle one little harmless delusion?

Enough! He forced his mind back to what he was doing.

"But before I show you anything, I want to define a couple of biological terms," He looked apologetically at Bauer and Wan Chu. "Very basically, of course. They have to do with the difference between parasitical and symbiotic relationships . . . "

Below him, he sensed satisfaction and impatience from the German and Chinese scientists. They had just had their suspicions confirmed, and wanted him to get on with it. Good, no problems there.

" . . . in that a parasite lives off its host without providing anything in return, and often winds up damaging or even killing its host. While in a symbiotic relationship, there is a mutual benefit for both the host and 'rider,' let's call it." Now, some of the others were beginning to catch on and Erik stressed the last, again. "Neither the host nor the rider suffer. Both need the *partnership*," he stressed the word, "to survive. It's usually a relationship that has evolved over a long period of time."

Nearly everyone knew what to expect now, so he flashed the first images on the screen. They showed, from behind, a hairy and dark humanoid being wandering through a

murky landscape. It stood a little under five feet tall, by itself. It was possible to tell because of the size of the Shounna draped over its shoulders and back, tentacles firmly placed on the skull of the host. He sensed satisfaction from Bauer and Wan Chu, fascination from most of the others, and barely controlled disgust from Dr. Bennet. Her mind had flashed on an old pulp novel from the mid-twentieth century about an alien invasion by ameboid creatures who rode and controlled humans in order to take over the world. Mentally, Erik tried to single her out to flash a stern message to her.

(*That was a parasitical relationship, Dr. Bennet. Quite a different thing!*)

He saw her flinch and control herself, as everyone studied the images with varying degrees of fascination.

Even though it was still a little unnerving, the host really wasn't all that human-looking after one had studied it a while. It stood erect, but its legs were shorter and stockier than a human's, and the body seemed deformed, until one saw that the spine was curved and the back solidly muscled to support the weight and bulk of its Shounna rider.

Erik concentrated. He had the images, but could he share them?

Carefully extending his control, he sought out each mind and strengthened his link to it, carefully feeding in the proper images to each, helped by Samantha's "essence." Gradually, everyone was absorbed in the proper sequence . . .

THEY WERE ONE OF THE PEOPLE RIDING ON THEIR MOUNT, HAVING JUST BEEN RELEASED FROM TRAINING FOR THEIR FIRST SOLO RIDE. THEY WERE "PROUD" ABOUT THEIR RESPONSIBILITY FOR THE MOUNTS. IT WAS A SOLEMN DUTY TO CARE FOR THEM, FEED THEM AND KEEP THEM HEALTHY. IT WAS DIFFICULT SINCE IT WAS NECESSARY TO SPEED UP ONE'S TIME RATE TO MATCH THE MOUNTS' FRANTIC LIFE PACE. ONLY THE EVER-PRESENT ESSENCES OF ONE'S ANCESTORS HELPED THERE. BUT THEY WOULD ONLY ASSIST. MASTERY WOULD HAVE TO BE LEARNED. THEY KNEW THEY COULD, THOUGH. THEY CAME FROM A LONG AND HONORED LINE AND WOULD PROVE THEIR WORTH TO THEIR SPAWN-MATES.

Erik grabbed for the podium spastically, the whole illusionary lecture hall wavering until, with Samantha's help, the world stabilized around them. Erik shook his head.

"I'm sorry. There are too many of you, and there is too much there. But maybe that helps."

The others all looked numb as they reviewed their impressions. For a moment, they had been one with the Shounna, feeling and thinking with it. There had been a lot they couldn't understand, and even what they did, was confusing.

Mackey was the first to speak up. "They're *old!* That relationship, as you call it, has been going on for a *long* time. I couldn't understand their concept of time, but that much was clear."

Erik nodded. "They measure time by their spawnings—which isn't

often—and they've been at it for thousands of spawnings.

"And it's more than a tradition. The Shounna provide vital elements for their hosts in return for extended vision, hearing, strength and mobility. But the Shounna don't need the hosts anymore. There are mechanical substitutes for everything. Except the emotional bond . . ."

Leah's turn to interrupt. "They love those mounts!" She looked confused, unsure.

"That is my impression, too." Wan Chu added. "But it is not quite love, as we think of it."

Erik shook his head. "No, but it's as close as they can come. As far as I can figure, the Shounna, alone, can't feel much emotion; they don't need it. But when joined with a host, they share the full emotional range of that host and it's a very special relationship that develops between the two."

The others all tried to digest that, as Erik changed the subject.

"But before I say anything else, I have to explain how Sam . . . Ms. Cooper died. And why the alien did."

The others waited expectantly as Erik gathered his thoughts.

"First of all," Erik began. "it's important to understand that the Shounna consider themselves unique. In all the time that they have been around, they have never encountered another intelligent life-form. By this time, they can't even conceive of one existing, even if they started by looking for them.

"Needless to say, Ms. Cooper came as quite a shock. She, and all of us, appear as nothing more than deformed mounts, and they were expecting to meet our 'hosts,' but when Samantha contacted the Shounna prisoner directly—demonstrating free will, intelligence and *superior* telepathic abilities—then the Shounna assumed it was hallucinating, therefore diseased. So it killed itself!"

"I don't understand. Killed itself?" Bauer looked confused, while Wan Chu suddenly looked thoughtful.

"Yes, of course."

The others looked at him, annoyed, as Erik took him off the hook.

"What Chu is referring to is that the Shounna are very susceptible to disease, since communication between them requires physical contact. From what I can piece together, it used to be that a Shounna who was sick with a minor illness just went off alone until it wasn't sick any more, but if it had a terminal illness, it killed itself—away from other Shounna—in order to protect the others. Modern Shounna, of course, with access to familiar technology and communications, just call for a doctor, like we do. But here, isolated and confined, the old survival instincts took over and the prisoner acted instinctively to protect the species."

"That's terrible!" Cindy Bennet burst out, suddenly finding something to pity in the aliens.

Leah straightened, understanding spreading across her face. "And Samantha was directly linked with the Shounna when it suicided!"

"Exactly. And her brain was somehow short-circuited by it." Erik finished. "But she lived just long enough

to pass on to me what she had learned."

There was a long silence as the others digested that, and then . . .

"So why are they here?" Bennet again, switching back to being suspicious, and Erik saw the same question on the faces of the others.

This would be the tricky part. Well, in stages.

"They came because their outposts in this region of space began picking up fragments of our electronic communication . . . "

"That's no news." Ford and Mackey cut in together. "That's why we were able to communicate so quickly. There's more."

"Yes. They came to find out what happened." He sensed confusion, even as he saw Bauer and Wan Chu nodding thoughtfully. It figured, they would be the first to catch on. Bauer looked unhappy, though, and Erik wondered why. But he brushed it aside and continued.

"The Shounna were here before, a long time ago," Now the others started catching on. "And they left a colony here. Something must have happened and the Shounna riders died off. The hosts, deprived of the guiding riders had to survive on their own and develop. A great many probably died, but enough lived on without the Shounna's restricting control—"

"To evolve, cross-breed with our own ancestors and eventually become us. Is that what you were going to say, *mein freund*?" Bauer cut him off abruptly, shaking his head, and not waiting for an answer.

"*Nein*, no. I can not believe it."

"But it has to be. That's what the Shounna believe—which is what is so dangerous."

Bauer's turn to look confused, until Erik explained.

"The Shounna are considering three theories right now. One is what you just laid out. That makes us poor little riderless orphans in need of guidance." He ignored the swell of protest.

"The second idea is that a mutation occurred which boosted our intelligence and that we killed off our riders because we were sick and insane — and we know what remedy there is for that! Except they would just release a virus to sterilize us and then Earth would be empty of humanity in less than a century."

Everyone gasped, and he felt a roiling mix of anger, fear, and indignation fill the room.

"Finally, a third theory, and one which is the majority view, is basically the same as the first. The only difference is that this view recognizes that there might still be a danger of infection to Shounna. If so, the only solution is to isolate us and warn the Shounna planet against future contact.

"Needless to say, the Shounna already here would destroy themselves after sending home a warning."

There were mixed reactions to that, guilty relief among the strongest. Erik ignored it, though, and speared Bauer with a challenging look as he saw that the German remained stubbornly doubtful about something.

Bauer didn't waste any time. "*Nicht möglich!* I still say it is impossible. All three theories are based on a false supposition." He shifted in his seat to address the whole group.

"Life here on Earth is the result of a long chain of miraculous and unlikely coincidences, guided perhaps by a god? Who knows? But it is impossible to believe that the same coincidences could happen on two isolated worlds to produce two such similar life-forms—genetically compatible life-forms, mind you! We are too obviously related and linked to other life on this planet, and the Shounna are too different to have come from a world like ours. No, it is impossible." He was adamant, and Erik saw Wan Chu nod in agreement, and felt himself forced to agree, as well.

"So, Heinrich. What happened?"

Bauer considered for a long moment, the rest of the room waiting expectantly, and then he brightened.

"It is just an idea. But consider this scenario. The Shounna originally had different, native hosts. They came to Earth on a survey expedition and took samples of life-forms here, including our anthropoid ancestors . . ."

"And brought them home!" Erik's turn to interrupt excitedly—though Bauer looked annoyed—as he seized the idea and went on with it.

"They saw the potential for more adaptable hosts, genetically engineered them and replaced their original hosts with our cousins. That explains the need to provide their hosts with dietary supplements. Elements not found on their world, but that we have, and need. I think you've got it!" He turned to Ito and Wan Chu.

"What do you think?" Both of them grinned and as Erik looked around he saw everyone else nodding in agreement.

Without anyone realizing it, the entire mental illusion had collapsed since Erik had been too excited about finding an answer to maintain the lecture setting. Now, with an idea of what he should be looking for, he closed his eyes and forced the others out of his mind, casting his thoughts back over the Shounna memories hidden away in his mind. He sensed Samantha helping him as he dug into the Shounna images. He soon realized that the aliens possessed a well developed race-memory that was always accessible and even interacting with the conscious mind to an extent. He had missed it at first since it was on a slightly different level of thought, but as he delved deeper into the past in his search for a particular image, he uncovered layer after layer of rich and varied memories.

Then he found what he was looking for.

Rejoining the others, who had been sitting staring curiously at him, he explained what he had found and concentrated to bring them back to the illusionary auditorium.

"Sorry, but I wanted to show you something." It was amazing how much easier it was to control the illusion this time.

Once again they were back in front

of the podium, facing the large screen on which a different image was forming. A Shounna and its host again, but a different host.

It was a four-legged animal, about the size of a Shetland pony, with a vaguely lizard-like head. Widely spaced bulbous eyes scanned both sides independently while the impeding underbrush was pushed aside by thick tentacles, like the Shounnas's but without the extra, more dexterous, branchings on the end.

"*Ganz gut!*" Bauer exclaimed happily, his theory having been supported. "That is exactly what I would have pictured. They had different hosts originally, and for whatever the reason, the Shounna decided that a bipedal anthropoid host would be more suitable. More versatile, certainly." Some of the others looked a little uncomfortable at Bauer's mechanistic analysis, but his point made sense.

At that point the meeting ground to a halt, with no one proposing what to do next. Erik collapsed the mental conference room since it had served its purpose, and besides, it was tiring trying to maintain it. He also noticed the glazed looks that were coming over several faces and looked over at Leah, only to realize she had also seen it.

She stood up and looked out over the conference table, called for attention, and then dismissed the meeting, after requesting everyone to work on analyzing the probability of Bauer's theory being true.

* * *

VII.

The next morning began with a quick agreement that Bauer's theory was indeed the only logical one after which everyone started to free-fall again, unsure of where to go from that point. Everything hinged on how to approach the Shounna about the death of their shipmate and how to avoid traumatizing them with the truth about the relationship between humans and the Shounna hosts. Not to mention the shock that humans were mental equals (though a few disputed that, half-seriously).

For a while, Leah listened patiently as they wrestled it all back and forth without getting anywhere, until she finally cleared her throat impatiently. It was a measure of her influence that the room fell silent almost immediately, everyone's attention turning to her.

"The way I see it," she began, "the biggest problem remaining is how to approach the Shounna, and let me offer a suggestion." Elbows on the table, she leaned forward and clasped her hands under her chin, looking deceptively casual.

"Consider this. We contact them, apologizing for our radio silence which was due to equipment problems and we present the following." She paused a moment to order her thoughts, and then continued, raising one finger with her first point.

"First we offer our sincere regrets over the unfortunate demise of their crewmate who was in our custody. We explain that it took its own life and that in trying to discover why it killed itself, we came up with some ideas we want to discuss." A second finger extended gracefully.

"Here we ask very humbly, if we could be right in theorizing that early Shounna expeditions to Earth sampled various life forms, including our own animal ancestors. And also that those animals—and we stress that word—were later, and with care, adapted to replace less versatile hosts.

"Next," another finger popped up, "we thank the Shounna for being considerate enough not to mention this to us so as not to upset us . . . "

"But they wouldn't have cared." Kagama interrupted.

Leah smiled sweetly. "No, but we do, and this way we let them know that."

Erik had to grin, *and he thought he was a psychologist?*

Leah continued, another manicured nail revealing itself. "Then we tell them that in our attempt to communicate this to the Shounna representative on board," she emphasized the wording, "some misunderstanding must have occurred, with the tragic loss of life we mentioned."

She separated her hands, spreading one for emphasis, "And finally, we explain that we must regretfully terminate contact for a period of a few decades or so to allow our people to adjust to the fact that we have contacted a superior intelligence and that we must be sure that the Shounna symbiotic relationship is not misunderstood."

"Hell!" Kagama cut in again. "With a good media campaign it wouldn't take more than a few months to have everyone on Earth ready to welcome them like long-lost family."

Erik couldn't restrain himself.

"Yes, *we* can adjust that quick, but the Shounna can't. They need time to adjust to having found another intelligent race, even an 'inferior' one. We also have to be careful not to reveal the true facts about the suicide or of telepathic abilities. We don't want to overload the Shounna and risk a repeat of what happened to our prisoner."

Leah had taken advantage of Erik's interruption to take a sip of water, but as he finished, she took over again.

"Like I said. The key points will be to protect their feelings and give them time to adjust. And to suck up and cover our asses!

"It won't be easy, but if we do it this way, it gives us a relationship claim and a reason for the Shounna to want to protect us, and it removes any threat we might pose. Well?" She looked out at the others.

Bit by bit skepticism and nervousness disappeared, replaced by relieved satisfaction. Leah had done it. She had put together a story that covered everything.

Seeing the response, she got up. "First, if we're all agreed," She waited until the expected chorus of support faded. "I'll take this to the U.N. Rep for approval." Which was academic since the cursor had been on Leah's screen all along. But maintaining face was important everywhere.

Then she headed for the door, shooting Erik a challenging look. He took the hint and entered her mind to find a warm and receptive mental embrace waiting for him.

"Tonight, my love. Tonight!"

VIII.

IN THE BURROW THAT FLIES BETWEEN WORLDS, ORGANIZER CON-

SIDERED THE LATEST COMMUNICATION FROM THE LOST ONES. AS MUCH AS IT COULD FEEL EMOTION WHEN NOT JOINED WITH A PARTNER, IT FELT PITY. THESE BEINGS HAD NEVER KNOWN TRUE FUSION OR PARTNERSHIP, AND YET THEY TRIED TO UNDERSTAND.

ORGANIZER COULD NOT UNDERSTAND EVERYTHING THEY HAD SAID ABOUT THE DEATH OF CONTACTER NUMBER TWO. IT WAS NOT RATIONAL. PERHAPS AN ERROR IN TRANSLATION? WHATEVER. IT WAS UNIMPORTANT AS ALL THREE CONTACTERS HAD BEEN EXPENDABLE, HAVING "SHARED" OF THEIR ESSENCES BEFORE LEAVING THE BURROW.

THE ESSENCES OF CONTACTERS NUMBER ONE AND NUMBER TWO HAD NATURALLY BEEN PURGED FROM THE "MIND" OF THE BURROW SINCE THEY HAD OBVIOUSLY BEEN DISEASED. ORGANIZER FELT A MOMENTARY "SADNESS" OVER THEIR LOSS. NUMBER ONE HAD OBVIOUSLY NOT BEEN ABLE TO TOLERATE THE SEPARATION FROM ITS PARTNER AND HAD CONFUSED THE LOST ONE WITH AN UNCLAIMED PARTNER, TRYING TO FUSE WITH IT. THEN WHEN IT HAD BEEN KILLED BY THE OTHER LOST ONES, NUMBER TWO HAD LOST CONTROL AND TERMINATED ONE OF THEM. CLEAR PROOF THAT IT, TOO, HAD BEEN UNSTABLE, EVEN IF IT HAD ONLY ACTED TO PROTECT THE BROOD.

AS FOR THE THEORY THAT THE LOST ONES HAD PROPOSED, IT HAD BEEN CONSIDERED IN FULL CREW FUSION, AND ACCEPTED AS LOGICAL. BUT THEIR DESIRE TO BREAK CONTACT FOR SEVERAL TENS OF PLANETARY REVOLUTIONS WAS CONFUSING. THERE MUST HAVE BEEN ANOTHER ERROR THERE. IT WOULD TAKE MANY TIMES AS LONG MERELY TO RETURN HOME. THEN THE PEOPLE THERE WOULD HAVE TO CONSIDER THE COURSE OF THE CONTACT.

NO MATTER. THE EXTRA TIME WOULD SERVE THE LOST ONES WELL. EVEN AT THEIR FRANTIC LIFE-PACE, THEY WERE PLAINLY NOT CAPABLE OF QUICKLY BREEDING THE NEW GENERATIONS THAT WOULD ACCEPT THE NEW INTERSTELLAR RELATIONSHIP. IT WAS OBVIOUS JUST FROM LOOKING AT THEM. THEY HAD NOT EVEN ATTAINED A UNIFORM APPEARANCE YET, NECESSARY BEFORE TRUE UNION AND HARMONY COULD BE ATTAINED.

A FEW HUNDRED REVOLUTIONS MIGHT PASS, BUT PERHAPS BY THAT TIME, THESE BEINGS WOULD BE FULLY READY TO MEET THEIR VISITORS, WHO WOULD ALSO BE PREPARED TO ACCEPT THIS POOR INCOMPLETE SPECIES.

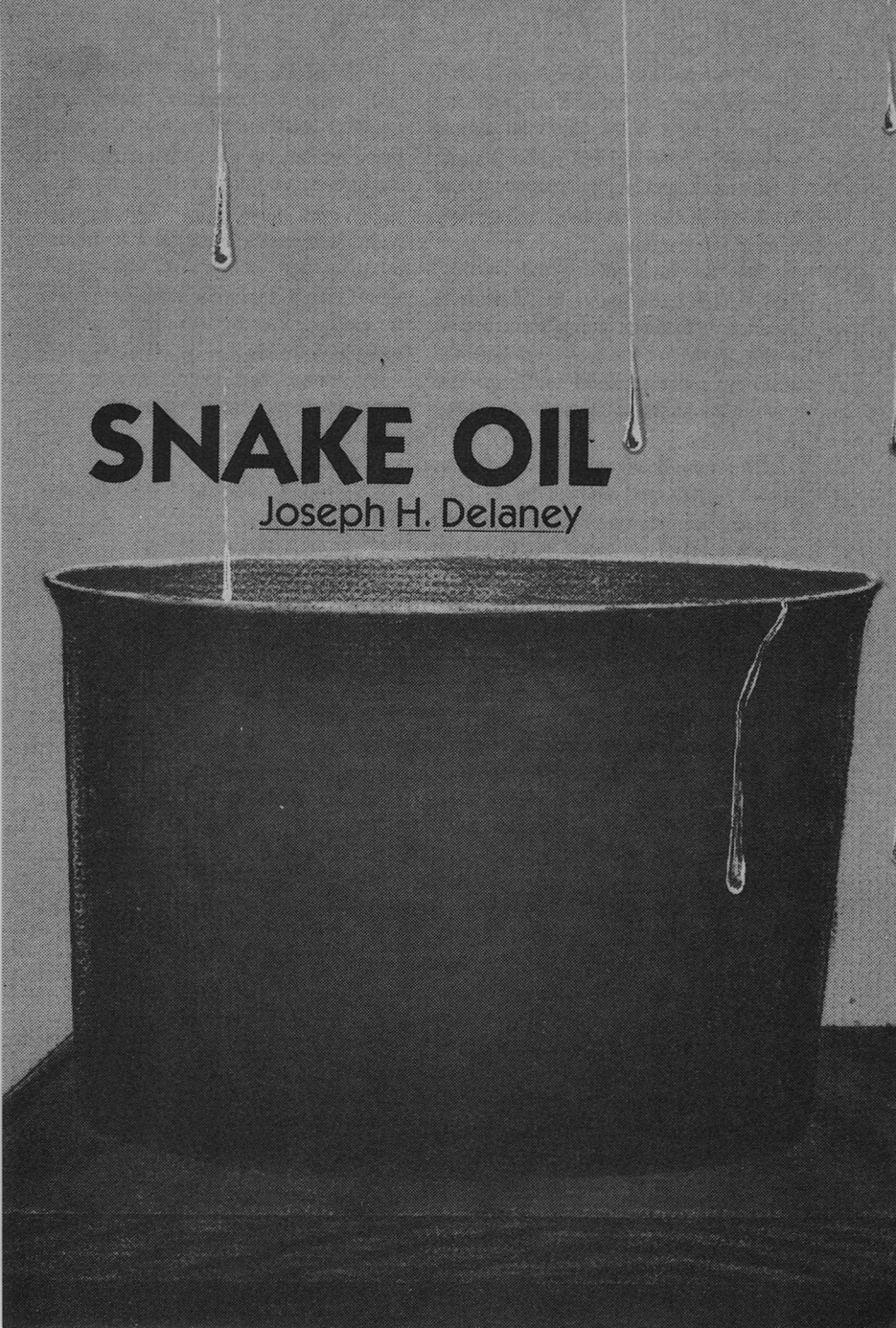
ORGANIZER WOULD ASK TO LEAD THE RETURN JOURNEY AS WELL. IT WAS CURIOUS TO SEE WHAT MIGHT DEVELOP. IT WOULD ASK FOR ASSISTANCE FROM GENETICS IN ANALYZING THE DATA FROM THESE BEINGS TO SEE IF PERHAPS A WAY COULD BE FOUND TO EXTEND THEIR LIFE-SPAN SO THAT THEY, TOO, COULD TRAVEL THE STARS. THE LIFE-BALANCE OF THE PARTNERS AT HOME WAS TOO DELICATE TO ALLOW ANY MORE ALTERATIONS, BUT THESE BEINGS SEEMED HARDY. IT WOULD BE AN INTERESTING CHALLENGE. AND IT WOULD BE NICE NOT TO HAVE TO BE ISOLATED FROM A PARTNER DURING THE LONG REVOLUTIONS BETWEEN WORLDS.

YES, THERE WAS MUCH TO CONSIDER. ■


Problems, of course, are the direct inspiration for solutions. And sometimes it works the other way . . .
William R. Warren, Jr.

SNAKE OIL

Joseph H. Delaney



From their politics to their taste in ties, the governor of New York and the mayor of New York City had almost nothing in common; but when it came to frustration and anguish they were soul brothers. In their common agony they behaved as friends.

"We have to work together on this, Ted," His Excellency, the governor, groaned. "It keeps going from bad to worse. Why, on the way over here the attorney general called and said our *friends* up in Maine had filed another suit."

"But I'm doing everything I can, Dario," Hizzoner moaned back. 'The City has been studying the problem for decades. We've spent millions on grants—"

"Grants! Grants are part of the problem. Give a scientist a grant and get him used to eating regularly and he starts looking around for ways to keep it going. Nobody but an idiot would solve a problem he's getting paid to study."

"You're right, Dario," the mayor suddenly became grim. "We have to find some other way to get rid of the stuff before Central Park gets full, too, and at 22,000 tons a day that won't take much longer—seven, eight months at the outside."

Dario nodded. Despite the fact they were on opposite sides of the political fence he really had admired the way Ted had handled that one, in an election year at that, but then, the mayor's constituency consisted overwhelmingly of people who never used the park anyhow and it did have a beneficial side effect—it drove the muggers out of the bushes and back into the alleys where they belonged.

"My people calculate," Ted continued, "that at the most we have seven months, and then there won't be anyplace we can put the garbage except on the streets. People won't stop creating it, or even slow down. The environmentalists won't let us burn it, there's no place left to bury it, other states won't take it, other countries won't take it, and the federal government enjoined us from dumping it at sea. What's left?"

"I dunno, Ted, magic, maybe. Science doesn't seem to give a—heeey, wait a minute. . . ."

"What?"

"I think I just said something profound."

"Oh yeh? What?"

The governor smugly tucked his thumbs in the armholes of his vest and gave his chair a push back from the table where the two of them sat. "Grants, Ted. I've got this gut feeling that this is the snag. Let me ask you this, Ted, how do you get the garbage collected to begin with?"

Hizzoner cast the governor a suspicious glance and took a sip of his bourbon and soda. "I don't think," he began cautiously, "that you want to hear about these guys that come around in the big trucks while it's still dark and—"

"Right: I mean, how do you get your contracts?"

"Same as the state does, we advertise for bids, the bidders pay the aldermen, the taxpayers pay them. . . ."

"Crude, Ted, crude." He paused for a chuckle. "Still, what's wrong with advertising for separate bids to dispose of it?"

"That's always been a part of the

prime contract. The collection company takes care of it.''

''Yeh, but they're not taking care of it.''

''Dario, I don't see how—''

''It'd be a roundabout way to get the taxpayers to pay for recycling. My God, man, why not try it? What have we got to lose? You will agree, something has to be done.''

''It won't work, Dario. We won't get any bidders, we'll still have the problem. . . .''

''But the voters won't be able to blame us, Ted. Ted, I'm up for reelection in seven months, just about the same time you run out of room. Now, I've tried to see *your* problem—how about you looking at mine; your city makes the garbage but it's part of my state, and if you can't handle things, the people will expect me to do it. Without New York City we *could* manage the rest of the state's output. It's insignificant by comparison.''

Hizzoner looked at the governor, and sympathy crept through even though he was on record in support of Dario's opponent. That was partly because he knew if Dario couldn't hack it and got beaten, his own party's candidate would have the problem to face and then they would all be hurting. ''All right. I'll push an ordinance through. Lemme call my girl.'' He picked up the phone and stabbed at the intercom button. ''Miss Delgado, want to bring your book in here?''

The ''girl,'' Rachel Delgado, obediently appeared, clearly unhappy with the circumstances, but resigned to them. She took a seat across the room, struck a provocative pose, lifted the shorthand book, and drew a ballpoint from behind her ear. For the next ten minutes she struggled to keep up with Hizzoner's rapid-fire dictation, but when she left she had the text of his proposed ordinance and that of the city's ad, to be run as soon as they were sure the rest of the ruling hierarchy would approve.

Rachel struggled to move the heavy and badly soiled canvas mailbag off the countertop and onto a chair, where someone of her short stature could see in. She felt like throwing up when she saw that most of it had been forwarded by the municipal services department down in the basement. That meant a lot of work for her, letters to answer, letters mostly from crackpots or neophytes who didn't really understand how the bidding process worked.

And Rachel was relatively poorly equipped for secretarial work. It wasn't that she didn't have the smarts, it was because she didn't have the skills. She was acquiring them, and faking it in the interim, but this did take time. The upshot was she had to work three or four times as hard as people who knew what they were doing.

The ad in the *Wall Street Journal* had been running for over a month, and still hadn't produced anything but political results. Rachel knew that the mayor had set up a new department, and hired people, his relatives and those of some of the leading aldermen, to run it, but she found that when it came to the work she was still doing all of that. At first, the mayor had taken an enthusiastic part, as had the governor—before the word got back to the country's industrial giants that this wasn't just another

trough for them to put their feet in; that there would be no grants for "feasibility studies." After that, the project was dumped back on Rachel.

She worked hard that day, conscientiously screening the replies. The pure crackpot letters went back into the bag for transportation to the shredder. The others, so long as they had any merit at all or made any pretense of addressing the ordinance, she stacked in priority piles, and spent the afternoon laboriously typing letters and scrawling Hizzoner's signature at the bottom.

But the last letter she came to was different. Stuck on the bottom of the pile, perhaps because it was such a short one she had thought it unimportant, this one listed a local hotel as an address and requested a telephone reply.

Rachel glanced up at the clock on the outer wall. It was only 4:45 P.M. She quit at five so there was still time. She punched the number out and when the hotel operator answered the video screen lit up, as it always did when two telephones so equipped were connected. Naturally, the mayor had one.

"I'd like room 1009," she said.

The operator rang it but no answer, so Rachel left her name and number for Dr. Hill.

To her everlasting disgust Dr. Hill returned the call just as she was about to leave for home. Tonight, of all nights, she didn't want to be late. It was the twins' birthday.

The voice on the other end was drawly, originating some place in the south or perhaps the southwest, Rachel couldn't tell. But Sam Hill was an understanding sort, and when she told him she was in such a hurry he invited her to call him back later that evening. Rachel was grateful, and readily agreed; then promptly forgot all about the incident until the party was over and it was almost bedtime. And then she was glad she had remembered.

"Mr. Mayor, I made you an appointment for 9:00 A.M., day after tomorrow, with Dr. Hill."

"Who's Dr. Hill, and why so early, Miss Delgado? You know I don't like to travel during morning rush."

"He's from Earth."

"A nut?"

"No, sir, he's straight. Earth's a little town someplace in Texas. He was one of the bidders, the only one I've found so far who I think deserves serious consideration, and he has to go home on the noon plane. I think you'll find his proposition very interesting. I did."

Hizzoner pumped her ruthlessly but Rachel would say no more, and in the end, the mayor had to be satisfied with reading his written proposal. Whoever he was, this Dr. Hill was an upstart. He proposed to dispose of all the garbage at existing facilities, and to do it for a nominal fee. Ted wondered just what sort of proposition Rachel had gotten. Certainly, his own didn't look too promising. The mayor adhered to the theory that what looked too good to be true inevitably was.

"Actually, Sam, I lied to you. I'm not really a secretary, but I fake it, and I was good enough to do that. Shorthand was the hardest part. I didn't know any, so I had to invent my own system. But now," Rachel purred, "I'm almost as fast as the rest of the girls." She dipped

her fork experimentally into the lobster thermidor the waiter had just delivered, and took a cautious taste. "Exactly where is Earth, anyhow?"

Sam was also testing the fare. "Don't usually get seafood this good where I live," he retorted. "Uh, Earth's up in the panhandle, Lamb County, between Muleshoe and Halfway." He grinned, realizing that meant nothing to her. "Go forty miles southeast and you're in Lubbock."

"Oh." It still didn't mean anything to Rachel.

"Earth's a nice peaceful place, about 2,500 people, some oil, some cotton and lots of cows."

"And you're in the oil business?" Rachel's recollection of the telephone conversation on the previous evening was a little threadbare. The mention of oil had impressed her, but she'd been sooo sleepy. "How does a molecular biologist get into the oil business?"

"Texas style—by accident. Bugs are going to be important to the oil business one of these days, because they can be used to increase production. When I first started developing *Mongrelcillus oleonus*. . . . "What was that?"

"Mongrelcillus oleanus?"

"That's what I thought you said. The taxonomists will be all over you."

"Let them, they can just talk to my lawyer. He said the inventor has the sole and absolute right to name his creation and that he'd shave his fee if I'd let him do it. It's his way of hitting back at the physical scientists he claims equate his discipline with magic—of showing them a really good magician could mess up their neat little act.

"But let me finish before I derail my train of thought; I was looking for a way to reduce viscosity. West Texas is famous for its light crudes but these are mostly gone now. What's left is heavy stuff, some of it almost like tar, that won't pour, won't pool, and won't pump. People have tried to recover this by steam injection or by pumping solvents down to thin it out, but that's both expensive and risky."

"And you're going to do it with bacteria?"

"I'm doing it already."

"Then why do you want to fool around with New York City's garbage?"

"Because while *Mongrelcillus* does work, it is a slowpoke. It's going to take years before enough oil pools in the first treated wells will be worth pumping out. I won't be getting any royalties until then and the advances I've earned for work done so far won't keep me eating in the meantime. That's the first reason."

"Oh? And the second?" Rachel cooed demurely.

"The second reason is that I know something the rest of the world doesn't, and that's the way I plan to keep it—uh, for a while, anyway." His voice cracked on the last remark, as though he feared he might have sounded too firm to retain Rachel's further interest. He cleared his throat with a swallow of his Llano Blanco. "How do you like the wine?"

"Very good. French?"

"Hardly! French wine isn't half good enough for a girl like you even if all French grapes do grow on Texas root stock. No, this is from Llano Estacado, Lubbock, Texas. The name means

'staked plains,' but I guess I don't have to translate for you.''

''Yes you do. My grandparents were from Puerto Rico but I'm third generation in New York. Sorry. Uh, I'll have to stock my own cellar with it,'' Rachel replied, meaning she'd make room in her tiny pantry for a bottle or two, if and when she could afford it.

''You haven't talked much about yourself, Rachel,'' Sam said, feeling relieved. ''What's a nice girl like you doing in a place like the mayor's office?''

''I needed a job. I've got an MBA from Radcliffe, and for a while I thought I was sitting pretty. But then the twins came along, suddenly and unexpectantly, and their father left, suddenly and unexpectantly. I found myself overqualified for most everything, including welfare, but nobody wanted an entry-level MBA who couldn't work practically around the clock for the cause.

''So, in desperation I started passing myself off as an executive secretary, presuming most employers would emphasize versatility over the traditional mundane skills. I was wrong, and they didn't, at least big high reward companies didn't. Which left the sleaze jobs, like government work, where the big shots still refer to you as 'my girl,' and expect you to be part waitress, part courtesan, part messenger and all doormat.''

Across his rising fork Sam shot a sober glance at her. He chewed contemplatively, swallowed, and said, ''I've put a small organization together, Rachel, mostly close friends with a little money. We have some venture capital to go with my plan but there's something else we need. And getting that is the primary reason why I came here. I think I've found it.''

''What is it?''

''An ambitious, aggressive, capable, reliable chief executive officer. You.''

''M-me?''

''You earned that MBA?''

''By sweating blood. But, I don't know anything about your—''

''In good time. We'll make a night of it, and I'll fill you in completely.''

That remark raised Rachel's suspicions as well as her hackles, because it was beginning to look like an old and classic move. But it wasn't. Although she spent the bulk of the night in Sam's hotel room she did it with her clothes on.

''So I sezs t'the broad, I sez, 'OK, it'll cost you a $1,000 an acre and half of anything you find.' I figured that's the way to call a bluff.''

Nate Rhodes had never handled negotiations for a mineral lease before and didn't know anybody locally who had. New York law on such matters was also a little sparse and sketchy. Nevertheless, he decided to wing it. ''What's she after, Sal, did she say?''

''Just 'minerals.' Uh, she finally made an offer of $200 an acre and one-eighth of any minerals. Whaddayuh think?''

''Could be a con, somebody selling 'snake oil,' as they called it in the old days. You probably ought to take the money and run. The state's gonna close you down pretty soon anyhow, Sal. Your dump's full and there probably isn't any productive use you can put it to after that. Not without a lot of ex-

pensive tests. How much land have you got?''

''Two hundred acres. I always figured it'd be worth a bundle when the trash settled; figured some developer'd come along and . . .''

''Ever heard of 'Love Canal'? That's what I meant by 'expensive tests.' You've been dumping for over sixty years. You don't know what's down there.'' Nate squirmed as he tried to remember what little he knew about the subject, and suddenly got a brainstorm. ''As I understand it, in the normal situation, you'd retain surface rights anyhow, which means you could still develop if you could get clearance. So maybe it would be smart to consider the offer. You could require extraction to be done in such a way that it wouldn't interfere with other uses. And, in the meantime, $200 an acre would pay the taxes and maybe finance the tests you need.''

''Couldn't hurt, huh?''

Nate stuck his neck way out. ''Uh, that'd be my offhand opinion. Tell you what, why don't you call her—who is she anyway?''

''Her name's Rachel Delgado. She works for some company down in Texas, uh, Earthian Enterprises.''

''Oil, Sal! That has to be it! Tell me, have you talked to any of the neighbors?''

''Yeh. A few.''

''And?''

''None of them ever heard of her. Nobody else got an offer, or if they did they're keeping quiet.''

''OK, Sal, call her, ask her to write it up, and then bring it to me to check—can you do that?''

''S-sure. You think this is on the level, then?''

''I didn't say that. I don't know yet. I'll have to see. Now, I gotta run you out, Sal; gotta get to court in a few minutes.''

''OK, I'll get back to you as soon as I can,'' Sal muttered, rising. ''I'm gonna ask around some more, just in case.''

''You do that,'' Nate replied impatiently. He couldn't wait for Sal to leave so he could call a classmate now practicing in Houston, and get the skinny on oil and gas law.

Ted's new secretary was a bovine type, and he was enjoying the popeyed expression on Dario's face as she bent to deliver his coffee.

He stirred it contemplatively, then took an experimental sip, during which Ted waited with bated breath, and then when his host's agony peaked, the governor relieved it. ''Every landfill of any consequence in this state is under lease to Earthian Enterprises, Ted. I had our tax people check it out on the excuse that it might enable us to levy a severance tax. But it doesn't stop there. The same thing happened in Jersey, Massachusetts, and Rhode Island.''

''There has to be lots more to it than we know now,'' Ted moaned. ''The city took Hill's bid. We had to, it was only ten cents a ton. We figured it was phony, and that it must have cost him at least that much in grease, but it got us off the hook.''

''I understand Central Park's full. Where is he taking the stuff?''

''To some of the old dumps, I guess. I don't see how that can last very long,

though. They're all old, all nearly at capacity. We always had trouble interesting them in city contracts before because private industry paid better."

"You and me, Ted, we've got to let bygones be bygones, make this a nonpartisan thing, you know what I mean?"

"S-sure, Dario." And he did. Ted knew, just like Dario, that something was going down, and they both wanted in on it.

"There's something I didn't tell you, Ted—that secretary you had, Rachel—"

"She's long gone—"

"She's CEO for Earthian Enterprises now, Ted, first vice-president and also bed-warmer to the president, Sam Hill. She wasn't really a secretary in the first place, Ted. You got snookered."

Hizzoner paused, aware that his face was turning crimson. "We need to know more about that, Dario. If she falsified her employment application maybe we can prosecute—"

"Let's not slaughter any golden geese, Ted. I agree we need to know more, and I've got some capable people I can put on that operation, but, sometimes it's better just to let people know you know and then wait for their reaction."

"Uh, yes, I see." Hizzoner's face was back to normal. He'd had time to reflect and he could now readily see that the entire bureaucratic organization, normally very astute, had been caught with its pants down. "I've got some people of my own who can help them. I suggest we make this a joint inquiry."

It was Melva Hughes's very first real acting job, although she had been telling her johns for years that she was really an actress and hooking was only a sideline. And the pay was super, so much that she didn't mind spending the time her one priority customer took, didn't mind that somebody watched her constantly to see that she didn't solicit more business, didn't mind the daily medical checkups. But she was beginning to wonder what it was all about.

She turned over, adjusted the covers and ran her fingers through her dozing companion's hair. "Don't go to sleep on me, Bull, we're not through yet, remember."

"Umph."

"Where'd you get a name like Bull, anyhow?"

Bull Dawson really was tired, and he knew he had no reason to be ashamed of his performance so far this evening, but he also knew women, and he knew they didn't like being put off. "Goes back to my football days," he answered. "Football's real important where I come from. I used to charge through the other side's line like a bull, until I hurt my knee, that is, and then I went into drilling."

"Oh. I thought it was because you're such a smooth talker. Uh, dontcha know there ain't no oil around here?"

"Nope. I don't know that a'tall. Don't care, neither, s'long as they pay me every week, and they do, and they pay good, and the work's easy. Why, all I gotta do is go down 'bout 500 feet. I'm using an ordinary old fishtail, cause there ain't no rock to go through. Don't even need mud. I drill 'em, they case 'em, and I go on to the next one. Now, you take drilling down in the Permian, that's hard work and holes take months sometimes. This is easy."

"Then you've rested long enough. . . ."

"Hey, waita—"

"No question about it, Mr. Mayor, these people are drilling oil wells in all those old dumps."

"Oil wells! Oil wells? I know there've been schemes to collect gas, but . . ."

"That ain't it, Mr. Mayor. I've got people inside some of the dumps, and some of them know about stuff like that. They say there's pumpjacks and holding tanks going in but no compressors or pressure bottles, so it means oil. We haven't figured out the rest of it, but the agent we have working under—I mean on—the driller says these are all shallow, under 500 feet in most cases, but that they drill lots of holes."

"Um, yes. Well, I'm going to call the—my—uh, colleague, and see what he's found out, but you keep on it, OK?"

"Right."

Ted lost no time dialing Dario's number as soon as the line was clear. "Dario, my men confirm what you said. They're after oil. What about the EPA survey?"

"Shh, Ted, you don't want to talk like that."

"S-sorry. Uh, heard anything new?"

"Some kind of bacterial culture is being implanted in every hole. We don't know what it is yet but they handle it like it was hot. Also, after it's in, they seal the holes and now they've got armed guards—"

"Guards? What for?"

"We don't know, but they're supposed to be mean-looking dudes, and they patrol on horseback. We think Hill brought his own people up from Texas."

"There must be some kind of tracks on whatever it is. What does the —uh—your source say about it?"

"*Mongrelcillus O.*"

"Sounds Italian. The Mob?"

"No. They're poking around, though. We think they may even own a few dumps, but—no, that's supposed to be a trade name, a patented life form."

"That's a start. We'll get a search and buy a copy. That shouldn't be too hard."

"Good thinking, Ted. The claims will give us a general idea of what it's expected to do in the dumps. Uh, but that may sour some other plans, uh, it you get my meaning."

"Yeh. Look, Dario, I'm going to get started on that part. Talk to you later, OK?" Ted hung up in Dario's ear.

"Well, Rachel, looks like we're in business." Sam Hill closed the tap and held a graduated cylinder up to the light. He tilted it slightly. "Looks almost like number two diesel, except for the color. *M.O.*'s doing a great job." He sniffed it. "Gonna be a problem with sulphur though, worse when we really get rolling."

"How can you tell it's sulphur the way this place stinks, Sam?"

"I got an educated nose. You know, there ought to be some other bug that can utilize the sulphur and not poison our mix for *M.O.* Or maybe one that can separate the hydrocarbons from the acid so we can drain it off."

"You're over my head, Sam. I know you've tried to explain it to me but I still don't understand it. . . ."

"All you have to remember is that *M.O.* can eat just about anything, because I gave it genes from many different organisms. This is why it's comparatively large, and why I called it *Mongrelcillus*. It feeds off the end product, which the colony manufactures in steps. Because it's also what we call a facultative anaerobe it can carry out these various steps with or without the use of oxygen."

"But if it eats the oil—"

"Sorry, I misled you, Rachel. It doesn't eat the oil. It uses the feedstock hydrocarbon to build carbohydrates, and it pulls nitrates out of the waste to build protein. The oil is really the hydrocarbon shell each bacterium makes to protect itself from the oxygen when in its anaerobic state, and from sulphuric acid after the cycle starts producing that as a by-product. When we pump it out it's still in an anaerobic status, and it'd die eventually of oxygen poisoning even if the heat of refining didn't kill it. This is what persuaded the EPA to let me try this. It's safe when used as directed."

"Let's get out of here, Sam. I can't stand the smell any longer."

Sam walked her to the car, which drove off as soon as they were seated. They headed to the company's new office and laboratory on Lexington Street where Sam's experts would tell him dozens of things about their new "crude."

It turned out to be an eventful day—a profitable day once the news hit the futures market. Ted was gleeful. He was cleaning up, having taken advantage of what he knew—suspected to short out on petroleum issues for some time in advance of their dramatic drop. He made ready to move when the market recovered. He was feeling good about everything.

But then he didn't know that Dario hadn't acted with comparable sophistication.

As it turned out, Dario had simply positioned himself to leap in when the industry bottomed, bought heavily when it did, and waited for the recovery. The recovery was tardy and now his broker was asking for more money and hinting that he might call on the margin.

Since by now the two of them really had nothing more in common, the once tight little relationship began to unwind, and Ted essentially passed out of the picture.

Dario, however, continued the struggle with a vengeance, and with what was left of his espionage operation. His people succeeded in getting hold of a culture of living *Mongrelcillus oleonus*, and with the help of data from the patent they began to test the claims that Sam Hill had made and to look for omissions.

"The law of manmade organisms is new and fluid," his experts told him. "That means that many questions have yet to be resolved by the courts. We may be able to introduce enough variance so that we can claim a new variety ourselves."

"But there aren't any more big landfills available. Hill's got everything tied up, and his operation has a virtual monopoly. He's sucking the world dry of garbage."

"Even the American consumer, prolific as he is, can't keep up with the demand for petroleum, Governor," came the answer. "Ancillary sources have to

be developed. My advice would be to try to buy into some of the peat bogs, or even some of the scrub forest and bushland. After all, hydrocarbons are hydrocarbons and it will make little difference if nature buries them or if men do."

Dario took that advice. Also, he took a bath, but he converted his shaky portfolio of conventional oil issues into operating capital and beat the bushes, literally.

Rachel Delgado was still CEO and first vice-president, even though officially she was now Rachel Hill. She waited patiently in her office in the executive suite, waiting for Sam to call and tell her how the case had come out. He didn't. Instead, he suddenly appeared, tail tucked and looking bedraggled. She knew when she saw him it was bad news, but asked him anyway.

"We didn't get our injunction, Rachel. The court said we hadn't produced sufficient evidence of infringement to make out a *prima facie* case. That means all we get is damages after the case is over, if we prove it then, and that we have to go through the hassle of collection, if they are even collectible."

"No trustee, either?"

Sam shook his head. "They've got what in my opinion is an imitation of *M.O.*, but try to get any layman to understand that. They pay more attention to looks than to function." He sighed. "I knew I should have nailed down all the other strains with patents, too, but then, there were so many that had possibilities and I had so little money."

"We've got it now, Sam. That's some consolation."

"Not for me. I worked so hard, and now the crooks come along and take what I developed. It isn't fair."

Rachel handed him a cool drink.

Sam took it gratefully and carried on with his lament. "The political winds are against me now, Rachel. Even the federal government seems to be siding with the enemy. They're tickled pink to have the independence my discovery gives this country. And it's given New York and some of the other big cities more clout than they deserve. Poor Texas! It seems a shame it's got to suffer just because its people keep it clean."

"Sam, you have to have faith. In the end, justice prevails, somehow."

"You believe that?"

"Sam, if I didn't, would I go on? Don't you? Isn't that why you still try?"

"I don't know."

"Wait and see, Sam."

Dario's term was up. He had decided not to run for reelection, and instead moved back into the city, where he also maintained an office for his own enterprises.

These had grown remarkably in the year and a half since the alliance with Ted had tumbled down. Ted himself was no more, having expired of a sudden heart attack almost six months ago.

At times like these, on warm spring afternoons when the sun was getting high enough in the sky to make walking pleasant, he liked to go out for a stroll before dinner. Since he lived in the penthouse on the top floor of the building and there were so many fine restaurants within walking distance, he usually didn't trouble his household help by eating at home.

This evening, as he stepped out into the crispening air, there seemed to be something different in it, the smell of oil, to which Dario's nose had become accustomed from inspection of his own fields. He wondered where it could be coming from and asked the doorman.

"Don't know, Governor," the elderly man replied. "Can't be from the park, they hauled everything away. Maybe something happened down on the river."

Dario grunted and walked off, waiting at the light, killing time admiring a set of shapely buns ahead of him, allowing his gaze to drift down trim calves to the remarkably spiked heels of the woman's shoes.

Then the light changed, and as she stepped off the curb she suddenly fell. He reached down to help her up, wondering if this might not be the beginning of something for him.

But she was irate. Worse, she recognized him, and though she thanked him for his immediate assistance she let him know what she thought of politicians. "Look at my shoes," she screamed. "Look at my hands and knees. Some politician must have gotten a bundle of graft on this stuff. You call that asphalt? You call this a paved street?"

Dario ducked out, deciding she wasn't his type, and left her in the charge of the beat cop, who had in the meantime approached. Dario knew the cop would get rid of her in his own way, by asking her if she wanted to file a report.

But on the way to the restaurant he examined the street, and decided the girl was right. It *was* inferior material —only—only it wasn't new paving, it was old and discolored and even cracked and patched in places. He didn't know of any reason why it should be soft, yet it seemed to be. True, with the large surface area of his own feet he had to stomp pretty hard to make an impression, particularly after the temperature started to drop, but there were clear indications that the tires of vehicles were starting to make ruts. Oh well, he wasn't in city government anymore and it wasn't his problem.

"Sir, I can't stop it. I don't know what's wrong."

Dario stood shivering in his own living room, listening to the apology of his building engineer, who was shaking for other reasons.

"I've had my crew up there slapping asphalt on that roof for over an hour. No matter what they do it just keeps leaking and I can't tell you why."

"You said the stuff was running off?"

"I said 'something' was running off. In this downpour it's hard to tell what. B-but I got the roofing contractor who put it on a couple years ago on the way over. He says he can stop the worst of it with tarpaulin, and he'll fix it when the weather clears. There's a warranty, of course."

"I don't care about that. I just want the deluge stopped. What's keeping him?"

"I don't know. I'll call him again." The harried man, appearing grateful for the opportunity of distraction, rushed to a nearby phone. A brief exchange took place.

"What's the matter?" Having heard

one side of what sounded like a cop-out, Dario was insistent.

"He can't get over here with the stuff he needs, Governor. Something's wrong with his trucks."

"Trucks?"

"Yeh."

"All of them?"

"That's what he said. He said he's gonna try to stuff a few tarps in his own personal car, and that he's making this a priority job."

"Well, I should hope so—what'd he mean by that?"

"I don't know."

"Where'd it come from? We haven't had any spills, lately."

Standing in the heaving bows of the little cutter, Coast Guard ensign Kate Baker was feeling none too steady with her breakfast, and she didn't want to disgrace herself by getting seasick and throwing up. And then she had a horrible thought, suppose it wasn't seasickness? The thought of being a mother brought panic, and panic brought cold sweat, which she fought valiantly by concentrating on her report. "Must have been one far out at sea, Sir. Maybe we'll find it on the satellite pics. Wherever it was, it was a big one. We've got tons of tarballs washing inshore. The tourist commission is going to hate us."

"I know," the voice on the other end sighed. "No matter whose fault it really is we always get the blame. Continue on course. Report if you find anything that could be the source."

"Well," Sam squealed in triumph, "I have the answer, for all the good it will do. Thank God it wasn't *M.O.*"

Rachel didn't share Sam's glee. Rachel was scared. Rachel had occasionally gone down to street level during the week they had been cooped up here, and Sam hadn't. He had been so tightly wrapped up in his investigation that he paid no attention to incidentals, like her description of the facts.

That was then. Now, having had a few moments to savor his victory he was ready to tackle the next problem. He was ready to see for himself.

Even before they reached the ground they heard the siren. They found the sidewalk full of cars, and the space in front of the building under the control of a traffic cop who was desperately trying to make room for an ambulance. He finally made it, and then turned his attention to them. "What are you people doing here? This building was supposed to have been evacuated hours ago."

"W-we didn't know. We were busy. We were here over the weekend."

"You'll have to go now. The entire area's been designated a contaminated zone. We expect fires to break out any time now, and we haven't got any way to fight them except from the air. Surface transportation is about shut down and communications are terrible. Pretty soon the power will go off, so we've got the subway closed. Look, when the ambulance clears out I'll arrange for you to go to the river in one of the cars. That's where we have our command post and collection center. They'll get you over to Jersey."

"But I don't want to go to Jersey. Look, do you know who I am?"

"No, who are you?"

Sam told him, and for an instant he feared the cop would turn on him, de-

spite his hasty explanation that it was the competition's fault and not his.

"What's happened, Officer, is that their bug either mutated or they programmed it wrong to begin with. It must have gotten out of their bogs on vehicle tires, or on people's feet while the weather was still cold. It would have encysted, and by the time the ground warmed up again it would have been all over the place. Outside the planned environment it had to forage, found asphalt tasted just fine, ate that off streets, roofs and sidewalls, or wherever else it was available, and then graduated to plastics and rubber. It ate tires, electrical insulation, carpet, wall covering, whatever it could get. And now the rains are spreading it everywhere. It'll keep going unless somebody can find a way to stop it. I have the most experience with such organisms. I'm the best bet."

The cop stared blankly, waiting for Sam's next move.

"What I mean by that, Officer, is that if you're in communication with superiors you'd better tell them that, and make arrangements to get me to a place where I can do some good."

This time the cop understood. He went right to work, and it wasn't long before Sam and Rachel were rolling down the sidewalk perched on the forks of a lift truck the cops had commandeered somewhere. It was a harrowing ride, but it got them to the water, where they embarked on another strange journey, this time up the Hudson in an old wooden-hulled canvas-rigged sloop. "We gotta watch modern materials," a crewman chided, "unless we want to go down."

The secretary of the interior was in charge of the evacuation center in Ossining. He was grim. "This is only the tip of the iceberg, Dr. Hill. Large parts of the country, particularly rural areas, are still untouched, but eventually it'll get to them, too. Meanwhile the great commercial, industrial, and governmental centers are rapidly becoming uninhabitable, with sewers and basements full of explosive volatiles. It's fortunate this is summer, even though that will exacerbate the pollution problems, and we have time to prepare people for a hard winter. And at least," he forced a chuckle, "they'll have something to burn to keep warm."

He paused, waited, and spoke again. "Doc, can you do anything?"

"I don't know. This isn't as easy as controlling bigger creatures. Bacteria can adapt to almost any conditions, given time, and this one's pretty versatile already. But there is one natural advantage that should help us."

"What's that?"

"It has to follow natural laws just like any other organism. And one of those laws is that when a new environment opens up the creatures that can exploit it will exploit it, and do so to the fullest possible extent. That's encouraging. It means the infestation will be self-limiting. Sooner or later, this organism will reach its limits. When it's gobbled up all the readily accessible food, of which there admittedly happens to be a great deal, its propagation will stop, its population will stabilize, and we can address the problem by more conventional methods. The chief difficulty will be survival in the meantime."

"That sounds encouraging, Dr. Hill. Right now we need good news. We have

to spread as much of that as we can while we can still make use of our electronic communication network. I'd like you to go on the air with your opinion. I think it'd help a lot to head off panic and an even greater crisis than we have now."

"I'll be happy to do that, Mr. Secretary. Just tell me when."

"You were eloquent, Sam. I was proud of you."

Sam reflected momentarily, then silently agreed. He had done the job, he thought. He'd done it without rancor, too, or placing blame. He'd given people the facts.

They could and would find new materials for tires, fuel lines, and other critical transportation components the bugs now ate. He already knew how to do that, he thought, since what the organism wanted was the nitrogen out of the rubber molecule. And, of course both concrete and bricks made fine paving material, and glass was a fine insulator, at least at ordinary temperatures. It was a question of finding all these substitutes and getting them manufactured in time.

And there was time, he told the people. Breaking through a city was one thing, but it would take longer for it to span the continent and even more time to reach overseas. And it was the foreign countries who could provide these needed materials. Japan and Korea, and Taiwan for instance, all of whom depended on imported oil that the U.S. might once more be able to supply in quantity, though they would probably insist on some kind of quarantine or import only finished products.

Sam began to feel more and more optimistic, and he, in turn, infected Rachel. They celebrated with a little time to themselves. As a result, they were momentarily unaware of some important developments.

"It's gotten into the mines over in Pennsylvania, Dr. Hill," the secretary announced grimly. "It probably isn't neglecting West Virginia either, and it'll get all of Appalachia eventually. Evidently the organism can take things a step further and use the coal as a feedstock. It's a disaster."

"I don't see why, Mr. Secretary. The U.S. is the Saudi Arabia of coal. It'll be a bonanza. The problem with coal has always been extracting it. Now we can pump—"

"It's a disaster, Dr. Hill. There's something you don't know about. Something that just doesn't happen in the oilfields. But it's the curse of the coalfields—I'm talking about fire. All through Appalachia there are vast underground fires. Some of them have been smoldering for over a century. Up until now the big danger has been caveins; the coal formation burns away and the overburden collapses. Now —well you can certainly appreciate the potential hazard, trillions and trillions of barrels of light hydrocarbons sloshing around until they meet a fire. . . ."

"I think I'd better get back to Earth as soon as I can, Mr. Secretary. I've got a fine lab back there and I need to get to work."

"I'll arrange it at once, Dr. Hill. Uh, you do have some ideas?"

"Several, Mr. Secretary."

"I don't quite understand, Sam. Oh,

I like Earth and all that, and your laboratory does strike me as adequate, speaking as a layman, of course. But wouldn't you be more effective if you were closer to the action?''

''Maybe, for a while I would, Rachel. But I wasn't just bragging when I said I had a better chance of cracking the problem than most anybody else. Also, I kept in mind what you said about justice being triumphant in the end.''

''I don't understand.''

''Well, look at it this way. With all that coal these other states are going to be the energy kings, like Texas used to be—if I make it, or if one of the other researchers does. But what if we fail? With *M.O.*'s help Texas will still produce substantial amounts of fuel, and oil's an end product for these bugs so they won't be much of a bother here. But those other places might not even be habitable, and it's highly likely that even if they are their new found riches will go up in smoke. I didn't think that was anyplace for us to be raising a family. I think that we're better off doing that here in a land that's really blessed.''

''Blessed?''

''Texas has almost no coal, Rachel, but it's got all the rest of the things we need. It doesn't mean I'm not going to try to help, but Earth is where I'll do it.''

Rachel's gaze turned to the north. ''Easy come, easy go,'' she murmured. ■

IN TIMES TO COME

It might seem obvious that justice would be a simple matter if technology supplied a foolproof way to establish the facts surrounding an alleged crime. But experience shows that the obvious is not always correct—and there's more to justice than the facts. Case in point: next month's lead novella, "The Mountains of Mourning," by Lois McMaster Bujold, with cover by Alan Gutierrez. Bujold's last appearance here, the serial *Falling Free,* appears as I write this to be a leading contender for the "Best Novel" Nebula Award; and "The Mountains of Mourning" is just as engaging and thought-provoking.

Warren Salomon has a fact article on an aspect of going to the stars which is often glossed over: the economics of interstellar commerce. Most of us would like to go to the stars, or at least see our descendants able to—but who will pay the bills, and what will make it worthwhile?

The rest of the fiction line-up includes stories by Rick Shelley and W. T. Quick, both familiar from recent appearances here, plus one with the unlikely title of "When Life Hands You a Lemming . . .," by our own book reviewer, Thomas A. Easton, and a long-overdue return appearance by Dean McLaughlin.

the reference library

By Tom Easton

Drowning Towers, George Turner, Arbor House/William Morrow, $18.95, 318 pp.
Peacekeepers, Ben Bova, TOR, $17.95, 337 pp.
Return to Eden, Harry Harrison, Bantam, $18.95, xiii + 349 pp.
Mona Lisa Overdrive, William Gibson, Bantam, $18.95, 260 pp.
Timelapse, David F. Nighbert, St. Martin's, $17.95, 294 pp.
The Crystal Warriors, William R. Forstchen and Greg Morrison, Avon, $3.50, 308 pp.
The Paradox Planet, Steven G. Spruill, Doubleday, $14.95, 182 pp.
Other Americas, Norman Spinrad, Bantam, $3.95, xiv + 273 pp.
Flinx in Flux, Alan Dean Foster, Ballantine/Del Rey, $3.95, 325 pp.

Science fiction readers all know that the world is going to hell in a handbasket. Right? There is overpopulation, new diseases such as AIDS, the Greenhouse Effect, the hole in the ozone layer, looming war, resource exhaustion, and more. You've read about them all, in fact articles and stories in this magazine, in news and science magazines, in books. You've seen them on TV. you know that though people are talk-talk-talking they are also wiping their brows, saying, "Sure, disaster is coming. But not in my time, thank goodness," and refusing to do much that has any real hope of forestalling the problems. No recycling, no disarmament, no power-sats, no asteroid mines, no birth control. Business and government think that perpetual economic growth (from a fixed resource base) is both possible and desirable and that "long-term" planning means looking five years down the road, ten at most. Precious few think in terms of generations or centuries. And that is what makes disaster inevitable. There is a Dark Age coming from which the human species may never again emerge.

There are plenty of SF stories that ignore or duck the truth. Their writers

pretend that the real Space Age, with its wealth of resources and opportunities, is just around the corner. They may be right, though a reasonably close reading of the daily paper hints that this country is so paralyzed by the fear of risk that it is never going anywhere at all, much less into space. We are leaving that for the Russians. There are also the threats to perpetual economic growth posed by Third-World markets developing their own productive capacities, by the crippling burdens of international debt, trade deficits, and defense budgets, and more. Avoiding disaster will take a miracle. It may take a miracle to survive the disaster.

You've heard me rant before. But this is also George Turner's message in his marvelous new novel, **Drowning Towers.** He gives us the world of a millennium hence, when people are finally emerging from the disaster. Sea levels are up, the climate is finally cooling from the Greenhouse days (with now an ice age looming), population is vastly shrunken. And a famous actor-playwright has called upon a historian for tutoring in the bad old days. She takes him on a tour of the ruins of Melbourne (Turner is an Australian, after all), mostly drowned, the stubs of ancient towers jutting from the waves. She tells him the towers were where the ancients stashed their millions of unemployed poor, the Swill, while the employed Sweet did their best to hold things together and keep from losing their jobs and sliding into—horrors!—Swilldom. She gives him the manuscript of a book she has written, a novelization of history, reconstructed from surviving snippets of information. And Turner gives us that novel, *The Sea and Summer,* with its marvelous evocation of catastrophe looming over the 21st century as the seas rose and the climate warmed, as the global economy strangled, of coping with an ever drabber present, an ever less shiny future, with its message that one must face the truth squarely, see both good and evil clearly, and do what is necessary. One must not deceive oneself with false optimism. One must not give in to greed and loot present resources and future hopes. One must not, above all, settle for a complacent "Not in my time, thank goodness."

The world, says Turner, is full of people who ignore those "must nots," even on the very edge of disaster. He shows them to us as he displays a family sliding into Swilldom. Daddy loses his job and cuts his throat. Mama stiffens her upper lip and makes the best of the move from the comfortable suburbs to the slum on the fringes of the towers. One son, Teddy, flees as soon as he can, into training as an Extra, to become in time one of those who will see clearly and do what is necessary to hold the system together as long as possible. The other son, Francis, is a selfish brat who slips into the underworld of greed on the strength of a talent for mental arithmetic, and therefore for sub rosa accounting. Billy Kovacs, the rude, crude Boss of nearby Tower 23, tries to be a second daddy to the boys, but they reject him as not Sweet, as filthy, foul, impoverished, depraved Swill. Mama, the elemental Mother with her unconscious eye on the survival of the family and the species, doesn't; eventually we too see that he embodies the clear-eyed ideal that Turner recommends. He does what he must in the name of humanity. He is the face of the future, as are a very few others at all levels of society. Manners are irrelevant, for survival depends much less on please and thank you and other formal rules than on a family-like sense of sharing.

I recommend this one heartily, and

with the fond hope that it may do some good.

If you wish to know what to expect of Ben Bova's **Peacekeepers,** consider that he has described in his nonfiction the potential of something along the lines of the Strategic Defense Initiative not just to protect one nation, but to prevent any nation from attacking any other. He has also presented the interventionist ideal in at least one short story in these pages, and that short story is one of the chapters of *Peacekeepers.*

The novel's structure is that of a series of anecdotal reflections by the International Peacekeeping Force's archivist. It begins when the archivist says, "Let's hike up to the top of this mountain to see where the last nuclear bomb exploded." We thus know the IPF is a success. What we do not know is how it got there. This is the task of the book's successive segments, first to tell us of how the world's governments created the organization in stunned reaction to a nuclear Mideast War that ended when a madman, Jabal Shamar, destroyed Jerusalem with radioactive dust and ran off with half a dozen nuclear bombs. Then to show us how some military and political vested interests conspired to subvert the IPF, and finally to describe the hunt for Jabal Shamar and his bombs. This hunt, lead by a survivor of Jerusalem, is much of what keeps *Peacekeepers* moving along toward its preordained end.

Peacekeepers seems much more real than *Timelapse* (see below), for no one refuses decisive action in the name of sentiment. Ben knows that true heroes will put their loved ones as readily as themselves on the line. They are prepared both to suffer and to let others suffer, and the prospect of neither inhibits their heroism. They do what is necessary.

* * *

Harry Harrison concludes his trilogy of dinosaurs versus humans on an Earth the comet missed 70 million years ago with **Return to Eden.** And yes, I know he insists that I refuse to understand that his heroic, erect, naked primates are not really humans. One subspecies is furred and tailed. The main subspecies, on which he centers our attention, bears children whose eyes are shut. And he makes these details clear in the text of his story.

So he should holler at his editors, too. Here's a quote from the jacket copy: "... his most ambitious project to date. He brought to vivid life the world as it might have been, where dinosaurs survived, where their intelligent descendants, the Yilane, challenged humans for mastery of the Earth, and where the human Kerrick, a young hunter of the Tanu tribe, grew among the dinosaurs and rose to become their most feared enemy."

The enmity is that of the Yilane. Kerrick, admittedly an effective foe once he realized his adoptive kin cum petmistresses were out to exterminate his kind, is now a peacemaker. He thinks it is possible to live and let live, as do the insanely aberrant (by Yilane standards) Daughters of Life in their city of Ambalasokei at the mouth of the Amazon. But Vainte, vain, power-hungry, voracious, banished for her part in the loss of the Florida city Alpeasak to the humans (though the Yilane did in time reclaim it), has emerged from her period of vegetation on the African shore to return. She has two missions: first to find the Daughters of Life and recover the gengineered ichthyosaur they stole when they escaped captivity, second to find Kerrick and get that sucker.

I needn't say much more. It's the closing volume of a trilogy, so you know that Vainte must have victory in

her grasp but lose, and Kerrick must win. There must be a crescendo of drums, of melodrama, and then the violins must sound the chords of resolution. Peace must come, or seem to come, at least for the next generation or so. There must also be a promise of victory for the Mammalia Kerrick represents, for innovation and tool-using over the slow plodding of the reptilian gengineers.

It's all there. The trilogy concludes as expected, having pursued the premise[1] with which Harrison started as far and as well as anyone could ask. The result is a good read, an excuse for you to look forward to your next trip to the bookstore.

Unfortunately, this volume suffers from a problem that may unbearably confuse some readers. Harrison has invented a great many names, and he—and his editors—have fallen victim to a hazard of the practice. Entoban* is the continent of Africa. Gendasi* is North America. And a number of times (see, e.g., pages 182–183 and 197), the two are switched. Other writers should take this lesson to heart: If you must invent new vocabularies to go with your worlds, be posilutely paranoid about your proofreading.

William Gibson is getting better and better. The proof is in his latest, **Mona Lisa Overdrive.** Here he shows, once more, his gift for bringing life to a world built on the dregs of the mechanical age, a world where New Jersey's vast rubbish piles and factory jungles have become the Solitude, a plain of crushed rubble and in it the Factory, where derelicts find niches in which to build obsessive robotic sculptures; to probe the shape of cyberspace, seeking signs of godhead; or simply to rave. A world where Kumiko, the withdrawn daughter of a Japanese crime lord—but the crimes are of data manipulation—can be shipped off to England with an artificially intelligent guidebook named Colin. Where Mona Lisa is a cheap whore about to be sold to masters who will turn her into a physical duplicate for a media star whom they intend to kidnap and replace. Where that media star, Angie, was once the daughter of a biochip specialist who rewired her brain to perceive cyberspace directly, and the voodoo-identified intelligences that resided therein; she was rescued in the desert by Bobby Newmark, now wired permanently into cyberspace and confined to a gurney in the Factory. Where . . .

Do you follow? *Mona Lisa Overdrive* brings together the people of Gibson's *Neuromancer* and *Count Zero* to turn the whole into a very satisfying trilogy whose single entries, quite unusually, stand very well alone. Now we learn more of the Tessier-Ashpool family of *Neuromancer* and the determined clone, Jane. We see what the voodoo loas truly are, how Bobby and Angie may find happiness together, and what companionship the Neuromancer is sensing in the distant dark.

Good stuff. Great stuff, impressively, convincingly detailed and kept beautifully to a headlong pace. Don't miss.

I enjoyed David F. Nighbert's first novel, **Timelapse.** The scene is an interstellar civilization whose worlds relegate the poor shipped out from Earth to ghettoes. There is no effort to educate or train the transportees, or to settle them in each world's empty hinterlands. The transportees are understandably ripe for rebellion when the first rabble-rouser comes along. He is Tessarian, who has already helped revolutionaries seize control of Earth; he became a

1. I have explained before why I argue with the premise.

transportee himself when his fellows turned on him; now he is the chief of an Empire torn from the guts of the United Planets.

UP, naturally, wants Tessarian dead. Yet forthright war does not seem to be in the cards. Assassination is the game, and the assassin is Anton Stryker, who at age six, when he was wondering where his mother had vanished to, saw Tesserian begin the rousing of his home world. He has tried for the Emperor twice already. Once he was rescued from certain execution. Once he was not, coming home in thirteen pieces. But then he was cloned and cyborged, and now Intelligence has learned that Tessarian is about to have his mind transferred into a larger, warrior-type body. He must try again.

He succeeds, of course. He tracks down the right body-bank with the aid of a man whose mind shares space with that of a Hellcat in the latter's body. Then, with the aid of a small girl, he destroys both the old and the new bodies of the Emperor. He even escapes, taking the little girl with him to protect her from reprisal. Then, at a strange place that just may be a gate to distant marvels, prepared by mysterious, unknown aliens, he finds his true love, is captured once more by Tessarian, and is forced by his inability to let one person suffer to prepare the doom of millions of innocents.

I expect you will enjoy the yarn even though Stryker is a chump. Nighbert has read Heinlein and honors him with at least one of his many gimmicks. And Tessarian is a beautiful example of the master manipulator.

There is a variety of science fiction and fantasy that grants its heroes and villains alike, superpowers or superweapons restricted only by the caveat that before they may be evoked, their user must stick the little finger of his left hand up his—*in* his—right ear. The stories of this genre typically involve vast slaughter of aliens, demons, opposing warlocks and wizards, and innocent bystanders. And they rot the mind.

Consider **The Crystal Warriors,** by William R. Forstchen and Greg Morrison. Bill has done some nice work using his education in history (the *Ice Prophet* series). His friend Greg is a tech-oriented executive recruiter; this is his first fiction sale. The story is that of a World War II B-29 crew that crashes in Manchuria and surrenders to a squad of Japanese in the face of a local warlord out to slaughter them all. They take refuge in an ancient temple whose floor bears a pentagram. And then this crew of evil wizards in another universe, hunting demons with which to start a war, pulls them through the portal (the pentagram) to Haven. There they are drafted into the forces of the local lord, Allic, who claims to be the son of a living god, one of Haven's creators. They also turn out to lack the gene that keeps most of the local humans from being able to use the Essence of magic with which the creators imbued Haven. That is, they are virtually instant wizards, and they promptly turn out to be crucial to the developing war.

It's a fairly conventional wish-fulfillment military fantasy, with the entirely worthy subtext that foes really ought to get to know each other so they can respect each other and be buddies. Unfortunately, many readers may be unable to read past page seven, in chapter one, where we see the lines:

"I've got them on my screen!" Kochanski shouted.

"Giorgini, lock them into central fire control."

"Locked in."

"Here they come. . . ."

The Dragon Fire *shook as her guns, guided by the B-29's central fire system, swung into action, setting out an arc of tracers to greet the first Zero as it rolled in low for a sweeping pass. . . .*

If I read that correctly, Forstchen and Morrison are suggesting that a 1944 B-29 didn't need the gunners we see in old movies. Instead, it carried a computer, presumably electronic and digital, capable of finding targets and aiming and firing a number of guns. I'm not an expert on the history of military technology, so I won't object to the mention of airborne radar in the same lines, though 1944 does seem to be a little early. But computers, much less computerized fire control systems? I suspect undue haste in the writing. Or maybe mind-rot.[2]

I found it very hard to finish Steven G. Spruill's **The Paradox Planet.** The reason was simple: The tale moves right along, full of danger, sex, suspense, and whiz-bang action, but within the first few pages, Spruill gives his reader rat-size bugs that burst into flame, instantly, when exposed to a flame-thrower improvised from the methane vent pipe on a spacecraft's sewage tank. In the process, he notes the rotten-egg smell of methane. A few pages later on he tells us that on a high-gravity world, because a person weighs more, he or she is less buoyant in water.

So what's the problem? First, living flesh has too high a water content to burst into flame that quickly, especially since the gas from a sewage tank has a relatively low energy content. Second, it seems likely that a spaceship would aerate its sewage in order to prevent anaerobic decomposition and the buildup of methane, which can be hazardous. Third, methane is odorless, sewer gas smells like shit, and the rotten-egg smell belongs to hydrogen sulfide. Fourth, high gravity may affect your buoyancy, but not because it makes you weigh more; after all, as every school child learns, Archimedes discovered that buoyancy is a matter of displaced mass, and hence volume; the only effect of high gravity would be via the compression of the air in your lungs.

I could go on, but if I spent too much time dumping on Spruill's notion that an animal evolved for high gravity somehow requires a source of psychic energy in order to survive, and evolves an organ that allows it to tap that energy from other organisms, and that humans can excise that organ and use it for murder, I would be in serious danger of telling you too much. I could also dump on the notion that a direct ideological descendant of the U.S.A.'s democratic system would smell enormously of the old British Empire, even unto the viceroys in charge of distant outposts.

There is so much bafflegab, so much technical ignorance, so much cliché, that we dare not call the book SF. It's sci-fi, skiffy, mental pablum.

But what about the story? *Paradox Planet* is a Kane and Pendrake novel, meaning that it follows the account of how the good, kind Emperor of the Terran Empire lost his head. Now hero Kane and Pendrake (a pumpkin-colored pacifist whose sole reason for existence seems to be to break down walls on Kane's behalf) are summoned by the new Empress, the Emperor's daughter and Kane's sometime lover, who may

2. If I'm making a jackass of myself by displaying unforgivable total ignorance of some miraculous analog computer, I am sure that someone will let me know. In that case, I remain correct in saying this kind of fantasy rots the mind. Obviously, it rotted mine.

or may not be pregnant with Kane's child. Three investigators have died on the colony of Cassiodorus, sole source of the beta-steel that lets the Terran dreadnoughts navigate paraspace at humongous speeds. Kane must go forth, investigate, and save the empire, accompanied by Pendrake, a force of Imperial stormtroopers, and—to his surprise—his true love, medic Martha Reik, of whom the Empress is jealous.

He does, of course, and everyone except the villains lives happily ever after. There is even hope for the Emperor, who is not entirely dead, you see, because Martha had mounted the severed head on a life-support system that will keep him dreaming until the day comes when he can be given a new body.

If you get the general impression that I do not recommend this one to your fond attentions, you are quite right.

Norman Spinrad is an uncompromising, pugnacious, ass-kickin', bird-flippin' child of the sixties. He has a lasting mad on for oppressive, self-serving, hypocritical authority. He objects, loudly and strenuously, whenever his work is censored or his toes are otherwise stepped on.

He is also an energetic and audacious writer who tells stories like no one else's. If he bears comparison to SF's other angry young man, Harlan Ellison, it is only for the quality of his writing and the intensity of his anger. His stories are very different, more daring in many ways, certainly wittier and more provoking of laughter.

He invents a convincing street jive on the bare edge of incomprehensibility. He despairs for an America dying of terminal selfishness. He howls at the idiocies of political, military, and religious carnikopfs (meatheads, remember?). He dreams of making those who would ban his, and other writers' books, stuff it. In the process, he draws from us sympathy, dread, despair, anger, and belly laughs to match his own.

Even when I think he fails, as I have at times, I am tremendously impressed by his skill and his ambition. Few other writers would dare to attempt the foul realism of "Street Meat" (set in streets akin to those of *Little Heroes*); or the mad comedy of "World War Last," in which a drug-freak sheik, in order to trigger Armageddon, turns an American president into a sex maniac who then, with the aid of an electronic zombie Soviet premier, defeats the sheik most justly; or the self-celebrating projection of "La Vie Continue," in which Spinrad defeats the censors magnificently. Others might be capable of the dystopian commentary of "The Lost Continent," but none could give it Spinrad's bite.

"La Vie Continue" was written especially for his collection of novellas, **Other Americas.** "Lost Continent," "Street Meat," and "World War Last" have appeared elsewhere, but don't let that stop you. "Vie" is hilarious enough to be worth the price of the book alone, and the others bear rereading marvelously well.

I love him. I love his stories. I love *Other Americas.* And so will you.

And here is Alan Dean Foster's continuing tale of Flinx, the slum-dwelling thief who, designed by arrogant outlaw gengineers, carries a pet poison-spitting minidragon from adventure to adventure, from the Tar-Aiym Krang to the tunnel-digging Ujurrians to, finally, the true love he finds in **Flinx in Flux.** He rescues fair maiden and gengineer Clarity Held from militant ecofanatics and

begins to come to terms with his heritage. At the same time, when the Ujurrians pop up with word of an immense and distant threat, he finds his mission in life.

Not major, but deft, imaginative, and satisfying. It gains points, too, for the detail it adds to Foster's vision of the Humanx Commonwealth, a very intriguing future history concept. ■

FUTURES

(continued from page 71)

Combat is resolved, starting with the killer satellites and working down to the ground units in the contested zones.

Building is an important part of the game, and players can use their factories to turn out new units.

And what units . . .

The game comes with over 360 plastic pieces, including figurines of the Leaders, Transports, Troopers, Gennies (mutant soldiers), assorted Fighters, Gunboats and Factories. If you look at this game, you'll want to play it.

Fortunately, the game design warrants the lavish treatment. The gameboard, depicting the planets near Earth and the various moons and asteroids, rewards strategic planning. Players will have to use their Transports and Factories wisely, to build up a powerful attacking force. Planets and asteroids orbit the sun, and a careless defender might find himself/herself surprised by the sudden appearance of an invader.

* * *

While I enjoy this tactile development in games, a component that has been part of gameplay since the days of Fox and Hounds in Ancient Egypt; the essential ingredient in a game remains imagination.

The Avalon Hill Game Company (4517 Harford Rd., Baltimore, MD 21214) has also just released a new SF game, *Merchant of Venus*. And though it doesn't feature hundreds of plastic pieces, it is an exciting, innovative game.

Merchant is a game of trading, hauling exotic goods like Living Toys (sounds interesting) and Immortal Grease (no thanks) along the space lanes for fun and profit. While the basic game is all about galactic wheeling and dealing, there's an advanced version that offers rules introducing weapons, war, and piracy.

Best of all, *Merchant of Venus* is designed to be played solitaire, or with as many as six people, with neither version sacrificing anything in playability. ■

brass tacks

Dear Stan,

Your editorial about summer vacations was interesting, and your point was valid, but please consider another facet of the question.

I am the mother of an intelligent, funny, good-hearted boy who has never fit the public school mold. I always felt that learning to write, do math, and get organized shouldn't be so darn hard for a kid, and I knew that my son was genuinely trying but without success. The teachers and other school officials uniformly agreed that he was "an underachiever" and that if he, or I, would just do more: change our lifestyle, spend more time on homework (my pleas that we spent *hours* on the simplest drills fell on uncomprehending ears), see a psychiatrist, spank more, spank less, yell more, yell less—the suggestions were diverse and many—my son could, and should, be a straight-A student. While all the wrangling went on, with school insisting that the only problem was my inadequacy as a parent and me insisting that something must be wrong somewhere, my son was repeating the pattern each successive year: inability to concentrate, illegible printing and later, script, complete disorganization of papers, books, notebooks, and a general sense of being lost. Miraculously, through it all he managed to get at least a "C" average through grade four.

The problem has been labeled "Attention Deficit Disorder" and drug therapy was tried, with mixed success. He can write legibly on Ritalin, and he can focus for longer periods, but the teachers have made him feel conspicuous and "different" by reminding him publicly to take the medication, and he hates the whole idea. School is an ordeal, and learning to conform, to just be able to sit and do the work, is arduous.

This is my point: it takes months for a child with this different circuitry to get into the swing of school routines. His visual orientation has to be overcome, channeled into auditory orientation, his defective speech translator has to be kicked repeatedly so he can hear and understand the masses of information the teachers give orally or in print. It is very hard. The teachers never really understand that he isn't goofing off, daydreaming, being intentionally rude. (After six years of it he sometimes gets fed up and does the deed he's so often accused of.) And by about the first of May he gets into the groove, the homework goes faster, the nasty notes and phone calls slack off, the grades go up—and school lets out for the summer. Three months is just long enough for him to get out of the habit of trying 110% all the time just to tread water.

The first three months of school are torture around our house. If a year-round system were instituted, kids like mine would have the routine they desperately need all year round. I have heard proposed six weeks on, two off, which would provide needed time away from the grind, but not time to forget everything that went before. Ask any grade school kid, he'll tell you the first three to six weeks each year is devoted to relearning last year's stuff. Year-round school would solve that waste, too. The time off would be the same, just spread out throughout the year.

Summer camps would still get campers for their two weeks, some day care problems would actually be easier to manage, and school buildings would be used all the time, which could cut down on summer vandalism. I can't think of a good argument against such a plan. I'll bet the parents of learning disabled and different kids all over the country think so, too.

D.R. GARENS
1413 S. High St.
Brady, TX 76825

I don't particularly care how the vacation is distributed, as long as it isn't done away with. And I sympathize with whatever learning problems particular people have—but since no two people learn in quite the same way, you have to be very careful about prescribing general practices on the basis of what would be best for particular groups, especially if those groups are small. What would be much more beneficial to more people would be a system with enough flexibility to take advantage of individual traits, instead of treating them as obstacles just because they happen to differ from the majority.

To the Editor,

I am a physician and a biologist who has been interested in human reproduction for all my professional life. I would like to thank you for your excellent editorial (June 1988).

I believe all scientists have an obligation to think about the consequences of human population growth. As our planet heats up, as large parts of the environment are degraded by overexploitation and as people move to cities in unprecedented numbers, we certainly have reason to worry about the future.

The decisions we make in the next ten years could well determine whether our children inherit a world of around 8 thousand million inhabitants or more than 12 thousand million. The decisions which we make in the next ten years can determine a *difference* in the world population in the middle of the 21st century that is not too far from the total population currently alive.

The World Fertility Survey in the 1970s and more recent Health and Demographic Surveys show that there is a large unmet demand for family planning in Third World countries. Approximately half the women with three or more children do not want any more. The fact that tens of millions of women are willing to resort to illegal abortion each year also underscores the fact that family planning services can and must be improved. As U.S. citizens we contribute approximately one dollar per person to the U.S. international effort in family planning. It would be reasonable and achievable to double our investment and also to set a target of doubling contraceptive prevalence in the coming decade. If this is achieved, we could be more certain that the world's population will merely double rather than treble. As you rightly point out in your editorial, we have obligations to our children—and to their children that do not yet exist.

Sadly, no human society has ever seen a decline in the birth rate without a considerable resort to induced abortion. Whether abortions are legal or illegal appears to make relatively little difference in the total numbers, although it has an important impact on the costs and risks to the individual woman seeking to terminate her pregnancy.

There are some important improvements in contraceptive technology, but none is likely to provide methods which are sufficiently predictable and acceptable to eliminate the need for abortion, although greater emphasis on contra-

ception can certainly reduce the demand for abortion.

I would like to end by sharing a perspective that differs a little from your editorial. Talking of the past, you state, "Populations were still so small, land so plentiful, and infant mortality so high, that existing populations pretty clearly needed all the children they could get." This is somewhat misleading: like other large mammals, such as elephants, our reproductive system has been carefully attuned by evolution to our environment. In reality, we are the slowest breeding animal that has ever been observed. In the past, we had a uniquely late puberty; preliterate societies observed in New Guinea still do not begin menstruation until a mean age of 20. The later puberty occurs, the greater the number of anovulatory cycles which take place before conception. Again, the tribes in New Guinea with late puberty have an even later age of first pregnancy —approximately 24-25 years —even though they have never seen a contraceptive.

In Western nations, over the past 200 years, the mean age of puberty has come down from 17 or 18 to 12 or 13. This probably relates to changes in nutrition, although all the variables are not fully understood. Socially it is a catastrophe, but perhaps we should remind ourselves that teenage sexuality is a product of our own civilization and not something with which we were always burdened.

Until recently, human pregnancies were naturally spaced out at an interval of three or four years by the anovulation associated with on-demand breastfeeding. Under "natural" conditions women probably had four or five live born children in a lifetime, of whom half probably died before puberty. The population of the hunter-gatherers in the Kalahari desert, the !Kung, have been studied in detail, and they have a population which doubles every 300 years. By contrast, modern Kenyans have a population that doubles in less than 28 years.

In other words, the populations of large mammals such as ourselves have been adjusted to grow very slowly. Our present problems arise from the fact that the age of puberty has come tumbling down, we have abandoned the long intervals of frequent breastfeeding that were characteristic of our evolutionary history, *and* we have achieved a spectacular fall in infant mortality.

We live in an artificial world, and we must control our reproduction artificially. I believe that this simple statement also has moral implications. For example, it is totally illogical to condemn artificial contraception and not to condemn artificial feeding of babies, because biologically the two are inextricably linked. Either the Pope should condemn baby's feeding bottles and rubber nipples, or he should stop condemning condoms—both are important, ethically and clinically significant interruptions of "natural" patterns of reproduction. (Incidentally, condoms can save lives, while feeding bottles improperly used can kill.) It is also interesting to note that, biologically, most mammals have a high reproductive wastage early in pregnancy.

The ability to control our fertility and induce abortion is one of the few things that distinguishes us from chimpanzees, with whom we share 97.8% of our genetic structure. Instead of being ashamed of our ability to control fertility, we should be proud of it and realize that it is central to our species survival.

MALCOLM POTTS, MB, BChir, PhD
President, Family Health International

Dear Dr. Schmidt,

I am writing in regard to Thomas

Donaldson's "24th Century Medicine," in the September issue.

I appreciate Mr. Donaldson's effort to lay out a broad view of where medicine may be 300 years from now, but I find much of his reasoning too uncritical, too "gee-whiz."

For example, he states on page 79, that "all currently known medical problems will be easy exercises for novice doctors." Three hundred years is a long time, but this would require an intimate and exact knowledge of the developmental process—the one which converts a single-celled egg into a far more complex baby. We know that there are thousands of ways this can go wrong. Will we be able to fix all of them?

When dealing with biological systems of *any* complexity, we must remember that the whole is far more than the sum of its parts. Even if nanotechnology exists in the well developed form envisioned in the article, we would have to be able to go from the cellular level through the tissue, organ, and individual. Currently, the way the egg develops into an adult organism is only fully understood in one organism, a small worm consisting of about 200 cells. This is a major achievement, but it should be remembered that this is not even a vertebrate, let alone a man.

In biology, full understanding of one level does not mean understanding of the next. For example, we understood how the nerve impulses sent from the eye are interpreted as vision in the brain. We still would not know how the sign of a golden arch triggers thoughts of a clown. On a more basic level, supposing we had full knowledge of how the genetic program is converted by the developing embryo into a series of steps that leads to the differentiation of the various tissues and organs. And if we understood that, would we be able to cure cancer? There are puzzles within puzzles in our bodies and we cannot begin to guess what surprises we will find.

Mr. Donaldson mentions the possibility of engineering the human body to function on the basis of non-water chemistries. The myriad functions of the body which are affected are staggering. How would DNA function under these circumstances? The intricate mechanisms that allow the genetic material to reproduce itself with an error of less than one in a billion has to be preserved intact for the organism to survive, let alone reproduce. The same question arises for neurochemistry. Would the synapses and their neurotransmitters have to be redesigned? The burgeoning complexity of such changes makes me wonder if such a system could be debugged, or if it would be worth it.

There are some errors of fact and, I believe, interpretation in the article. The section on aging and immortality states (Box 5) that aging may be a result of running out of self-repair programs. I don't know if he means running beyond the end of their functioning, as in a computer program, or that they are no longer sufficient for the task. This implies that aging is a passive thing, the "secondary effect" of the accumulated injuries suffered during the individual's lifetime. There is evidence that this is not so. Human cells, when grown *in vitro*, will only continue to divide for a certain number of generations (ie. cell divisions) and then stop. The resulting colonies show some of the symptoms of senescence. It was only when the cells were forced to fuse, in the laboratory, with cancerous cells (which are characterized by uncontrolled growth—cell division again) that immortal cell lines became possible. This is what makes the technology of monoclonal antibod-

ies possible. Thus there seems to be an active mechanism behind some aspects of aging.

In the section on immortality, it is stated that "old age has no positive evolutionary effects," which I interpret to mean there is no evolutionary advantage to be gained by aging. Aging is irrelevant to evolution. The old saw, "survival of the fittest" is misleading because it does not refer to personal survival (life-span) but evolutionary survival, the number of offspring which manage to reproduce in their own turn. Therefore short lives with high reproductive rates are just as evolutionarily valid as long lives and low evolutionary rates.

It is apparent then that only a long life-span with a correspondingly long reproductive life evolutionarily significant. But this is also presupposes that a long-life span is an inheritable characteristic, otherwise the effect is not real in Darwinian terms. Granted that this is the case, how does it benefit women? The eggs in their ovaries are fixed in number and when they are gone, menopause is the result. Sperm are simpler structures than eggs and their stem cells are still present in the testes, which accounts for men being fertile into old age.

The technology postulated in the article would probably allow this to be overcome, but it brings us to my final point: that the article ignores the environmental and social context.

We already see the controversy that our current limited technology generates when reproductive issues are involved. Test tube babies, fertility drugs, and abortion are powerful emotional issues. We are almost able to do some things which we generally agree we should not (cloning comes to mind). We may be able to do things that we will choose not to, though I realize I differ from Mr. Donaldson.

Early in the article is the statement that "nobody dies of scarlet fever anymore." Again, this is not true. Thousands die of scarlet fever, polio, diarrhea and other conditions in Africa, South America and Asia. We should not be deceived by our privileged positions.

I do not mean to imply that human misery will not be greatly alleviated in the future (assuming no catastrophe such as nuclear war or the collapse of civilization). Having the capability to do something, though, is not the same as having the ability or even the will to do it. Even more, the medical condition of the world in the 24th century will depend just as much on the economic and political well being of the world, as it does today.

A good science fiction story could be written about the medical future, as many have been. I believe that an even more interesting story will involve the social fabric which will allow the development of these treatments and their dissemination to those that need them.

MARK FAGAN
Toronto, Ontario

The author replies. . . .

Mr. Fagan's letter raises too many points for me to deal justly with every one in a short reply. Its tone, however, is one of dismay at the possibilities I raised in my "24th Century Medicine" article. I hope to deal with that in my reply.

First, Mr. Fagan is astounded by the idea that by the 24th century we will have the required degree of control over living things. He states that living things are very complex, and tells us about the many levels of understanding required.

The main point I would make in my reply is that the article was not an attempt to specify exact dates when we would have this control over living things. If Mr. Fagan wants to rename

it "26th Century Medicine" I would not complain. However, I do think 300 years is reasonable and may even be a gross overestimate. But as points in favor of my dating, I would say first that the technological ability to operate on a molecular scale will give us considerable experimental abilities to unravel all the problems of living things. Second, a lot of complexity is apparent only due to our current lack of understanding.

There's no way to *prove* dates. True, we don't have such control now. And we can hypothesize all kinds of unknown obstacles to our understanding. However, 300 years is a very long time. Only 30 years ago people had just come to understand the significance of DNA. Three hundred years ago (1688) we were groping with the concept of gravity. Three hundred years feels like more than enough to me. I think 100 years may be too short.

As for medical problems like cancer, in my article I specifically said that we would have medical problems. These would not consist of cancer (too simple!) but of side-effects of the treatments which we applied i.e. they would be faults of our technology. Since no technology is perfect, we must expect faults.

Mr. Fagan is also distressed by engineering organisms and *people* to function in nonwater based chemistries. He raises many problems. Obviously we would have to solve all of them. This should not be difficult in 300 years.

He alleges various errors of fact about aging. His point here is actually quite complex and requires much more than a short letter to deal with. I will content myself with saying that there is indeed a Hayflick limit. Its relevance to the actual lifespan of whole animals is not obvious, since the cells survive many times longer than whole animals. Furthermore, since almost everything that happens in cells is because some gene is switched on or off, the fact that genes are switched on or off says nothing about whether or not aging is positively "programmed." It's true that Hayflick wants to claim it does. But then, in common with many gerontologists, Hayflick is not imbued with a technological, activist attitude toward aging. He is still wrestling with the issue of whether to intervene or not. I cannot feel sympathy for his problem.

In all of these objections, I feel that Mr. Fagan wouldn't really be satisfied just to put off our complete understanding of life to the 26th rather than the 24th Century. I detect an underlying attitude toward living things with which I very much do not agree. This is, that they are somehow essentially beyond our complete understanding in a way in that physics or electronics is not. That is not only a misguided opinion, but an inhumane one. We can hardly make medical progress so long as we consider living things as objects of worship rather than machines. It has even been rife in science fiction: in many stories, it is always the *aliens* who understand life. Human beings have to content themselves with electronics. This is absurd.

Mr. Fagan ends with a discussion of "environmental and social context," and the uproar over mild biotechnologies like "test tube" babies and cloning. These technologies present no moral problems except to those who wish to worship life rather than understand it.

I surmise also that he does not like my statement that immortality will become possible, nor any of the other redesigns I suggest. I am myself not only immortalist but cryonicist. My article summarizes the basic contradictions in present attitudes which will inevitably *force* us to develop immortality (see pages 77–78). I think the most

objective comment I can make about these issues is that science and engineering have already caused many fundamental revolutions in society and people's values. We should not be surprised to see this happen in the future too, again, and again, and again. . . .

THOMAS DONALDSON

Dear Dr. Schmidt:

Hypertext is indeed a fascinating concept, and your editorial in the September issue contains some interesting speculation about the future of what might be called the information environment. But I am far from convinced that it will have the enormous effect on thinking and reading that you and others have predicted, and I am also not convinced that the effects will all be good.

One factor most people are overlooking is this: until there is some way of storing and presenting text that is as easy to use as the book, most people will continue to read books instead of a computer screen. I, for one, would never try to read *Analog* on line: my eyes can't take green letters on a black background for very long, and it's impossible to slump down in an easy chair in the front room to read from my computer. In fact, I predict that book publishing, as it is now, will continue to exist even if a way is invented to store megabytes of text in a flat box no larger than a book. Let us suppose a device with a screen that showed black text on a white background, software that allowed very flexible control of the display, and batteries that allowed dozens of hours of use before needing to be recharged. This electronic book would differ from an ordinary book in only two ways: it could store many more pages in the same space, and it could have software and text that would allow it to come closer to the concept of hypertext. Of these advantages, I think the first is the more important: if one electronic book could store the equivalent of a hundred ordinary books, then it would be a tremendous boon to all sorts of people. The big disadvantage would be, of course, that once the batteries ran down, the electronic book would be unreadable until they were charged again.

The inflation in the flow of text caused by a hypertext system would not mean that a person would have access to that much more reading matter. It would mean that the amount of nonsense and gibberish published would greatly increase, all out of proportion to the increase in the amount worth reading. As a result, most people would probably subscribe to some sort of reader's service, in which filtering would take place at the beginning of the pipeline.

Hypertext itself is not, as is too often claimed, a revolutionary advance that will change the way everyone reads. In the first place, for the reader, hypertext is just as linear as any other text. No matter what sort of explicit interconnections exist between different parts of the text, a reader will still have to read it one word at a time. Second, the technique of hypertext is not suited to the literature of entertainment, as opposed to the literature of information. The idea behind hypertext is that the reader may follow any connecting path as far as he wants, or not at all, depending on whether he wants some more information about a given topic or not. Since a story does not offer a reader information, there would be no point in using a hypertext format to tell the story. Third, hypertext would, I think, tend to encourage breadth of knowledge at the expense of depth. Fourth, there are several areas of learning where a hypertext format could not be used in textbooks. Someone trying to learn a language has

to plow straight through, to learn the grammar, vocabulary, and usage one step at a time. Someone trying to learn a branch of mathematics would be well advised to stick to works that give a systematic exposition of that branch, instead of going through hypertext works that skip all over the mathematical universe.

My conclusion is that a hypertext system would do most good by making information that is hard to find much more easily available. It will turn out mainly to be a research tool. Authors, as a whole, will not use it as their main method of writing and publishing. Readers, though, probably would publish their comments on works in the hypertext system.

FREDERICK FOWLER

Atlanta, Ga.

We shall see; personally, I suspect you're being premature in dismissing large areas as unsuitable for hypertext. The literature of entertainment, for instance, may simply develop a whole new set of branches to take advantage of the unique capabilities of hypertext. Marc Stiegler's David's Sling *has already been published in a hypertext version, and he expects it to be just an early antecedent of far more elaborate efforts in the future. Please note: It does* not *eliminate the more familiar linear presentations, but just provides alternate options. One set of options in* David's Sling *allows you to read the novel exactly as you would read it in the book version—but there are many more possibilities. As for places where "hypertext could not be used in textbooks," I can't think of an example offhand, and I suspect you wouldn't give your examples if you had more experience with how hypertext works. I have a* lot *of experience with studying languages, and I can easily imagine a hypertext course in any one of the several I've studied that would be far more useful than any of the conventional texts I've used.* ■

●If a wheel is to spin freely without exerting forces and torques on its bearings, then it must be not only statically balanced, i.e., with its center of mass on the axis of rotation, but also dynamically balanced, i.e., the axis of rotation must be a principal axis of the inertia tensor, as any automobile mechanic knows.

Keith R. Symon

(continued from page 50)

must be an *a priori* for the colonization of space, and might, as space research has always yielded new technologies, lead to new, exciting therapies for medicine on Earth. Discovering new ways to manipulate the immune system will have virtually unlimited promise for controlling organ transplant rejection, autoimmune diseases, and the response to cancer.

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NASA is maintaining an active research program devoted to the study of the effects of zero gee on the immune system. Here is the address to send for information on this Biomedical Research Program and free publications:

Chief, Space Medicine Branch/EB
Life Sciences Division
NASA Headquarters,
Washington, D.C. 20546
USA

ABOUT THE AUTHOR

☐ *Kevin Steele is a Canadian, from the beautiful city of Vancouver, BC. He received his PhD from the University of British Columbia for the development of novel cancer therapies based on the concept of boosting the natural immune response against tumors. Since 1986, Dr. Steele has held a Research Fellowship in the Department of Pathology, Harvard Medical School, where he works to isolate and characterize suppressor cells and their factors which block the immune response to cancer. When experiments aboard the shuttle resume, the activity of these cells in orbit will be studied. Dr. Steele holds 3 patents, and is the author of over 20 scientific articles on the subject.*

ACKNOWLEDGEMENTS

☐ *The contribution of Mr. R.J. Mulhern for his critical review, and Scientific Graphics Systems (SGS) of Boston, MA for their illustrations, are gratefully noted.*

a calendar of analog upcoming events

31 March-1 April
TECHNICON 6 (Virginia SF conference) at Donaldson Brown Center, Blacksburg, Va. Guest of Honor—John M. Ford. Registration—$12 (students), $15 (others) in advance; $15 (students), $18 (others) at the door. Info: Technicon 6, % VTSFFC, Box 256, Blacksburg VA 24063-0256.

31 March-2 April
St. LOUIS FANTASY FAIR (media oriented SF conference) at Breckenridge Frontenac Hotel, St. Louis, Mo. Confirmed guests—John Levene and Janet Fielding. Registration—$35 until 15 February, $40 thereafter. Friday only $10, Saturday only $20, Sunday only $15. Info: St. Louis Fantasy Fair, Box 4302, Chesterfield MO 63006-4302.

31 March-2 April
ICON 8 (Long Island SF conference) at SUNY Stony Brook, N.Y. Guest of Honor — Frederik Pohl. Registration—$16 until 17 March 1989, more thereafter and at the door. Info: Icon 8, Box 550, Stony Brook NY 11790.

7-9 April
CONCATENNATION (Knoxville area SF conference) at Quality Inn West, Knoxville, Tenn. Guest of Honor—Mercedes Lackey, Artist Guest of Honor—Jean Elizabeth Martin, Fan Guests of Honor—Mike and Nelda Kennedy, TM—Andrew J. Offutt. Registration—$18 until 31 March 1989, $20 at the door. Info: ConcaTennation, 1028 Valley Ave., Knoxville TN 37920. (615) 579-3202.

21-23 April
GALACTIC TREK FEST (St. Louis area Star Trek oriented conference) at Henry VIII Hotel and Conference Center, St. Louis, Mo. Registration—$20 until 1 March 1989; Saturday $15, Sunday $10. Info: Galactic Trekfest, 640 White Street, Belleville IL 62221. (618) 233-2404.

21-23 April
NAME THAT CON 2 (Missouri area SF conference) at Stratford House, Fenton, Mo. Guest of Honor—Victor Milfan, Artist Guest of Honor—Dan Patterson, Fan Guests of Honor—David and Casey Means, TM — George Alec Effinger, Special Guest—Wilson "Bob" Tucker. Info: NameThatCon 2, Box 575, St. Charles MO 63301. (314) 773-6626.

27-30 April
NEXUS '89 (Colorado Springs multi-disciplanary conference) at United States Air Force Academy, Colorado Springs, Colo. Science fiction and science; emphasis on space (surprise!). Info: Nexus '89, Capt. Carmen Alatorre, HQ, USAFA/DFENG, USAF Acaemy, Colorado Springs CO 80840. (719) 472-3930.

31 August-4 September 1989
NOREASCON III (47th World Science Fiction Convention) at Sheraton-Boston Hotel & Hynes Convention Center, Boston, Mass. Guests of Honor—Andre Norton, Ian & Betty Ballantine; Fan Guest of Honor—The Stranger Club (Boston's first SF club). Registration—$70 (adult), $45 (child) to 15 March 1989; $80 (adult), $50 (child) to 15 July 1989. Supporting—$20 at all times. No advance memberships after 15 July 1989. 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. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: Noreascon III, Box 46, MIT Branch, Cambridge MA 02139.

—Anthony Lewis

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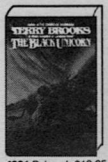

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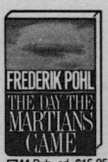

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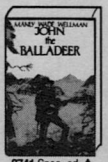

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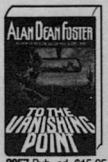

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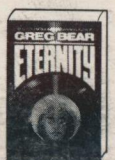

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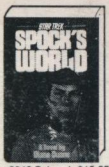

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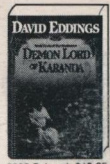

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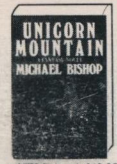

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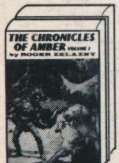

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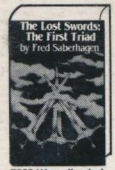

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